DENTAL X-RAY PROCEDURES

LEARNING OBJECTIVES:

Identify the proper patient positioning techniques.

Identify how to position the tube head.

Identify structures shown in an x-ray.

PATIENT PREPARATION

To prepare a patient for a dental X-ray procedure, employ the following techniques:

1. Only a Dental Officer is authorized to order and diagnostically interpret dental radiographs.

2. Ensure all infection control procedures are followed.

3. Position the patient. Positioning varies according to the type of radiograph needed and the film placement technique.

4. If the patient is a female, ask her if she is pregnant. If she is or the HM suspects that she might be, consult the dental officer.

5. Ask the patient to remove eyeglasses, complete dentures, removable partial dentures, earrings, or any other objects about the head and neck.

6. Drape the patient with a lead apron and thyroid collar.

7. Quickly examine the patient's mouth to determine its anatomy. Such things as a small mouth, an abnormally shallow vault, crooked teeth, and bony protrusions can affect the placement of the film packet. The patient's overall bone size and density will determine proper setting. For a patient with a normal bone size and density, use a kVp setting of 87; for a patient with a thick bone size and density, use a 90 kVp setting.

8. Position the patient's head securely against the headrest.

9. Place the film packet in the patient's mouth. Occasionally, patients may gag when the film is placed in their mouth. The gagging reflex may be caused by nervousness, remain calm and reassure the patient. The HM may recommend that patients breathe through their nose, since it is difficult to gag while doing so. Having patients rinse out their mouth with water may also help or have patients concentrate on something other than gagging. Whatever technique is used, the HM will have to be swift in placing the film and making the exposure because the chance of keeping the gag reflex from returning for an extended period is highly unlikely.

After the X-ray procedure is completed, return the lead apron and thyroid collar to the storage device to avoid damage.

EQUIPMENT PREPARATION

Periapical Examination

A periapical examination is conducted to obtain radiographs of the crowns, roots, and supporting structures of the teeth. Figure 17-24 shows a typical periapical radiograph.

![Figure 17-24.—Parallel Technique](image)

There are two techniques available to take periapical radiographs: paralleling and bisecting-angle. Both techniques use the long axis of the tooth as a focal point. The paralleling technique is the preferred method. Film placement and techniques are discussed in the following sections.
When using the paralleling technique, center the X-ray film packet behind, and parallel with the long axis of the tooth being X-rayed. A tube head with a 16-inch X-ray source to cylinder end distance (long cone) should be used. The tube head must be positioned so that the central X-ray beam is projected perpendicular to the tooth and the film packet. To properly position the film and the tube head, use paralleling devices.

There are two different paralleling devices; one for radiographs of anterior teeth and one for radiographs of posterior teeth. Each paralleling device consists of a bite-block, indicator rod, and locator ring (Fig. 17-25). The bite-block has a slot and a film backing support to hold the X-ray film packet.

Assembling the Anterior Device

Figure 17-26 shows an assembled anterior paralleling device. Refer to this figure during the following explanation on assembling the paralleling device:

1. Grasp the periapical film packet between the thumb and first two fingers of the right hand. The printed surface of the packet should be facing the HM and the side with the raised dot should be in the film positioning slot of the paralleling device.

2. Hold the base of the anterior bite-block between the thumb and first two fingers of the left hand. Ensure that the plastic film support is pointed upward and the film positioning slot is away from the HM.

3. Holding the film packet in position, press it against the plastic support and slide the film down into the positioning slot. The printed side of the packet should be facing the plastic support, and the raised dot should be located toward the positioning slot.

4. The two prongs of the indicator rod are inserted into the openings in the bite-block. Slide the anterior locator ring onto the indicator rod. Look through the locator ring. If the bite-block and film are centered in the locator ring, the device is properly assembled and ready for positioning in the patient's mouth.

Figure 17-25.—Bite Blocks, Locator Rings, and Indicator Arms

Figure 17-26.—Assembled Anterior Paralleling Device
Assembling the Posterior Device

Figure 17-27 shows a fully assembled posterior paralleling device. Refer to this figure during the following discussion.

1. Insert the film into the posterior bite-block as previously discussed.

NOTE:
The posterior device shown in Figure 17-27 is used for film placement in the right maxillary and left mandibular quadrants.

The HM must reassemble the device, rotating the locator ring and the bite-block, before using it in the left maxillary or right mandibular quadrants.

Only the posterior device must be reassembled in this manner, the anterior device does not require reassembly.

2. Assemble the posterior paralleling device and place it in the patient’s mouth. Be very careful not to injure the oral tissue. If the patient gags, use the remedies discussed earlier.

3. Guide the bite-block and the film packet into position, centering the packet behind the area being X-rayed. The film packet should be positioned far enough behind the tooth so it will be parallel to the long axis of the tooth.

4. After positioning the film packet, slide the locator ring down the indicator rod until the ring almost touches the surface of the patient’s face. Then, position the tube head cylinder. The end of the cylinder should be parallel with the locator ring, and its side should be parallel with the indicator rod.

5. Once these procedures have been accomplished, the film packet and the tube head are in proper alignment. The HM is now ready to expose the film.

Exposure Routine for Full Mouth Periapical Examination

The full mouth periapical examination consists of 14 periapical radiographs (7 maxillary and 7 mandibular).

The series includes the following films and sequence starting with the maxillary arch and proceeding to the mandibular arch:

- Incisor area
- Left Cuspid area
- Left Bicuspid area
- Left Molar area
- Right Cuspid area
- Right Bicuspid area
- Right Molar area

BISECTING-ANGLE TECHNIQUE

Use the bisecting-angle technique when paralleling devices are not available; when a patient finds it painful or impossible to close on the bite-block; or when an X-ray is needed when a rubber dam is in place. This technique incorporates the use of a tube head with an X-ray source to cylinder end distance of 8 inches (short cone). The bisecting-angle technique is not recommended for routine use.

Paralleling devices are not used with the bisecting-angle technique. The HM must pay special attention to positioning the patient, the film packet, and the tube head.
Positioning the Patient

For all maxillary periapical radiographs, position the patient's head as shown in Figure 17-28 from the ala (the outer portion of the nostril) of the nose to the tragus of the ear (a projection of the cartilage on the front center of the ear). This ala-tragus line should be parallel with the floor. The patient's head should also be positioned so that the midsagittal plane is perpendicular to the floor.

For mandibular periapical radiographs, lower the headrest so the patient's head is positioned as shown in Figure 17-29. The figure shows a line running from the corner of the patient's mouth to the tragus of the ear. This line should be parallel with the floor. The midsagittal plane is perpendicular to the floor.

Positioning the Film

After the patient is positioned, insert the film packet in the patient's mouth with a pair of hemostats or other holding device. Never slide the packet in; this might irritate the oral mucosa or cause the patient to gag. Gently direct the holding device to the desired position. In order to adapt the packet to the area being radiographed and to relieve patient discomfort, it may be necessary to shape the packet. Do this by gently flexing the corners of the packet and holding it over the end of a thumb. DO NOT CREESE THE PACKET. Center the packet behind the tooth to be radiographed. The printed side of the packet should face away from the tooth, with the printed dot toward the occlusal surface. The film is held as close to the tooth as possible. At this point, the long axis of the tooth and the plane of the film should be nearly parallel. In order to project the proper image of the tooth onto the film, the HM must visualize an imaginary line bisecting the long axis of the tooth and the plane of the dental film. The central ray is then directed perpendicular to the bisecting line. This will project the proper dimensions of the tooth onto the film without elongation or foreshortening. If the anterior curvature of the patient's arch is narrow, insert a cotton roll between the packet and the teeth. This prevents the film from bending excessively and producing a distorted image.
After the film packet is properly positioned, guide a free hand of the patient to the holding device. The patient holds the device with the hand from the opposite side of the arch being radiographed.

**WARNING:**
The assistant should never hold the film packet in position during an exposure.

Each time the HM takes radiographs, standard film positioning must be used. This ensures proper comparison of radiographs taken at different times.

**Positioning the Tube Head**

After the film is inserted in the patient's mouth, position the tube head so the end of the cylinder is near the area to be radiographed. Position the tube head for correct vertical and horizontal angulation using anatomical landmarks on the patient's face. Tell the patient to maintain the position of the placement of the dental film and not to move while the radiograph is exposed.

**VERTICAL ANGULATION.**—This is the up-and-down positioning of the tube head. A $0^\circ$ vertical angulation indicates that the tube head is positioned with the cylinder parallel with the floor (Fig. 17-30). Angling the tube head so the cylinder points upward from $0^\circ$ will give a minus (−) degree of vertical angulation. Angling the tube head so the cylinder points downward from $0^\circ$ will give a plus (+) degree of vertical angulation.

Different areas of the mouth require different degrees of vertical angulation. The correct vertical angulation can usually be obtained by using the angles shown on the chart in Figure 17-30. Notice the tube head is angled downward for maxillary radiographs, and usually angled upward for mandibular radiographs. The tube head may be horizontal ($0^\circ$) when X-raying mandibular molars.

<table>
<thead>
<tr>
<th>Maxillary</th>
<th>Mandibular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisor</td>
<td>Incisor</td>
</tr>
<tr>
<td>+40 to +45</td>
<td>-15 to -20</td>
</tr>
<tr>
<td>Cuspid</td>
<td>Cuspid</td>
</tr>
<tr>
<td>+45 to +50</td>
<td>-20 to -25</td>
</tr>
<tr>
<td>Bicuspid</td>
<td>Bicuspid</td>
</tr>
<tr>
<td>+30 to +35</td>
<td>-10 to -15</td>
</tr>
<tr>
<td>Molar</td>
<td>Molar</td>
</tr>
<tr>
<td>+20 to +25</td>
<td>-5 to 0</td>
</tr>
</tbody>
</table>

**Figure 17-30.—Average Vertical Angulation**

The wrong angulation results in a distorted radiograph. Too little vertical angulation elongates the radiographic image; too much vertical angulation foreshortens the image.

A standard vertical angulation cannot be used for all patients because of differences in their oral structures. A patient may have an unusually high maxillary vault or an unusually deep palatal vault. In either case, the HM would decrease the standard vertical angulation by about $5^\circ$. For a patient with an unusually shallow vault, the HM would increase the angulation by about $5^\circ$.

After determining the correct vertical angulation for the area to be radiographed, adjust the tube head using the angle dial on the tube head as a reference. When the tube head has been set for the proper vertical angulation, center the tube head cylinder on the area to be radiographed. The cylinder should almost touch the surface of the patient's skin. Position the tube head for correct horizontal angulation.
HORIZONTAL ANGULATION.—
This is the side-to-side positioning of the tube head. Position the tube head so the central X-ray beam is directed straight through the embrasures of the teeth being radiographed. If the horizontal angulation is faulty, the central ray will be directed at an angle to the embrasures. This will produce a faulty radiograph, with the images of the teeth overlapping one another. Figure 17-31 illustrates the correct and incorrect cylinder direction.

![Figure 17-31.—Correct and Incorrect Direction for Horizontal Angulation](image)

Guidelines for Taking Periapical Radiographs, Bisecting-Angle Technique

Take the same 14 radiographs using the same exposure sequence as that discussed for the paralleling technique. Complete the following steps:

1. Program the X-ray machine for mA and kVp settings. The exposure time varies. Refer to the film manufacturer's instructions for correct time/impulse settings. Remember to reduce the kVp by 5 when taking radiographs in edentulous (condition of being toothless to at least some degree) areas, and to 70 when taking radiographs on children. Position the patient as shown in Figure 17-28 for maxillary radiographs or Figure 17-29 for mandibular radiographs. Remember that the patient's midsagittal plane must be perpendicular to the floor.

2. Position the film packet in the patient's mouth. Have the patient hold the film packet in place with a pair of hemostats or other holding device.

3. Set the vertical angulation of the tube head according to the chart in Figure 17-30.

4. Center the tube head cylinder on the area to be radiographed. To simplify this process, the numbered anatomical landmarks are provided in Figure 17-32. Take radiographs of the area by centering the tube head cylinder on these landmarks:

   a. Maxillary incisor area: Landmark 1, the tip of the nose.

   b. Maxillary cuspid area: Landmark 2, beside the ala of the nose.

   c. Maxillary bicuspid area: Landmark 3, below the pupil of the eye.

   d. Maxillary molar area: Landmark 4, below the outer angle of the eye and below the zygomatic bone.

   e. Mandibular incisor area: Landmark 5, the tip of the chin.

   f. Mandibular cuspid area: Landmark 6, directly below landmark 2 1/4 inches above the lower border of the mandible.

   g. Mandibular bicuspid area: Landmark 7, directly below landmark 3 1/4 inches above the lower border of the mandible.

   h. Mandibular molar area: Landmark 8, directly below landmark 1/4 inches above the lower border of the mandible.

![Figure 17-32.—Cylinder Positioning Landmarks for Periapical Radiographs](image)
5. With the tube head cylinder centered on the horizontal landmark, ensure that the correct horizontal angulation has been obtained. The central X-ray beam should be projected straight through embrasures of the teeth to be examined.

6. Make the exposure.

7. Remove the film packet from the patient’s mouth and place it in a clean paper cup. Place the disposable container in a lead container or behind a protective screen before making the next exposure.

INTERPROXIMAL (BITEWING) EXAMINATION

The interproximal examination reveals the presence of interproximal caries, certain pulp conditions, overhanging restorations, improperly fitting crowns, recurrent caries beneath restorations, and resorption of the alveolar bone. A typical interproximal radiograph (Fig. 17-33) records in a single exposure the coronal and cervical portions of both maxillary and mandibular teeth, along with the alveolar bone of the region.

![Figure 17-33.—Typical Interproximal Radiograph]

Bitewing X-ray film packets are used for the interproximal examination. The bitewing film packet (Fig. 17-34) has a paper tab, or wing, that the patient bites on to hold the packet in place during the exposure (thus the name bitewing). Interproximal radiographs can be made using either the paralleling technique or the bisecting angle technique.

![Figure 17-34.—Bitewing Film Packet]

PARALLEL PLACEMENT TECHNIQUE

The following procedures describe this technique:

1. Program the X-ray machine for the discussed time, mA settings, and kVp settings.

2. Prepare the interproximal paralleling device (Fig. 17-35). Fold the bitewing tab against the film packet and insert the packet into the bite-block so that the printed side faces the backing support. Insert the end of the indicator rod into the holes in the bite-block. Slide the locator ring onto the indicator rod. Look through the locator ring to see if the bite-block is centered in the ring. If it is, the paralleling device is ready for positioning in the patient's mouth.
3. Position the paralleling device with film in the patient's mouth so the anterior edge of the film touches the distal surface of the mandibular cuspid (Fig. 17-36). Have the patient close gently but firmly on the biteblock to hold the film in position. Slide the locator ring down the indicator rod until the ring almost touches the surface of the patient's face. Align the tube head using the same technique as previously described for the paralleling device.

4. Make the exposure. After making the exposure, put the exposed film in a lead lined container or behind a protective screen. The HM is now ready to take the radiograph on the opposite side of the patient's mouth.

**BISECTING-ANGLE TECHNIQUE**

The following procedures describe this technique:

1. Program the X-ray machine for the discussed time, mA settings, and kVp settings.

2. Position the patient so that the ala-tragus line is parallel with the floor and the midsagittal plane is perpendicular to the floor.

3. Position the film packet in the patient's mouth. Hold the wing of the packet between the thumb and index finger. Place the lower edge of the packet between the tongue and the lingual surfaces of the mandibular teeth. Position the packet so that its anterior edge touches the distal surface of the mandibular cuspid. Rest the wing of the packet on the occlusal surfaces of the mandibular teeth. Instruct the patient to close slowly. As the patient's maxillary teeth contact the HM's index finger, roll the finger out facially, permitting the patient's teeth to close on the wing (Fig. 17-37). The film packet is now positioned.

4. Set the vertical angulation of the tube head at +5° to +10°.
5. Center the tube head cylinder on the wing of the film packet. Be sure that the central X-ray beam passes through the embrasures as shown in Figure 17-38.

![Figure 17-38.—Centering the Tube Head Cylinder](Image)

6. Make the exposure. After making the exposure, put the exposed film in a clean paper cup and place in a lead lined container or behind a protective screen. The HM is now ready to take the radiograph on the opposite side of the patient's mouth.

**OCCLUSAL EXAMINATION**

An occlusal examination is usually conducted when fractures of the jaw or gross pathological conditions are suspected. A typical occlusal radiograph (Fig. 17-39) shows a large area of the maxillary or mandibular arch. The occlusal film packet is shaped much like the periapical packet, only larger. Unlike the periapical and bitewing packets, the occlusal packet contains two X-ray films. This allows different developing times to be used for these films. The finished radiographs can then be compared for diagnostic purposes. Occlusal radiographs are exposed using the bisected angle technique.

![Figure 17-39.—Typical Occlusal Radiographs](Image)

**MAXILLARY OCCLUSAL RADIOGRAPHS**

Maxillary occlusal radiographs are taken using the following procedures:

1. Set the X-ray machine at 10 mA, 90 kVp, and 60 impulses (1 second).
   a. Reduce the kilovoltage 5 kVp if the arch is edentulous.
   b. Use 70 kVp if the patient is a child.

2. Position the patient so that the ala-tragus line is parallel with the floor and the mid-sagittal plane is perpendicular to the floor.

3. Place the film in the patient's mouth. Occlusal films are normally very comfortable.
   a. Have the patient relax the muscles of the mouth and cheek as much as possible.
   b. The pebbled surface of the packet should be toward the occlusal surfaces of the maxillary teeth, and the narrow side of the packet toward the patient's cheeks.
   c. To place the packet, retract one corner of the patient's mouth until the packet can be inserted.
   d. Position the packet far enough in the mouth so that it covers all the teeth.
e. Special care must be taken to avoid gagging the patient. Have the patient close gently but firmly on the packet to hold it in place.

4. Position the tube head.

5. For maxillary anterior occlusal radiographs, set the vertical angulation of the tube head at $+65^\circ$. Center the tube head cylinder on the bridge of the patient's nose so that the central X-ray beam will be projected as shown in Figure 17-40.

![Figure 17-40.—Projection of Central Ray (CR) for Maxillary Anterior Oclusal Radiographs](image1)

6. For maxillary posterior occlusal radiographs, set the vertical angulation of the tube head at $+75^\circ$. Center the tube head at the top of the patient's nose so that the central X-ray beam will be projected as shown in Figure 17-40.

7. Projection of central ray (CR) for maxillary posterior occlusal radiographs.

8. Take the exposure.

**MANDIBULAR OCCLUSAL RADIOGRAPHS**

Mandibular occlusal radiographs are taken using the following procedures:

1. Program the X-ray machine for 10 mA, 90 kVp, and 60 impulses (1 second). (Reduce the kVp setting for edentulous patients and children as discussed earlier.)

2. Position the patient.

   a. For mandibular anterior occlusal radiographs, position the patient so the ala-tragus line is at a $45^\circ$ angle with the floor, and the midsagittal plane is perpendicular to the floor (Fig. 17-41).

![Figure 17-41.—Projection of central ray (CR) for Mandibular anterior radiograph](image2)

   b. For mandibular posterior occlusal radiographs, position the patient so that the ala-tragus line and mid-sagittal plane are perpendicular to the floor.

3. Place the film packet in the patient's mouth with the pebbled surface toward the occlusal surfaces of the mandibular teeth, and the short sides of the packet is toward the patient's cheeks. Have the patient close gently on the packet to hold it in place.

17-36
4. Position the tube head.
   a. For mandibular anterior occlusal radiographs, set the vertical angulation of the tube head at -10°. Center the tube head cylinder on the tip of the patient’s chin so that the central X-ray beam will be projected as shown in Figure 17-42.

   ![Figure 17-42.—Projection of Central Ray (CR) for Mandibular Anterior Radiograph](image)

   Figure 17-42.—Projection of Central Ray (CR) for Mandibular Anterior Radiograph

   b. For mandibular posterior occlusal radiographs, set the vertical angulation of the tube head at 0°. Center the tube head cylinder beneath the patient’s chin so that the central X-ray beam will be projected as shown in Figure 17-43.

   ![Figure 17-43.—Projection of central ray (CR) for mandibular-posterior occlusal radiographs](image)

   Figure 17-43.—Projection of central ray (CR) for mandibular-posterior occlusal radiographs

5. Make the exposure.

---

**FILM PROCESSING**

**LEARNING OBJECTIVES:**

- Identify film processing methods.
- Identify start-up and securing procedures for x-ray processors.
- Identify aspects of good and bad quality x-rays.

**FUNDAMENTALS**

After the film has been exposed by X-ray, it is processed to produce the finished radiograph. The film can be processed manually, or the HM can use an automatic film processor. The process requires conversion of the latent (invisible) image to the manifest (visible) image through chemical or digital conversion. The x-ray technologist is key to film processing; always ensuring quality control measures are met to ensure proper processing.

When the dental X-ray films are processed, the resulting radiographs provide the Medical or Dental Officer with a valuable diagnostic aid. Radiographs can be used to aid in identification in the case of a death.

**DIGITAL IMAGING**

Digital imaging is the fastest advancing technology in healthcare imaging. The advancements have led to an increased capability at a lower cost for healthcare image processing and storage. The digital imaging process may appear in two different capabilities: Computed Radiography (CR) or Direct Digital Radiography (DR). CR is a cassette based system that utilizes digital film screen technology. CR film screens are located in a conventional cassette similar to wet processing cassettes. The film screen is exposed and then placed into a separate plate reader for digital conversion. The image is displayed on a computer screen and stored on a secure server for future retrieval.

In DR, the imaging plate is fixed to the x-ray table. DR has digital image receptors that
interrupt the x-ray exposure based on the amount of x-radiation reaching the cassette. The image is then displayed on a computer screen. The stored information is placed on a secure server for future retrieval. In Radiology departments the HM may see either CR or DR. CR is the most economical based on current technologies.

Dental digital radiography uses an electronic sensor and computerized imaging system that produces x-ray images almost instantly on a computer monitor. In dental radiography, a sensor, or small detector, is placed inside the mouth of the patient to capture the radiographic image. The sensor is used instead of the intraoral dental film. As in conventional radiography, the x-ray beam from the tube head is aimed to strike the sensor. An electronic charge is produced on the surface of the sensor; the electronic signal is digitized, or converted into “digital” form. The digital sensor in turn transmits the information to a computer.

Digital radiography systems are not limited to intraoral images; panoramic and cephalometric images may also be obtained.

**WET PROCESSING**

Automatic film processors are the most commonly utilized systems. Manual processing can be used for a backup method for the automatic film processor. If the command has manual processing capabilities, refer to the manufacturer’s operating instructions.

There are five basic steps involved in processing X-ray film: developing, rinsing, fixing, washing, and drying.

**DARKROOM PROCEDURES**

The darkroom has two sources of illumination: white light and safelight. A white light is a standard ceiling light. It provides regular illumination for mixing solutions and cleaning the darkroom. An unwrapped, unprocessed X-ray film package must never be exposed to white light. Exposed film is useless.

A safelight, which contains a 15 watt bulb with a special filter (usually red) is the only safe source of illumination in the darkroom when processing X-ray film. The safelight must be located no less than 4 feet from the work surface so that the HM can open film cassette and process film. Limit the length of exposure of undeveloped imaging film to the safelight for no more than 2 minutes. Films not stored in protective coverings exceeding this time might get a fogged image (discussed under faulty radiographs).

Occasionally, film is exposed (ruined) because of light leakage. White light may leak through the filter on the safelight or it may leak into the darkroom from an outside source. A simple test will enable the HM to detect leakage. To check for possible light leakage from an outside source, perform the test with all lights off, including the safelight.

1. Obtain a piece of unexposed X-ray film.
2. Lay the film on the workbench, and place a penny over it for a period of 5 minutes.
3. Process the film.
4. The processed film should show no image. If the outline of the penny can be seen, there is light leakage and the HM should inform the supervisor.

The HM should perform this test at every location in the darkroom where unwrapped film is being processed.

**AUTOMATIC PROCESSING**

Automatic processing is the most commonly used method of processing medical and dental radiographs in the Navy. The automatic film processor mechanically transports exposed X-ray film through the developing, fixing, washing, and drying cycles. Automatic processing is quicker than manual processing, and it produces finished radiographs of uniform quality. A variety of automatic film processors are in use in the Navy and they can be generally classified as small or large. Refer to the command SOP or manufacturer’s guide for processing instructions.

**PROCEDURES FOR PROCESSING FILM**
If processing a large quantity of X-ray films, the HM must avoid any mix-up. To do this, after inserting one patient’s X-ray films, wait 15 seconds before inserting the next patient’s films. After inserting the X-ray films of each patient, set the X-ray mount, envelope, and identification label aside; make sure to keep them in the order in which they were processed. This will help the HM match the processed radiographs to the patient’s unit, envelope, or identification label when the film exits the processor.

For medical films, the identification flasher machine will be utilized to stamp the films with the patient’s information prior to the film being processed. This machine can be located either inside or outside of the darkroom.

Securing the Processor

The processor should be secured at the end of the day. The securing procedures are as follows:

1. Depress the on/off switch to the off position.
2. Turn the water supply valve to the off position. (Some models will be stand alone, and will not require this step.)
3. Unplug the power supply cable.
4. Wipe the cover and housing of the processor with a damp sponge or cloth.
5. Open the lid to allow ventilation

Chemistry Change

Change the developer and fixer at a minimum of once every 3 to 4 weeks. If a large quantity of X-rays has been processed, change the developer sooner. Replenish the solutions following the manufacturer’s instructions.

Because of the alkaline and acid nature of the developer and fixer solutions, minor chemical irritation or burns can occur when they come in contact with the skin, the eyes, and the mouth. Use caution when stirring or mixing solutions. Always wear rubber gloves and protective eye wear or a protective face shield and an apron when working around these solutions. If the solutions come in contact with the skin, flush the area with large amounts of water. If the solutions accidentally splash into the eyes or mouth, flush with large amounts of water and immediately seek medical attention. Fixer solution can stain and discolor clothing.

Maintenance Schedule

The HM is responsible only for user maintenance of the processor; equipment repairs are the responsibility of the Dental equipment repair technician.

Monthly maintenance consists of cleaning the roller transports and solution tanks. Weekly maintenance consists of soaking the transport rollers, solution agitators, and other removable internal parts for 5 to 10 minutes with a processor cleaner.

NOTE:
Any time the processor cover is lifted and maintenance is being performed, the HM must wear a safety face shield, apron, and protective gloves.

FAULTY RADIOGRAPHS

Faulty radiographs are caused by the incorrect positioning of the film packet or the tube head; incorrect kVp, mA and time setting; or by incorrect processing procedures. One common cause of faulty radiographs due to tube head and film misalignment have already been discussed (e.g., incorrect horizontal angles produce superimposed radiographic images, and incorrect vertical angles produce images that may be foreshortened or elongated). The following are additional causes of faulty radiographs:
- **No image** (Fig. 17-44): The film was immersed in the fixer before the developer. If the film is completely clear, it was never exposed.

- **Very light image** (Fig. 17-45): The film was underexposed (kilo-voltage too low); the developer was weak; or the film was not left in the developer long enough.

- **Very dark image** (Fig. 17-46): The film was over-exposed (kilo-voltage too high); the developer was too warm; or the film was left in the developer too long.

- **Partial image** (Fig. 17-47): The film was not completely immersed in the developer; the film came into contact with other film or the side of the tank while in the developer; or the film or tube head was incorrectly positioned (cone cutting).

**Figure 17-46.—Very Dark Image**

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*

**Figure 17-47.—Partial Image**

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*
- **Blurred image** (Fig. 17-48): The patient or tube head moved during the exposure

![Blurred Image](image1)

*Figure 17-48.—Blurred Image

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*

- **Fogged film** The film was outdated or contaminated; the film was overexposed by being held too close to the safelight; the film was exposed to stray radiation, excessive heat, chemical fumes, or light leaks in the darkroom; the developer was improperly mixed, contaminated, or too hot

- **Streaked or stained film**: The film was insufficiently washed or fixed; the processing solutions were dirty; or the film hanger was dirty

- **Reticulation**: There was a too rapid change in temperature during processing (e.g., the film was taken from a warm developer to a cold rinse)

- **Crescent-shaped lines** (Fig. 17-49): The film packet was creased or bent

![Crescent-Shaped Lines](image2)

*Figure 17-49.—Crescent-Shaped Lines

- **Herringbone image** (Fig. 17-50): The wrong side of the film, packet was facing the source of the X-ray beam during exposure causing the embossing pattern from the lead backing to appear on the film

![Herringbone Image](image3)

*Figure 17-50.—Herringbone Image

- **Black areas**: The film was pulled too rapidly from its black paper wrapping, causing a discharge of static electricity

- **White spots**: The developer failed to work on these areas because of dirt or air bubbles

- **Foreign object image** (Fig. 17-51): Dentures or other objects were in the patient's mouth during the exposure

![Foreign Object Image](image4)

*Figure 17-51.—Foreign Object Image

*Photograph provided by the Dental Readiness Department of National Naval Medical Center, Bethesda, MD.*
MOUNTING DENTAL RADIOGRAPHS

After processing the dental X-ray film, the HM will mount the finished radiographs in cardboard or plastic folders. Mounting makes the radiographs easy to view, keep them in a chronological order, and protect them from damage.

Mounted radiographs may be viewed from either the front or back of the mount. If viewed from the front, the teeth appear on the film as if the HM was looking directly into the patient's mouth. If viewed from the back, the teeth appear on the film as if the HM was sitting on the patient's tongue looking out. Always mount X-rays in anatomical order. After the HM mounts the radiographs, file the mount in the patient's Dental Record. The Dental Officer may want to retain the radiographs for diagnostic purposes (e.g., endodontic). These are normally placed in a drug envelope, labeled and dated, and placed in the dental record.

Medical x-rays are not mounted. They are placed in folders. If there are multiple types of medical x-rays (diagnostic, Ultrasound, Cat Scan, etc., the x-rays are placed in sub-folders to keep them separated and easier to locate.

Interproximal (Bite-Wing) Mounting

Figure 17-52 shows a serial mount for interproximal (bite-wing) radiographs. The mount contains slots for mounting five pairs of interproximal radiographs for a patient taken at different times/dates and mounted in chronological order. Serial mounting enables the Dental Officer to compare radiographs taken at different intervals to detect changes in the patient's oral structures.

The front of the mount contains spaces for the patient's name and social security number, mount number, and the date of each exposure. Fill in this information whenever a new mount is started. After completing the necessary information on the front side, turn the mount over and lay it face down on a table top.

Figure 17-52.—Mounted Inter-Proximal Radiographs

Photograph provided by HM2 Pablo A. Mercado of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD.

Place the radiographs on a flat, dry surface with the convex surface of the identifying "dimple" toward the observer. Pick up a radiograph by the edges. Hold it up to the film viewer. The line representing the occlusal surface of the bicusps and molars should gradually curve upward, forming one-half of a smile. If the line curves upward on the right, slide the radiograph into the right-hand slot on the back of the mount with the upward curve toward the outside of the mount. Keep the raised dimples facing outward. If the line curves upward on the left, slide the radiograph into the left-hand slot. If both radiographs are mounted correctly, they will appear as shown in Figure 17-55, forming a complete smile. Each time an additional pair of inter-proximal radiographs is mounted, enter the date on the line beneath the mounting slots.

Full Mouth Periapical Mounting

Figure 17-53 shows a full mouth periapical film mount. The mount contains 14 slots for periapical radiographs and 2 slots for interproximal (bite-wing) radiographs.
When mounting full mouth periapical radiographs, there will be multiple radiographs; take care to sort and mount them correctly. To do this, the HM must be able to recognize certain maxillary and mandibular anatomical landmarks.

ANATOMICAL LANDMARKS

During the following discussion, locate each anatomical landmark on Figure 17-54. The landmarks are indicated by arrows.

Maxillary Incisor Area

Radiographs of this area usually show a large white region caused by the bone of the nasal septum (Fig. 17-54).

Mandibular Incisor Area

Mandibular incisors are smaller than maxillary incisors. The mandibular incisor area has a network of tiny white lines around and below the roots (Fig. 17-54).

Maxillary Cuspid and Bicuspis Areas

Radiographs of these areas usually show a distinct wavy white line above or near the apices of the teeth (Fig. 17-54). The wavy white line identifies the floor of the maxillary sinus. This white line is not found in radiographs of the mandibular arch.

Mandibular Cuspid and Bicuspid Areas

Radiographs of these areas show a fine network of tiny white lines around and below the roots and a dark area in the cuspid area representing the mental foramen which is one of two holes ("foramina") located on the anterior surface of the mandible (Fig. 17-54).

Maxillary Molar Area

Radiographs of these areas show the maxillary arch and the roots of the maxillary molars curving slightly toward the rear of the mouth (Fig. 17-54). Maxillary molars have three roots; they tend to be indistinct on radiographs. In addition, the radiographs will usually show a distinct wavy white line above or near the apaxes of the teeth.

Mandibular Molar Area

Mandibular molars show two roots that are distinct on radiographs. The mandibular nerve canal frequently shows as a dark, narrow band running horizontally under the apaxes of the mandibular molars. The mandibular arch and the roots of the molars curve slightly toward the rear of the mouth. An impacted third molar will often be present on radiographs of the mandibular molar areas (Fig. 17-54).
Figure 17-54.—Maxillary and Mandibular Radiographic Landmarks
MOUNTING PROCEDURES

Place all the radiographs in the full mouth periapical series on a dry, flat working surface with the dimple side up. On the front of the film mount, enter the patient’s name, social security number, rank/rate, the date, and the name of the dental treatment facility. Place the mount face down on the working surface. The two small arrows on the back of the mount should point toward the HM. Follow these steps to mount the radiographs:

1. Check each radiograph and make sure each surface with be raised dimple faces the HM.

2. Mount interproximal radiographs. If interproximal (bite-wing) radiographs are included in the full mouth series, insert them in the slots provided.

3. Divide the radiographs into maxillary and mandibular groups. Using the film viewer, locate the anatomical landmarks discussed earlier. The maxillary radiographs are inserted in the 7 slots across the top of the film mount and the mandibular radiographs in the 7 slots across the bottom.

4. Insert the maxillary radiographs. Identify the radiograph of the central incisor area. Keeping the side with the raised dimple facing toward the HM, rotate the radiograph until the incisal edges of the teeth point down. With the back of the mount toward the HM, slide the radiograph into the incisor slot. When the radiograph is properly mounted, the side with the raised dimple will face the HM, and the incisal edges pointing down toward the center of the mount.

5. Work outward from the central incisor slot, inserting the rest of the maxillary radiographs in the following order: cuspid areas, bicuspid areas, and molar areas.

6. Insert the mandibular radiographs. Start with the radiographs of the central incisor areas and work outward. The raised dots will be toward the HM and the incisal/occlusal surfaces of the teeth should be pointing upward toward the center of the mount.

7. After inserting all of the radiographs, hold the mounted radiographs up to the viewer. Double check to see that each radiograph is mounted correctly.

PANORAMIC RADIOGRAPHS

The panoramic X-ray machine is used to produce an extraoral radiograph that shows both dental arches and the temporomandibular joints (Fig. 17-55). The radiograph is made by rotating the tube head and film around the patient while the patient remains stationary. Because of the different manufacturers and models of panoramic X-ray machines used in the Navy, this operation and maintenance will vary. Always refer to manufacturer’s instruction manual prior to use.
Operational Check

The operational check for the panoramic X-ray machine is accomplished without a patient. To perform the operational readiness check, perform the following procedures:

1. Turn on the pilot switch; the pilot light will illuminate.
2. Set the kVp selector switch to the desired voltage. Adjust the kVp meter as a reference for the desired kVp setting.
3. Select the mA settings, to be used. Adjust them according to the manufacturer's instructions. When the mA and kVp settings that give the best results are determined, enter them on a technique values chart. Remember each manufacturer's film is different, follow the recommendations.

WARNING:
When performing the operational check, keep the collimator (x-ray tube) covered with the lead cap.
Preparing the Film

When the X-ray machine is operational, prepare the panoramic film. Load the film into a cassette drum, and then mount it in the cassette drum assembly on the X-ray machine. To load and mount the cassette drum, follow the manufacturer's instructions.

Labeling the Cassette

The cassette is labeled for the purposes of orientation and patient identification.

There are two ways to label the cassette for patient identification. The HM can use a self-adhesive label or an X-ray film identification printer. Follow the manufacturer's instructions when using the printer. The patient information includes: the patient's name (last name, first name, and middle initial), family member prefix code, social security number, and the date of the exposure.

Requirements for a Good Panoramic Result

Follow the manufacturer's operating instructions for complete operation of the panoramic X-ray machine before attempting to use it. The following is a list of important procedures that must be followed to ensure a good quality X-ray is produced.

- Make sure patient's back and cervical spine are as straight as possible
- Check that the patient's mid-sagittal plane is centered within the unit
- Ensure the patient's Frankfurt plane (anatomical position of the human skull) is horizontal
- Ensure the anterior maxillary and mandibular teeth are located on the indent of the bite-block. If the patient's bite is abnormal, adjust mandible forward or backward to compensate
- Observe patient to ensure there is no movement during the radiographic procedure

Operating the Panoramic X-Ray Machine

With the machine operational and the film cassette drum in the cassette drum assembly, the HM is now ready to take the radiograph on the patient. Follow the manufacturer's instructions for patient positioning and operation. When the patient is being positioned, explain the exposure procedures. Make the exposure and process the film. The HM should wait 5 minutes between exposures to prevent overheating of the X-ray head.

Panoramic X-Ray Machine Maintenance

The panoramic X-ray machine requires very little user maintenance. Wipe the metal and painted parts with a soft, dry cloth daily. Report malfunctions to the supervisor. All repairs are the responsibility of the biomedical repair technician.

SUMMARY

This chapter outlined the details of radiation safety & protection applying to radiation workers, patients, and the population; patient positioning techniques; film processing techniques; and examples of finished radiographs. Ensuring that all of these details are followed will provide quality x-ray images for proper diagnosis in a setting that is destined to provide radiation exposure that follows the principles of ALARA (As Low As Reasonably Achievable). The imaging department is an integral part of the Healthcare Team that provides healthcare providers with the tools needed to combat medical and dental disease processes in any setting worldwide.