CHAPTER 17

RADIOLOGY

INTRODUCTION

Radiology technologists (X-Ray Technician) are Hospital Corpsmen (HM) performing diagnostic imaging. Technologists may specialize in a number of areas with the ultimate goal to provide quality radiographic images of patients for interpretation by a Radiologist.

Based on the American Society of Radiologic Technologists website, “Radiologic technologists often specialize in a particular diagnostic imaging area."

- General “Diagnostic” Radiographers “use radiation (x-rays) to produce black-and-white images of anatomy. The images are captured on film, computer or videotape. X-ray may be used to detect bone fractures, find foreign objects in the body, and demonstrate the relationship between bone and soft tissue. The most common type of x-ray exam is chest radiograph.”

- Computed Tomography (CT) Technologists “use a rotating x-ray unit to obtain "slices" of anatomy at different levels within the body. A computer then stacks and assembles the individual slices, creating a diagnostic image. With CT technology, physicians can view the inside of organs - a feat not possible with general radiography.”

- Magnetic Resonance (MR) Technologists “are specially trained to operate MR equipment. During a Magnetic Resonance Imaging (MRI) scan, atoms in the patient's body are exposed to a strong magnetic field. The technologist applies a radiofrequency pulse to the field, which knocks the atoms out of alignment. When the technologist turns the pulse off, the atoms return to their original position. In the process, they give off signals that are measured by a computer and processed to create detailed images of the patient's anatomy.”

- Cardiovascular-Interventional Technologists “use sophisticated imaging techniques such as biplane fluoroscopy to help guide catheters, vena cava filters, stents or other tools through the body. Using these techniques, disease can be treated without open surgery.”

- Nuclear Medicine Technologists “administer trace amounts of radiopharmaceuticals to a patient to obtain functional information about organs, tissues and bone. The technologist then uses a special camera to detect gamma rays emitted by the radiopharmaceuticals and create an image of the body part under study. The information is recorded on a computer screen or on film.”

- Sonographers “use sound waves to obtain images of organs and tissues in the body. During an ultrasound examination, the sonographer places a transducer in contact with the patient's body. It emits high-frequency sound waves that pass through the body, sending back "echoes" as they bounce off organs and tissues. Special computer equipment converts those echoes into visual data.”

- Mammographers “produce diagnostic images of breast tissue using special x-ray equipment. Under a federal law known as the Mammography Quality Standards Act, mammographers must meet stringent educational and experience criteria in order to perform mammographic procedures.”

- Oral radiography is the art of recording images of a patient’s oral structures on film by using X-rays. As the X-ray films are processed, the resulting radiographs provide the Dental Officer with a valuable diagnostic aid. In the case of death, radiographs can be used to aid in identification.
HISTORY OF X-RAY

LEARNING OBJECTIVE:

Explain the history of x-ray.

The rays were discovered in 1895 by a scientist, Wilhelm Conrad Roentgen. While experimenting with a device called a Crooke’s tube, which generated cathode rays, he noted that a photographic plate completely wrapped in black paper and lying near the tube was fogged when developed.

He knew that the cathode rays could travel only short distances outside the cathode tube and realized he was observing a new, unknown ray, which he called an X-ray because the symbol "X" is used for the unknown in mathematics.

The first dental radiograph was taken during the same year by Dr. Otto Walkoff. Within 10 years of the first discovery of x-ray, radiographs were being used for diagnosis of medical and dental conditions, for X-ray therapy, and for scientific studies. Although technology over the years has made tremendous improvements in X-ray equipment, the basic concepts are the same.

X-radiation can be harmful and HMs must observe safety precautions when using an X-ray machine or working areas using them. The major portion of this chapter is devoted to the operation of x-ray equipment, the process for taking radiographs, and safety precautions for x-radiation.

MEDICAL X-RAY EQUIPMENT

There are a number of medical imaging equipment pieces HMs might see. This chapter outlines the most common that are utilized. Figures 17-1 and 17-2 are medical and dental X-ray machines.

Figure 17-1.—Medical X-Ray Machine

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

Figure 17-2.—Dental X-Ray Machine

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

The film viewer is a metal case with a back-lighted screen. The viewer is used to mount and examine radiographs. Figure 17-3 shows a wall mount film viewer. Never light the film viewer in the darkroom when working with unwrapped or unprocessed film. Keep the viewer screen clean at all times (Fig. 17-3).

Figure 17-3.—Wall Mount Film Viewer

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

FUNDAMENTALS

LEARNING OBJECTIVES:

Identify the aspects of radiation safety.

Identify the aspects of patient protection.

MEDICAL X-RAY

Like visible light rays, X-rays are electromagnetic rays that traveling in a wave motion. The measurement of this wave motion is called a wavelength. The difference between X-rays and other electromagnetic rays is their wavelength. The wavelength for X-rays is extremely short in comparison to electromagnetic rays which are longer. The shorter wavelength enables them to penetrate matter that usually absorbs or reflects light. X-rays and other electromagnetic rays have actions that are considerably different.

Some of the characteristics and properties of X-rays are:

- They travel in straight lines at the speed of light
- They affect photographic film by producing a hidden image made visible by processing
- They cause certain substances to fluoresce (glow)
- They cause irritation of living cells. In large amounts can cause necrosis (death) of the cells, a fact that necessitates caution in using X-rays

X-rays are produced in the x-ray tube head when a metal (tungsten) target is bombarded by a stream of electrons. The X-rays are sent from the x-ray machine through the patient, and then reach the x-ray cassette (holds the film) to produce an image on the film.

The density of the X-ray image is controlled by four factors: kilo-voltage (kVp), exposure time, milli-amperage (mA), and target-film distance (TFD). All of these factors are interrelated and may be varied by the operator.

RADIATION SAFETY

Radiation safety and radiation protection are everyone’s responsibility. Proper warning signs are required in areas utilizing radiation.

Several groups and national committees were created to monitor the use of ionizing radiation after many occupational workers were killed or developed a medical condition due to excessive radiation exposure. One of these national groups is the Nuclear Regulatory Commission (NRC). During the early years of radiation use, there were no monitoring or governing bodies which resulted in improper use of radiation such as x-rays of shoes for foot size and heads for hats sizes.
Radiation protection is sub-divided into occupational radiation protection (protection of workers); medical radiation protection (protection of patients); and public radiation protection (protection of individual members of the public population). The types of exposure, as well as government regulations and legal exposure limits are different for each of these groups, so they must be considered separately.

There are several factors that affect the amount of exposure (dose) a patient receives from the source. Radiation exposure is managed by a combination of these factors:

- **Time:** Reducing the time of an exposure reduces the effective dose proportionally. An example of reducing radiation doses by reducing the time of exposures can be accomplished through operator training to reduce the amount of repeated x-rays. The MAS (milliampere per second) controls the exposure time to the patient.

- **Distance:** Increasing distance (x-ray source to patient) reduces dose due to the “Inverse Square” law. Another distance example includes having non essential personnel standing further away from the radiation exposure area.

- **Shielding:** Adding shielding will reduce radiation dose to the patient. The radiation getting through decreases with the thickness of the shield. The walls of X-ray rooms are lead lined providing an element of shielding to people outside the room. The X-ray machine operator is shielded when standing behind a leaded glass window and can wear a lead apron. Almost any material can act as a shield from X-rays if used in sufficient amounts. Lead aprons and vests are the best methods of shielding.

A good rule is the acronym, ALARA, "As Low As Reasonably Achievable." The aim is to minimize the risk of radioactive exposure or other hazards. The rule of ALARA is based on the principle that any amount of radiation exposure, no matter how small, can increase the chance of negative biological effects such as cancer.

It is based on the principle that the probability of the occurrence of negative effects of radiation exposure increases with the total lifetime dose. X-ray and other practices involving the use of radiation bring great benefit to the patient population and limiting radiation exposure will reduce negative effects when utilized safely.

Attention to shielding and the rule of ALARA protects the patient and workers. There are four major ways to reduce radiation exposure to patient and workers:

- **Shielding:** Use proper barriers to block or reduce ionizing radiation
- **Time:** Spend less time in radiation fields
- **Distance:** Increase distance between radioactive sources and workers or population. As a good rule during radiation exposures, the radiation worker should be a minimum distance of 6 feet from the source
- **Amount:** Limit the number of x-ray exposure taken to the lowest number possible

The facility will have Standard Operating Procedures (SOP) for the operation of radiographic (X-ray) units and equipment. The HM will be required to read these procedures before operating equipment in the Radiology Department.

**RADIATION PROTECTION STANDARDS**

**Patient Protection**

Safety precautions will be observed by all persons working in or near an area where X-rays are generated. A number of precautions are taken to prevent the patient from being overexposed to radiation.

When taking radiographs, the HM should always have patients wear lead aprons and thyroid collars to shield reproductive organs and thyroid glands. The only exception is when obtaining a panorex radiograph as the thyroid collar blocks part of the X-ray beam.
Before taking radiographs on a female, always ask whether or not she is pregnant or if pregnancy is questionable. If there is belief of a pregnancy, consult a provider.

Other radiation safety measures include X-ray machines that have built-in safeguards that filter out harmful radiation and restrict the central X-ray to the smallest possible area.

Occupational Worker Protection

When working near a source of radiation, personnel assigned to the Radiology department will be issued an environmental dosimetry radiation film badge (Fig. 17-4). Film badges are used to monitor scatter (stray) radiation that occurs in the Radiology department. The badges are placed in the X-ray room behind the technician’s protective lead-lined barrier or at least 6 feet from the tube head and never in the direct line of radiation during exposure.

The film badges contain X-ray sensitive film in a light-tight packet. They are collected by radiation health technician every 6 to 7 weeks. After collection, the film is sent to the radiation detection laboratory for processing and evaluation. In an ideal environment, zero REM [Radiological Equivalent Man or mammal] exposure is expected for all workers. On occasion there might be an exposure (i.e., greater than 0.010 REM) and will be referred to the Radiation Health Office for investigation.

Radioactive material shall not be used in such a manner to cause any non-radiation worker to exceed a total effective dose equivalent of 500 mRem (5 mSv) per year considering occupancy factors and source usage. When taking radiographs on a patient, observe the following precautions to avoid unnecessary exposure to radiation:

- **NEVER** stand in the path of the central X-ray beam during exposure
- **NEVER** hold the X-ray film packet in the patient's mouth during a dental exposure
- **NEVER** hold the tube head or the tube head cylinder of the X-ray machine during exposure
- **ALWAYS** stand behind a lead-lined window during an exposure

X-Ray Film Log

Another aspect of radiation safety is accounting for all radiographs that are taken. An X-ray film log is maintained in all X-ray rooms and will contain the following information: Patient's name, rank, SSN, unit assigned, reason for x-ray retake (if applicable), number of exposures taken, and the settings (if possible).

NOTE:
When stating the reason for an x-ray retake, be specific on the nature of the retake.

For example: cone-cut, elongated, foreshortened, dark image, etc.

Radiation Levels

The NRC has established total whole body doses for radiation workers which is found in Title 10, Part 20, of the Code of Federal Regulations (10 CFR Part 20), "Standards for Protection Against Radiation." It sets the annual total effective dose limit at 5,000 mRem (5 Rem) for the entire body.
The Navy has trained Radiation Health professionals to monitor medical and non-medical radiation doses. Refer to the local Radiation Health department or the P-5055, Radiation Health Protection Manual, for further guidance.

**Bio Effects**

Prolonged exposure to radiation may result in loss of hair, redness and inflammation of the skin, blood count change, cell atrophy (wasting away), ulcerations, sterility, genetic damage, cancer, leukemia, and death. Adherence to radiation safety will reduce the possibility of these conditions.

**Precious Metals Recovery Program**

The precious metals recovery program is designated to save Department of Defense (DOD) money by recycling precious metals and using those funds to offset the cost of supplies for DOD activities. Both lead and silver are precious metals found in all x-ray departments. Lead is found in X-ray tube packets, floor coverings, wall shielding, patient shields, and x-ray packets. Silver is found in used fixer solutions and medical/dental films. Precious metals will be saved and turned into the Supply Department following the guidelines in BUMEDINST 4010.3, Precious Metals Recovery Program.

**Infection Control**

Both radiographic equipment and film can become contaminated resulting in the transmission of infectious agents. To protect workers and the patients, HMs will ensure that infection control standards are used in the radiology area. Information and procedures on the Infection Control Program can be found in BUMEDINST 6220.9 Series, Nosocomial Infection Control Program and BUMEDINST 6600.10 series, Dental Infection Control Program.

**Handwashing**

Follow proper hand washing procedures when treating radiology patients. Refer to Chapter 9 of this manual for handwashing technique.

**Darkroom**

The darkroom might be a location that is overlooked as an area being contaminated. Disinfect all surfaces that the HM comes in contact with on daily basis which includes doorknobs, light switches, and other surfaces. Good infection control measures include disinfecting all area that HMs and patients touch.

**Oral Film Positioning Devices**

Film positioning devices should be disposable (single use) or steam sterilized between patients. The treatment facility should have an adequate supply of film positioning devices for the daily patient load. If supplies are short, the HM may disinfect film positioning devices between patients by immersion in an EPA-registered chemical disinfection such as a 2 percent glutaraldehyde solution. Rinse thoroughly after disinfection. Follow manufacturer's instructions for high-level disinfection. Wear gloves when placing intra-oral films and handling contaminated film packets.

**Panoramic Unit Bite-Blocks**

Use a disposable panoramic unit bite block cover for each patient. When disposable covers are not available, disinfect bite blocks in the same manner as a film holding device.

**Intraoral Film Packets**

Intraoral film packets become contaminated when placed in a patient's mouth during exposure. The following section explains procedures to handle and process contaminated intraoral film packets from the X-ray room to the dark room to avoid cross contamination.
PATIENT PREPARATION PROCEDURES

LEARNING OBJECTIVE:

Identify steps for preparing a patient for an x-ray.

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

1. Ensure a provider’s order for the examination.
   a. Only a Medical Officer, Dental Officer, Nurse Practitioner, Physician Assistant (PA) and Independent Duty Corpsmen (IDC) can order a radiographic examination.
   b. The order may be in the Composite Health Computer System (CHCS) or a written order on a SF-519, RADIOLOGIC CONSULTATION REQUEST/REPORT.

   **NOTE:**

   If working in an operational environment or area not within close proximity of a Radiologist, seek the ordering provider’s impression of findings prior to forwarding the films to the Radiologist.

2. If the patient is a woman, ask if she is pregnant.
3. If she is or the HM suspects that she might be, consult the ordering physician.
4. Ask the patient to remove eyeglasses, jewelry (affected area), or any other object in the area of examination.
5. Drape the patient with a lead apron ensuring the reproductive organs are covered, unless area of examination will preclude covering.
6. Position the affected anatomy securely against the film screen. Positioning the patient varies according to the type of radiographic examination and the film placement technique to be used.
7. Give appropriate instructions (breathing, remain still, etc.) to the patient.
8. Set KVp and Mas based on current facility charts.
9. Make the exposure.

After the X-ray procedure is completed, return the lead apron and/or thyroid collar back to the storage device(s) to avoid damage.
MEDICAL X-RAY PROCEDURES

LEARNING OBJECTIVES:

Identify the proper patient positioning techniques.

Identify the proper film size for an x-ray exam.

Identify structures shown in an x-ray.

POSITIONING OF THE HAND

Posterior anterior (PA) Projection (Fig. 17-5)

1. Film Size 8 X 10 or 10 X 12
2. Source to image distance (SID)- 40 inches (x-ray tube 40 inches from film)
3. Part position
   a. Rest the patient’s forearm on the table:
   b. Place the hand with the palm down
   c. Slightly spread the fingers
4. Central ray
   a. Perpendicular to the film
   b. Direct the central ray to the third metacarpophalangeal (MCP) joint
   c. Adjust the long axis of the cassette parallel with the long axis of the hand and forearm
5. Structures shown
   a. PA projection of the:
      i. Carpals
      ii. Metacarpals
      iii. Phalanges
      iv. Thumb will be oblique to 45°
      v. Interarticulations of the hand
      vi. Distal radius and ulna
6. Indications
   a. Discomfort due to mechanism of injury

Figure 17-5.—Posterior Anterior (PA) Projection of the Hand

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Oblique Projection (Fig. 17-6)

1. Film size 8 X 10 or 10 X 12
2. SID - 40 inches
3. Part Position
   a. Rest the patient’s forearm on the table with the hand pronated and the palm resting on the cassette. If possible use an angled sponge as it will allow the fingers to remain straight and provide increased visualization of the joint spaces.
   b. Adjust the obliquity of the hand so that the MCP joints form an angle of approximately 45 degrees with the cassette
   c. Fingers are flexed with fingertips resting on the cassette
4. Central ray
   a. Perpendicular to the film
   b. Direct central ray to the third metacarpophalangeal joint
   c. Adjust the midline to be parallel with the long axis of the hand and forearm
5. Structure shown:
   a. PA oblique projection of the bones and soft tissues of the hand
6. Indication
   a. Determine possibility of fracture

Figure 17-6.—Oblique Projection of the Hand

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-7)

1. Film size 8 X 10 or 10 X 12
2. SID - 40 inches
3. Part position
   a. Extend the patient’s digits and adjust the first digit at a right angle to the palm
   b. Place the palm surface perpendicular to the cassette
   c. Evenly fan the fingers apart
4. Central ray
   a. Perpendicular to the film
   b. Direct the central ray through the second metacarpophalangeal joint
   c. Adjust the midline to be parallel with the long axis of the hand and forearm
5. Structures shown
   a. Lateral projection of the structures of the hand
   b. An extended lateral hand will demonstrate the second through fifth digits superimposed

   **NOTE:**
   X-rays of the wrist use the same positions as hand x-rays. Finger extension is not required.

6. Indication
   a. Phalangeal fracture

*Figure 17-7.—Lateral Projection of the Hand*

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
POSITIONING OF THE CHEST
Posterior anterior (PA) projection\textsuperscript{15} (Fig. 17-8)

1. Film size - 14 x 17
2. SID - 72 inches
3. Part position
   a. Patient is in the upright position
   b. The upper border of the film is positioned approximately 1 \(\frac{1}{2}\) inches above the relaxed shoulders
   c. The median sagittal plane of the body is centered to the midline of the grid device
   d. Body weight is evenly distributed over both feet
   e. The head is adjusted so that the median sagittal plane of the skull is vertical and the chin is resting over the edge of the grid device
   f. Place the back of the hands on the hips
   g. Adjust the shoulders to lie in the same transverse plane
   h. If a woman’s breasts are large enough to superimpose over the lower part of the lung field, have the patient pull them upward and laterally
4. Central ray (Cross-hairs)
   a. Perpendicular to the film
   b. Directed to the level of T-7 (Inferior Scapula Angle)
5. Respirations
   a. Exposure is made following full inhalation on the second breath
   b. For certain conditions, an additional exposure is taken following exhalation
6. Indications
   a. Routine physical
   b. Chronic cough
   c. Respiratory disease
   d. Asbestos
   e. Fractured ribs
   f. Pain with respirations

\textit{Figure 17-8.—Posterior Anterior (PA) Projection of the Chest}

\textit{Photograph provided by HMI James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.}
Lateral Projection\textsuperscript{15} (Fig. 17-9)

1. Film size - 14 x 17
2. SID - 72 inches
3. Part position
   a. Patient is in the upright position
   b. Place the appropriate shoulder (Left Lateral preferred) against the grid device
   c. The median sagittal plane of the body is parallel to the cassette with the adjacent shoulder in contact with the grid device
   d. The upper border of the film is 1 to 2 inches above the shoulders
   e. Center the thorax to the grid device
   f. Extend the arms over the head
4. Central ray
   a. Perpendicular to the film
   b. Directed to the level of T7
5. Respirations
   a. Exposure is made following full inspiration on the second breath
6. Structures shown
   a. Lateral projection of the heart and aorta
   b. Pulmonary lesions of the side closest to the film
   c. Interlobular fissures
   d. The lobes are differentiated
7. Indications
   a. Routine physical
   b. Chronic cough
   c. Respiratory disease
   d. Asbestos
   e. Fractured ribs
   f. Pain with respirations

Figure 17-9.—Lateral Projection of the Chest

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
POSITIONING OF THE ABDOMEN

KUB (Kidneys, Ureter, Bladder) AP projection (Supine/standing position) (Fig. 17-10)

1. Film size - 14 X 17 lengthwise
2. SID – 40 inches
3. Part Position
   a. Patient is supine or standing
   b. The median sagittal plane is perpendicular and centered to the grid device
   c. Adjust the shoulders to lie in the same transverse plane and place arms where they will not cast shadows on the film
4. Central ray (cross-hairs)
   a. Perpendicular to the cassette
   b. Centered to the level of the iliac crest for supine
   c. 2” above iliac crest for standing position.
5. Respirations
   a. Suspended at the end of exhalation
6. Structures shown:
   a. Bilaterally Kidney
   b. Ureter
   c. Bladder

NOTE:
For standing, must include inferior aspect of lungs (Costophrenic angles).

7. Indications
   a. Quadrant pain
   b. Abnormal bowel movement
   c. Bladder trauma
   d. Abdominal trauma
   e. Impaled object
   f. Lower spine (defects, trauma related, impaled, injuries.)

Figure 17-10.—AP Projection of the Abdomen

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Positioning of the Cervical Spine

AP axial projection (Fig. 17-11)

1. Film size - 8 x 10 or 10 x 12
2. SID - 40 inches
3. Part position
   a. Patient is supine or upright
   b. Adjust the shoulders to lie in the same transverse plane
   c. Center the median sagittal plane of the patient’s body to the midline of the grid device
   d. Extend the chin so that a line from the upper occlusal plane to the mastoid tips is perpendicular to the grid device
   e. Center the cassette at C4 (1/2” above Adam’s apple)
4. Central ray
   a. Angled 15 - 20 degrees cephalic (towards head)
   b. Directed to C4 (1/2” above Adam’s apple)
5. Respirations
   a. Suspended
6. Structures shown
   a. C3 to T1 in entirety
7. Indications
   a. Tracheal deviation
   b. Foreign body
   c. Trauma

Figure 17-11.—AP Axial Projection of the Cervical Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral projection (Fig. 17-12)

1. Film size - 8 x 10 or 10 x 12
2. SID - 72 inches
3. Part position
   a. Patient is upright and in the true lateral position
   b. Adjust cassette so that it is centered at C4 (1/2” above Adam’s Apple)
   c. Center the coronal plane that passed through the mastoid tips to the midline of the film
   d. Place adjacent shoulder in contact with the grid device
   e. Adjust the shoulders to lie in the same transverse plane, depress them as much as possible and immobilize them by using sandbags of equal weight distributed in both hands
   f. Elevate the chin slightly to prevent superimposition of the mandibular rami over the cervical spine
   g. Ensure the long axis of the cervical spine is parallel to the film
4. Central ray
   a. Horizontal
   b. Perpendicular to the film
   c. Directed to the level of C4
5. Respiration
   a. Suspended at the end of full exhalation
6. Structures shown
   a. Lateral view of the c-spine vertebrae from C1-T1.
7. Indications
   a. Musculoskeletal injuries

Figure 17-12.—Lateral Projection of the Cervical Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Positioning of the Thoracic Spine

AP projection (Fig. 17-13)

1. Film size: 14 x 17
2. SID – 40 inches
3. Part position
   a. Patient is in the supine or upright position
   b. Center the median sagittal plane of the body to the midline of the grid
   c. Place arms along the sides of the body
   d. If the patient is supine, flex the hips and knees to place back in contact with the table
   e. If the patient is erect, distribute body weight equally between both feet
   f. Center film at the level of the T-7 approximately three to four inches below the manubrial notch (Normally this will place the upper edge of the cassette 1 1/2 to 2 inches above the shoulder)
4. Central ray
   a. Directed perpendicularly to T7
   b. Utilize the anode heel effect by positioning the cathode end of the tube towards the feet
5. Respirations
   a. Breathing technique
      i. Slow, shallow breaths
   b. Non-breathing technique
      i. Suspend following full exhalation
6. Structures shown
   a. AP projection of the thoracic bodies, interpediculate spaces and surrounding structures
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-13.—AP Projection of the Thoracic Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral projection (Fig. 17-14)

1. Film size: 14 X 17
2. SID – 40 inches
3. Part position
   a. Patient is in a true lateral position, either recumbent or upright
   b. Place a firm pillow under the patient’s head
   c. Flex the hips and knees to a comfortable position
   d. Center the median coronal plane of the body to the midline of the grid at the level of T7
   e. Adjust the arms at right angles to the long axis of the body
   f. Use a radiolucent support under the lower thoracic region to place the vertebral column horizontal with the film
4. Central ray
   a. Directed perpendicularly to the median coronal plane at the level of T7
   b. Utilize an angulation of 10 degrees for women and 15 degrees for men, due to the differing shoulder widths, if necessary
5. Respiration
   a. Long exposure
      i. Quiet breathing
   b. Short Exposure
      i. Suspend respirations at the end of exhalation
6. Structures shown
   a. A lateral image of the thoracic bodies, their interspaces, the intervertebral foramina and the lower spinous processes
   b. The upper three or four segments are usually not demonstrated in this position
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical Spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-14.—Lateral Projection of the Thoracic Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Positioning of the Lumbar Spine
AP Projection (Fig. 17-15)

1. Film size: 11 x 14
2. SID – 40 inches
3. Part position
   a. Patient may be either supine or upright
   b. Center the median sagittal plane to the midline of the grid
   c. Adjust the shoulders to lie in the same transverse plane
   d. Flex the knees to help flatten the natural lordotic curve of the spine
   e. Flex the patient’s elbows and place the hands on the upper chest
   f. Center the film at the level of L-3
4. Central ray
   a. Perpendicular to the film
   b. Directed to the level of L-3
5. Respirations
   a. Suspended on expiration
6. Structures shown
   a. Lumbar bodies
   b. Intervertebral disk space
   c. Interpediculate spaces
   d. Laminae
   e. Spinous and transverse processes
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical Spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-15.—AP Projection of the Lumbar Spine

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-16)

1. Film size: 11 X 14 lengthwise
2. SID – 40 inches
3. Part position
   a. Use the same body position (recumbent or upright) as used for the AP
   b. Place patient on the indicated side and flex the hips and knees for stability and comfort
   c. Align the median coronal plane of the body to the midline of the grid
   d. Place the arms at right angles to the body
   e. If needed, place a support under the lower thorax to position the long axis of the spine in a horizontal plane
   f. Place a sheet of leaded rubber on the table behind the patient
4. Central ray
   a. Perpendicular to the film
   b. Directed to the level of L3
5. Respirations
   a. Suspended on exhalation
6. Structures shown
   a. Lumbar bodies and their interspaces
   b. Spinous processes
   c. Lumbosacral junction
   d. The first four lumbar intervertebral foramina
7. Indications
   a. Chronic pain
   b. Trauma
   c. Cervical spine
   d. Musculoskeletal injuries/abnormalities

Figure 17-16.—Lateral Projection of the Lumbar Spine

*Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.*
Positioning of the Pelvis

AP Projection (Fig. 17-17)

1. Film size 14 x 17 crosswise
2. SID – 40 inches
3. Position of patient
   a. Place the patient on the table in the supine position
4. Position of part
   a. Center the mid-sagittal plane of the body to the mid-line of the grid
   b. Adjust the patient in a true supine position
   c. Have the patient rest their hands across their chest
   d. Unless contraindicated, medially rotate the feet and lower limbs about 15-20 degrees to place the femoral neck parallel with the plane of the cassette
   e. The heels should be 8-10 inches apart
   f. Immobilize the legs with a sandbag across the ankles, if needed
   g. Position upper border of the film 1 ½ inches above the iliac crest
5. Respirations
   a. Suspend respiration prior to exposure
6. Central ray
   a. Perpendicular to the midpoint of the cassette
7. Shield reproductive organs
8. Structures shown
   a. AP projection of
      i. The pelvis
      ii. Femoral head
      iii. Femoral neck
      iv. Trochanters
      v. Proximal 1/3 or 1/4 of the shaft of the femur
9. Indications
   a. Pelvic fracture
   b. Genitourinary system complications
   c. Discoloration
   d. Deformity
   e. Hip pain

Figure 17-17.—AP Projection of the Pelvis

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
POSITIONING OF THE FOOT

AP Projection (Fig. 17-18)

1. Film size 8 x 10 or 10 x 12
2. SID - 40 inches
3. Position of patient
   a. Place the patient on seated or supine position on the table
   b. Flex the knee of the affected side
   c. Rest the sole of the foot firmly on the radiographic table
4. Position of part
   a. Position the cassette under the patient’s foot
   b. Center the cassette to the base of the third metatarsal
   c. Adjust cassette so that its long axis is parallel with the long axis of the foot
   d. Ensure that no rotation of the foot occurs
5. Central ray
   a. 10 degrees towards the heel
   b. Direct central ray to the base of the third metatarsal
6. Shield reproductive organs
7. Structure shown:
   a. AP projection (Dorsoplantar) of the:
      i. Tarsal bones anterior to the talus
      ii. Metatarsals
      iii. Phalanges
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-18.—AP Projection of the Foot

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Oblique Projection (Fig. 17-19)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Place the patient on a seated or supine position
   b. Flex the knee of the affected side
   c. Rest plantar surface of the foot firmly on the radiographic table
4. Position of part
   a. Place the cassette under the patient’s foot
   b. Place film parallel to the foot and with its long axis
   c. Center film to the midline of the foot at the level of the base of the third metatarsal
   d. Rotate the foot medially until the plantar surface forms an angle of 30 degrees to the plane of the cassette
5. Central ray
   a. Perpendicular to the film
   b. Direct central ray to the base of third metatarsal
6. Shield reproductive organs
7. Structures shown
   a. Interspaces between the following:
      i. The Cuboid and the Calcaneus
      ii. The Cuboid and the fourth and fifth Metatarsals
      iii. The Cuboid and the lateral Cuneiform
      iv. The Talus and the Navicular bone
      v. The Cuboid is shown in profile
   b. The Sinus Tarsi is also well demonstrated
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-19.—Oblique Projection of the Foot

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-20)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Have the patient lie on the radiographic table and turn toward the affected side
   b. Place the opposite leg behind the patient
4. Position of part
   a. Elevate the patient’s knee enough to place the patella perpendicular to the horizontal plane
   b. Adjust a sandbag support under the knee
   c. Center the cassette to the mid-area of the foot
   d. Adjust the cassette so that its long axis is parallel to the long axis of the foot
   e. Dorisflex the foot to form a 90-degree angle with the lower leg
5. Central ray
   a. Perpendicular to the film
   b. Direct central ray to the base of the third metatarsal
6. Shield reproductive organs
7. Structures shown
   a. The entire foot in profile
   b. The ankle joint
   c. The distal ends of the tibia and fibula
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-20.—Lateral Projection of the Foot

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Positioning of the Ankle
AP Projection (Fig. 17-21)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Place the patient in the supine or seated position with the affected limb fully extended
4. Part position
   a. Adjust the ankle joint in the anatomic position to obtain a true AP projection
   b. Flex the ankle and foot enough to place the long axis of the foot in the vertical position
   c. The leg should have no rotation
5. Central ray
   a. Perpendicular to the ankle joint at a point midway between the Malleoli
6. Shield reproductive organs
7. Structures shown
   a. Ankle joint
   b. Distal ends of the Tibia and Fibula
   c. Proximal portion of the talus
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-21.—AP Projection of the Ankle

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Oblique Projection (Medial Rotation)
(Fig. 17-22)

1. Film size 8 x10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Place the patient in the supine or seated position with the affected limb fully extended
4. Part position
   a. Center the cassette to the ankle joint midway between the Malleoli
   b. Adjust the cassette so that its long axis is parallel with the long axis of the leg
   c. Dorsiflex the foot enough to place the ankle at nearly right-angle flexion
   d. Grasp the lower femur with one hand and the foot with the other. Internally rotate the entire leg and foot together until the 45-degree position is achieved
5. Central ray
   a. Perpendicular to the ankle joint
   b. Entering midway between the Malleoli
6. Shield reproductive organs
7. Structures shown
   a. Distal ends of the Tibia and Fibula
   b. Parts of Tibia and Fibula are often superimposed over the talus
   c. Tibiofibular articulation should be demonstrated
8. Indications
   a. Chronic pain
   b. Trauma
   c. Abnormalities

Figure 17-22.—Oblique Projection of the Ankle

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
Lateral Projection (Fig. 17-23)

1. Film size 8 x 10 or 10 x 12
2. SID – 40 inches
3. Position of patient
   a. Have the supine patient turn toward the affected side until the ankle is lateral
4. Part position
   a. Place the long axis of the cassette parallel with the long axis of the patient’s leg and center it to the ankle joint
   b. Have the patient turn anteriorly or posteriorly as required to place the patella perpendicular to the horizontal plane
   c. Place a support under the knees if necessary
   d. Dorisflex the foot, and adjust it in the lateral position
5. Central ray
   a. Perpendicular to the ankle joint, entering the medial Malleolus
6. Shield reproductive organs
7. Structures shown
   a. Lower third of the Tibia and Fibula
   b. Ankle joint/Tarsal Bones
8. Indications
   a. Calcaneous fracture
   b. Abnormalities
   c. Twisted ankles

Figure 17-23.—Lateral Projection of the Ankle

Photograph provided by HM1 James Q. Royal of the Biomedical Photography Department of Navy Medicine Support Command, Bethesda, MD by the Radiology Department of National Naval Medical Center, Bethesda, MD.
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.—Parlleling 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.
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 CREASE 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° 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° will give a minus (–) degree of vertical angulation. Angling the tube head so the cylinder points downward from 0° 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°) when X-raying mandibular molars.

<table>
<thead>
<tr>
<th>Maxillary</th>
<th>Mandibular</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incisor +40 to +45</td>
<td>Incisor -15 to -20</td>
</tr>
<tr>
<td>Cuspid +45 to +50</td>
<td>Cuspid -20 to -25</td>
</tr>
<tr>
<td>Bicuspid +30 to +35</td>
<td>Bicuspid -10 to -15</td>
</tr>
<tr>
<td>Molar +20 to +25</td>
<td>Molar -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°. For a patient with an unusually shallow vault, the HM would increase the angulation by about 5°.

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

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
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.

Bitewing X-ray film packets are used for the interpromixal 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). Interpromixal radiographs can be made using either the paralleling technique or the bisecting angle technique.

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 inter-proximal 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.

Figure 17-34.—Bitewing Film Packet

Figure 17-33.—Typical Interproximal Radiograph
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 bite-block 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.

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.

**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°. 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.

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° angle with the floor, and the midsagittal plane is perpendicular to the floor (Fig. 17-41).

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.
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)

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)

5. Make the exposure.

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**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 file 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 17-44.—No Image**

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

**Figure 17-45.—Very Light Image**

**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.jpg)

*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.jpg)

*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.jpg)

*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.jpg)

*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 holders. 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 interpromixal 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.

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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 Bicuspid 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 apices 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 apexes 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 the 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 indents 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.