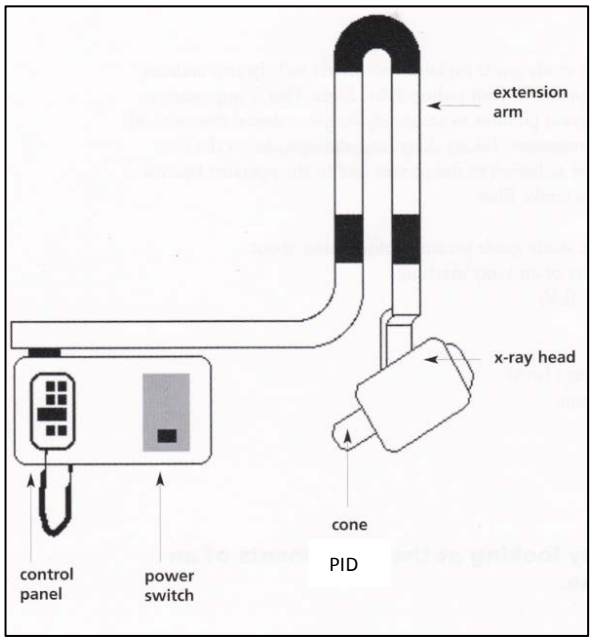
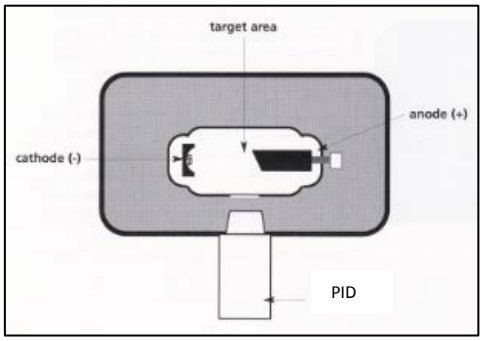
Chapter 2
Dental Digital Imaging Equipment

Your goal when taking dental digital images is to get quality images of the teeth and surrounding hard and soft tissues. You must have knowledge of the equipment and how it works to take quality images that have: good contrast (structures are seen in black, gray and white); appropriate density (not too dark or too light); and no distortion (clear with no blurring or magnification). This is important because dentists need to have quality digital images to accurately diagnose dental diseases, and plan appropriate treatment. The information in this chapter explains the equipment you will be using to take digital images.

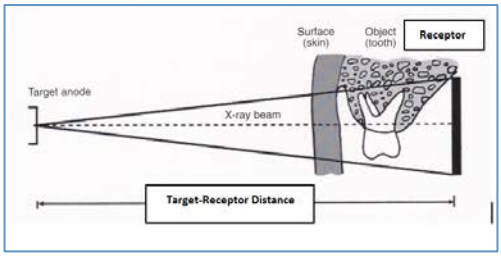
Let's look at the different parts of an X-ray unit, and the inside of an X-ray head.



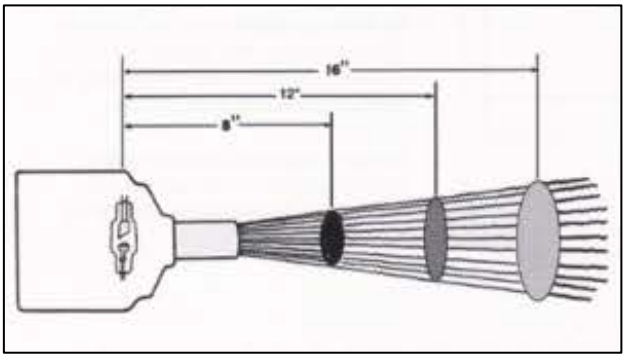


X-rays are created inside the X-ray head. Electrical current passes between the anode and the cathode and hit the target area where X-rays are produced. The X-rays then travel through the PID (positioning indicator device) where the X-ray beam exposes the receptor. The X-ray head and the PID are lead lined to contain the X-rays and prevent unnecessary radiation exposure to the patient and the operator. The PID is also called a cone.

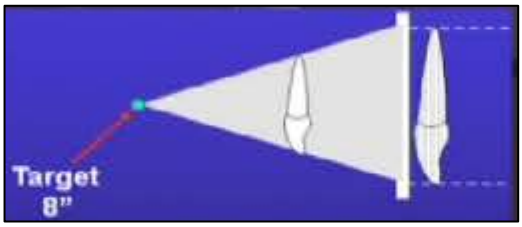
The measurement between the target area and the receptor is called the target-receptor distance.

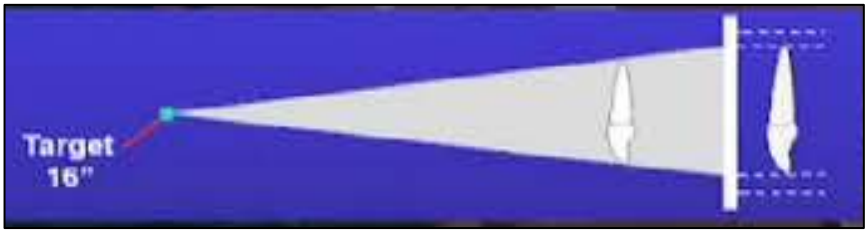


The target-receptor distance depends on the length of the PID. It may be 8, 12, or 16 inches long. The farther X-rays move from their source (target area), the more spread out and less intense they become.



The diagrams below show how the X-ray beam is altered by distance. The X-rays are more intense at 8 inches than at 16 inches. When the target-receptor distance is increased (by using a longer PID), less radiation reaches the patient and the receptor.



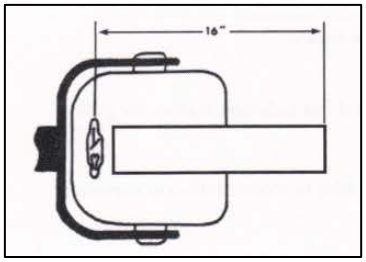


A longer PID provides the following advantages over a shorter one:

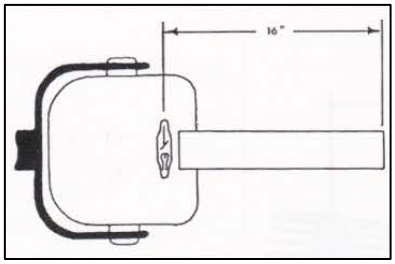
1. An increase in target-receptor distance (a longer PID) improves image sharpness by reducing magnification and distortion. The tooth image is more truly represented.

2. Increased target-receptor distance reduces radiation exposure to the patient and the operator.

Some PIDs may look like they are short, but may be recessed inside the X-ray head. Check to see what length PID is used in your dental clinic.



Recessed 16" PID



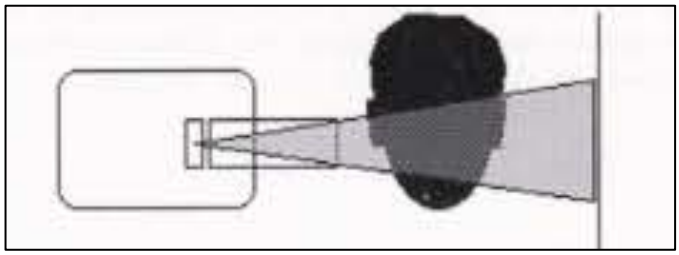
16" PID

The important thing to remember is, a longer cone or PID will provide a more accurate and diagnostic image with reduced radiation exposure for the patient and the operator than a shorter PID.

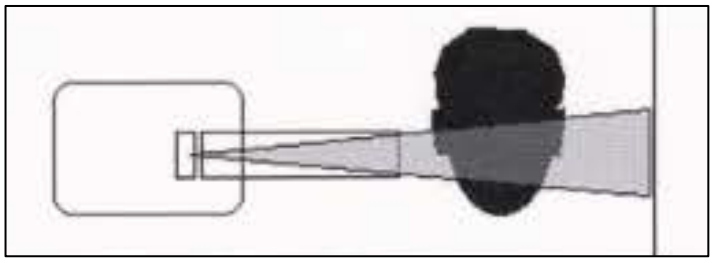
Some PIDs may be rectangular in shaped rather than round. A rectangular collimating device may be put at the end of a round PID. The rectangular PID or collimating device limits the X-ray beam to the actual size of the receptor.

Examples of different rectangular collimators

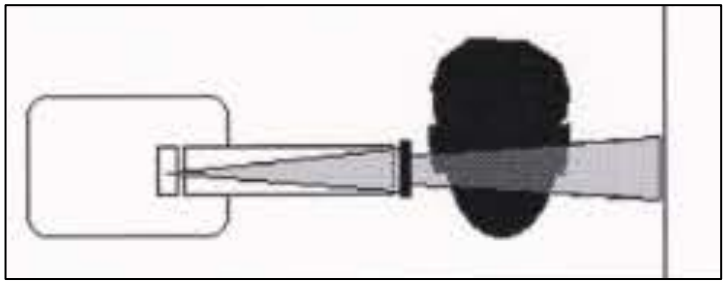
These illustrations show the effect of different types of PIDs on the amount of radiation exposure a patient would receive.

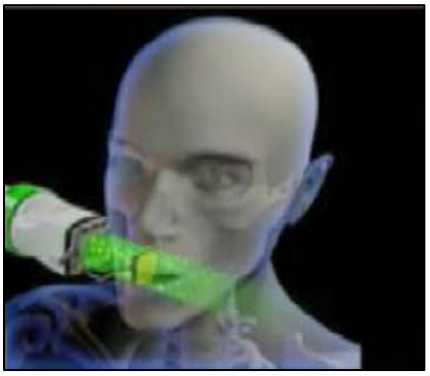


Using a short PID exposes most of the patient's head to radiation. This would include the patient's eyes and thyroid.



When using a longer PID, the X-rays are contained. This reduces radiation exposure to the patient.





Using a 16" PID and a rectangular collimator the X-ray beam is approximately the same size as the receptor. A patient's radiation exposure is reduced significantly.

X-ray Unit Control Panel
To actually produce X-rays, you must press the exposure button on the control panel.

Let's look at the different selections on the control panel.

Kilovoltage (kV) Selection 

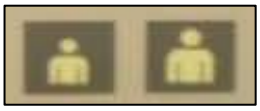
Kilovoltage refers to the energy of the electrons that are produced by the X-ray unit. Higher kV creates shorter wavelengths with more energy in the X-ray beam. The more energy the X-ray beam has, the more penetrating power the X-rays have. Lower kV decreases the energy of the X-ray beam. Longer wavelengths do not possess enough energy to pass through the body to reach the receptor, and are absorbed by the patient's tissues and can cause damage. The longer wavelengths also scatter causing potential exposure to dental staff.

The correct kilovoltage setting will range between 60-70 kV.

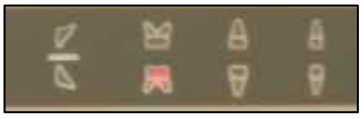
Remember, if you select the correct kV, you will take images that have good density and contrast while using less radiation. This reduces patient and operator exposure to radiation.

Milliamperage (mA) 

Milliamperage refers to the amount of electrical current used to generate electrons that produce X-rays. Higher current or mA produces a greater number or quantity of X-rays. The mA setting does not by itself produce X-rays. It simply presets the amount of X-rays produced during a given exposure time. Milliamperage will vary from 6mA to 8mA depending on the design of the x-ray machine. The lower mA benefits the patient by reducing the total radiation exposure. Many newer x-ray machines have preset mA, and cannot be adjusted by the operator. It is always a good practice to read the manufacturer's instructions before taking images.

Type of Patient 

If you are taking images on a child, you would select the child patient button. If your patient is an adult, you select the adult patient button.

Type of Images 

If you want to take a mandibular molar PA, you would select the button that shows a mandibular tooth on the lower row. If you were going to take a maxillary molar periapical (PA), you would select the button with the molar on the upper row. If you were going to take a mandibular anterior periapical (PA), you would select the button with the central on the lower row.

Exposure Time 

After you select the kV, the type of patient and type of image you will be taking, the exposure time is displayed. The exposure time shows how long the X-ray unit produces a preset amount of X-rays.

Exposure times may have to be altered to compensate for such factors as missing teeth, and the size of the patient. For example, maxillary molars would have a longer exposure time than for mandibular anterior teeth. For edentulous areas, you would reduce the exposure time; for a heavy set adult, you would increase the exposure time; and for children, you would decrease the exposure time.

Exposure Button

In order to expose a receptor, you have to press the exposure button. If you have selected the appropriate buttons for type of patient and type of image, you will have a dental image that has the right amount of density and contrast.

See if you can figure out the answer to these questions.

1. Which area would require more exposure time, maxillary molars or mandibular anterior teeth?

   The answer is maxillary molars. When X-rays have to penetrate many layers of hard and soft tissue, like in the maxillary posterior areas, the exposure time needs to be more than what would be required for mandibular anterior teeth.

2. Would you increase or decrease the exposure time when taking images on children?

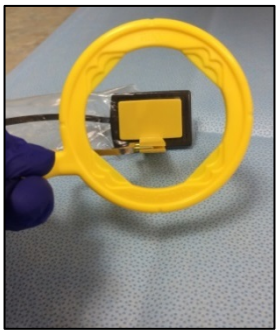
   The answer is decrease the exposure time. The amount of tissue and bone is less in children than adults so exposure time is decreased and diagnostic quality maintained.

3. Do areas of the mouth with teeth present require more or less exposure time than areas where teeth are missing?

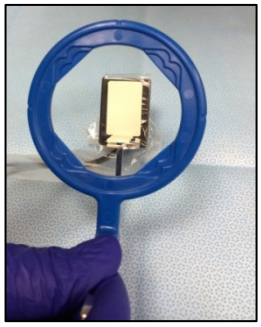
   The answer is more exposure time. X-rays have to penetrate more tissue when teeth are present than in areas where teeth are missing.

XCP

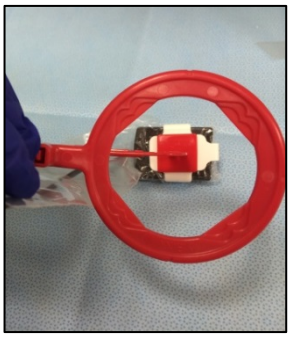
In addition to the X-ray unit, you will be using positioning devices like the XCP (extension cone paralleling). The XCP consists of a ring, a bite block, and an arm. They are color-coded, with yellow being used in the posterior area, blue in anterior, and red for horizontal and vertical bitewings.



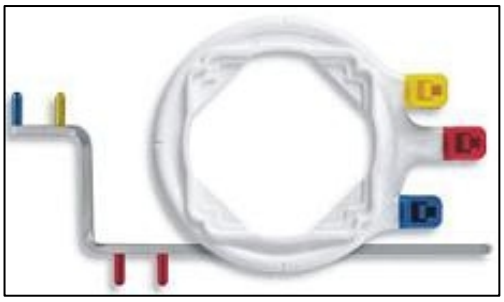
Posterior PAs



Anterior PAs



BWs



Universal XCP
Yellow for posterior PAs
Blue for anterior PAs
Red for BWs

The XCP stabilizes a receptor when taking an image. It also helps to prevent cone cuts, since the ring indicates the boundary of the receptor. You will learn more about the use of the XCP in Chapter 3.

To summarize:
In this chapter you learned about the different parts of an X-ray unit, and what they do to produce diagnostic images with good contrast and density. You also learned about the XCP which stabilizes a receptor when taking an image.

Taking diagnostic images on the first attempt reduces retakes which decreases unnecessary radiation exposure to the patient and to the operator. Correctly using the X-ray unit and the XCP receptor holder will help you "Do it right the first time!"

This completes Chapter 2: Dental Digital Imaging Equipment. You are now ready to test your understanding of the information you learned.