THE RADIOGRAPHIC FILM.

Neill Serman. Oct. 2001
W + P Ch 4

The pattern of remnant photons that exit from the mouth (object) carry diagnostic information that require to be recorded on an image receptor, which most frequently, in dentistry, is the x-ray film. Digital radiology is becoming more common place.

DENTAL FILM COVERING AND PACKAGING.

Intra-oral X-ray film is first surrounded by a black, light-proof paper; next, a thin sheet of lead foil backing is placed on the side of the film that will be placed away from the radiation source; an outer wrapping of moisture-resistant paper or plastic completes the assembly. Certain manufacturers make this black paper separate and which is placed separately in the front and the back of the film. It is better to have only one sheet that covers both sides to ensure that this is not mistaken for the film and thus processed in error.

The purpose of the **lead foil** backing is to attenuate the beam and to absorb scattered radiation **(back scatter**) from striking the film emulsion from the back side of the film (the side away from the tube), and which would then fog the film. A **tire track** or **herring-bone** appearance is seen on the film if placed the wrong way round and the film will **lack densit**y. Board question.

Each film packet has two sides - a tube side that faces the tube (radiation source) and a back side facing away from the source of radiation. The tube side is solid white (either paper or plastic) that is either smooth or slightly pebbly to prevent slippage in the mouth. The film also has a small embossed / **indicating dot** near one of the corners. In intra-oral radiography the tube side of the film faces the lingual / palatal surfaces of the teeth to be radiographed. The dot is utilized to determine the **left** or **right** side of the face and is placed facing the operator when mounting the film. Board question.

A small tab for opening the film is located on the side away from the tube. To open it, one lifts the edge of the flap and pulls it back gently. The tab is **color coded** indicating the **film speed** and **number** of films per packet.

Beige	=F-speed, 1 film	Lilac	=F-speed, 1 film
Pink	=E-speed, 2 films;	Blue	=E-speed, 1 film; Board question
Dark gray	=D-speed, 2 films;	Pale green	=D-speed, 1 film.
Beige	=F speed, 2 films;	Lilac	=F speed, 1 film

The back of the film containing the tab is smooth. The following information is printed on the back :- manufacturer's name, film speed, the number of films in the packet (one or two), a circle or mark indicating the location of the identifying dot, and the legend OPPOSITE SIDE TOWARD TUBE". There is also a small circle opposite the indicating dot..

Packets may contain one film or two films per packet. When a packet containing two X-ray films is exposed, duplicate radiographs result. This is useful whenever a radiograph is to be sent to another practitioner, to whom the patient is referred, or a radiograph is needed for legal evidence. The other radiograph remains a part of the patient's permanent record. The **exposure time** remains the **same** whether one or two film per packet are utilized. One does NOT require to increase the exposure times when utilizing two films per packet. The **amount** of radiation that the patient receives is the same for one film per packet as for two films per packet.

A sheet of lead foil surrounds all the films inside the box to protect them from damage by stray radiation or chemical fumes during storage.

THE FILM.

The radiographic film is composed of a **base** and an **emulsion layer** joined together by the **substratu**m. The emulsion may be coated on one side (single emulsion film) or both sides (double emulsion film). Intra-oral dental films are coated on **both sides** as this provides increased film speed. The film is covered by a **protective layer** on both sides.

--------- Protective layer
--------- Emulsion layer
--------- Substratum

Base

--------- Protective layer
--------- Emulsion layer
--------- Substratum

a) THE BASE

1. The function of the base is to **support** the emulsion layer.
2. The base consists of cellulose triacetate or polyester which is about 0.2mm thick and provides **resilienc**e.
3. Polyester is used more often as it is thinner, more rigid and does not distort with age.
4. The base is tinted blue to provide less of a glare on the eye, but must transmit light (so that one can look through it when viewing the radiograph) and must **not cast** a **shadow** on the radiograph (attenuate the beam).
5. It must **not** dissolve in water and must not tear easily - important factors during the development process..3
6. It must be of **uniform thickness** otherwise the emulsion layer will not be uniformly thick.

b) **THE SUBSTRATUM**.

The base is covered on both sides with a thin layer of **adhesiv**e, the substratum - to ensure that the emulsion remains in contact with the base in a uniform thickness. Without this adhesive layer the emulsion layer would tear away from the base when being (wet) processed as it becomes swollen and soft. This adhesive layers washes away if the film is left too long in water.

c) **THE EMULSION**.

The emulsion layer on both sides of the base, must be sufficiently flexible to allow the film to bend. It consists of a very thin, transparent, homogeneous mixture of pure gelatin containing silver halide grains **sensitive to light and to photons**

i) The Gelatin
The gelatin is very pure (made from cattle bone) and allows light and energy to penetrate it **unattenuate**d. The function of the gelatin is a **vehicle** to keep the silver halide grains **evenly suspended** over the base of the film. The gelatin should **not dissolve** in water but **swells** exposing the silver halide to the chemicals and **permitting interaction** with the processing solutions. The gelatin should shrink **evenly** as it dries leaving a **smooth surfac**e.

ii) The Silver halide Crystals / grains
The silver halide crystals, which are the **active constituents** of the emulsion, are microscopic in size and are made up of **95% silver bromide** and **5% silver iodid**e. These atoms have a relatively high atomic number (Z = 53: Z = 35: Z = 47) compared to the base (Z=7). The silver bromide grains are very sensitive to radiant energy [and white light] and produce a latent image during an X-ray exposure. The iodide adds to the **sensitivity** which allows reduction of exposure time. As will be studied when we do the processing of the radiograph, photosensitivity of the halide depends upon the intentional incorporation of a **sulfur** contaminant during manufacture.

As seen under the microscope, the sensitive emulsion is made up of many tiny grains or **crystals** of silver halide in gelatin. The emulsion is placed on both sides of the base to provide increased speed in the film. The increased film speed means **less radiation** for the patient because of the shorter exposure time and fewer retakes as a result of movement during the exposure. In E speed film the grains are flatter and thus there is a larger surface area for the photons to strike.

d) **THE PROTECTIVE COATING**.
A very thin transparent, non abrasive layer of **pure gelatin** covers the film on both sides to help protect the film surface from mechanical damage. Without this layer the silver halide grains can react to gentle pressure or abrasion resulting in the appearance of dark spots or patches on the film.

The Latent Image.

When the remnant photons strike the emulsion layer many crystals are ionized. Thus a physical change has taken place. The **latent image** has been created. It is **not** visible to the naked eye. Processing converts the latent image to a visible image.

There are three types of intra-oral dental X-ray film.

1. **Periapical** film	E = E Speed Plus	D = D Speed: F/ I = Insight
2. **Bitewing** film	P = Periapical	F = Film- for D speed film only
3. **Occlusal** film	B = Bitewing	O = Occlusal

An improved E speed film reached the market early in 1999. Initially it was known as EP plus film. The older E speed film is no longer on the market and the "plus" has been dropped from the name. Insight film reached the market in mid 2000. The images are beeter than the E speed film but there is a further reduction of 20% of the exposure time which means the patient receives that much less radiation.

For Insight [IP] and also E Speed (plus film) the first number indicates the **size** of the film and the second number, the **number of films** per packet.

Always use the **largest size** film that can be placed in that part of the mouth in order to obtain as much information as possible. The film should be as large as the patient will tolerate but smaller than the size of the X-ray beam..5

1. Pericapical film [IP 01 (or 02) EP 01 (or EP 02) (DF 54)]; EP 11 (or 12) (DF 56) and EP 21 (DF 58)

   The numbers for the E-speed and the new Insight film (IP) is the same.

   The objective of the periapical film is to show the **images** of the **apices** of the teeth and surrounding bone, but in addition it should show the entire crown without any overlapping, elongation or foreshortening of teeth.

2. Bitewing film EB / IB31 (DF 42) EB 22

   The bitewing packet has a tab [possibly resembling a wing] on the side on which the patient bites. The bitewing films show the **crowns** of the maxillary and mandibular teeth and their **interproximal alveolar crest**s. Bitewing radiographs can be taken of the anterior or the posterior area of the mouth. The films can be placed with their long axis **vertical** or **horizonta**l. The bitewing film is longer than the EP 22. Most operators use the EP size 2 film to take bitewing views.

3. Occlusal film E 0 / IO 41 (or 42) (DF 50)

This film is considerably larger than the periapical film; 5 x 7.5 cm. [about 2x3 inches]. The object of the occlusal film is to show larger segments of the maxillary or mandibular arches or the floor of the mouth.

The occlusal film comes as either D or E speed film and the package and contents are the same as intra-oral films. With occlusal films, the central beam is positioned at 60 degrees (topographic view) or 90 degrees (cross sectional view) to the plane of the film.

EXTRA -ORAL FILM.

Extra-oral films are designed to be exposed while positioned outside the oral cavity. There of two types:

a. non-screen. Used for **direct** exposure to photons.
b. screen films [Screen = intensifying screens]

FILM SENSITIVITY / SPEED.

The efficiency with which a film responds to exposure is known as film sensitivity or speed. The shorter the exposure time, the less the amount of radiation to produce the same amount of density, the faster the film.

RADIOGRAPHIC DENSITY.

The overall degree of darkening of an exposed film is referred to as **DENSITY.** Fogging adds density but detracts from detail.

CONTRAST.

Image contrast is the difference in densities of adjacent images recorded on a film. The greater the difference in the densities, the greater the contrast.

DETAIL / DEFINITION.

The clarity of outline of an image is known as the detail or definition. The clearer the outline the more well defined or the better the detail of the image. There is an inter-relationship between density and detail but one must understand the difference. Without sufficient density, one can not determine detail. However, density due to **fogging reduces detai**l.