Radiology Sheet #5

Done By: Jumana Kussad

We talked last time about stochastic and deterministic effects of radiation and their features.

We mentioned the different ways used to quantify radiation, which is needed to be able to achieve safety and protection.
They are:
1) Exposure: the capacity of radiation to ionize air
2) Absorption dose: Ionizing radiation of any matter type
3) Equivalent dose: compares effect of different types of radiation
4) Effective dose: takes into consideration sensitivity of different tissues also.
Effective dose is considered the ultimate unit used to quantify radiation.

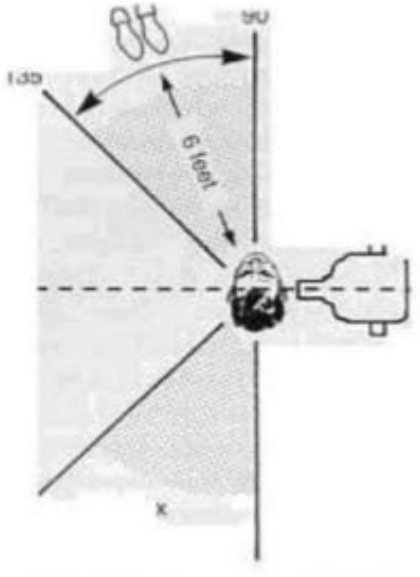
Also we mentioned the factors on which sensitivity of tissues depends, and that is: **1**.the proliferation rate of the tissue **2**.the number of future divisions.

remember that oocytes and lymphocytes are exceptions due to their high nuclear:cytoplasmic ratio.

All that guides us to something very important which is how to protect my patient and most importantly myself and my staff.
we need:

1. Awareness
2. Avoidance
3. Distance
4. Time

Dental units are not spatial places, yet a safety margin from an x-ray source is one of the most important safety measures for you as a dentist.
but how far is fine?
- After some experiments and maths it was found that you should be at least 6 ft away from the source, which is about 120 cm, at an angle between 90 and 135 degrees to the x-ray beam.



Why not right in front the machine? because we fear the penetration effect of radiation.
#Why not right behind it? because we fear the scattering effect of the radiation.

That's in case you need to be with the patient in the same room as he is taking the x-ray for some reason. YET, if you have the luxury to get out of the room or wear a barrier shield, then do it!

It's very important to stick to this safety rule, to minimize your long career exposure to radiation. Don't forget that even at low doses; high frequencies of exposure, would lead to stochastic effects.

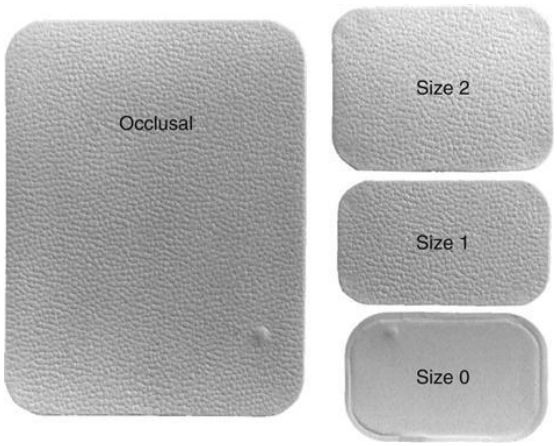
Radiographic Film:

There are many ways of capturing images, and one of the most traditional and historic ways is using a radiographic film.

In general there are two types of films in terms of exposure and sensitivity:

1. *Direct Exposure films*
-These are more sensitive to X-ray photons, and that's why they

are called "direct".
-All intra-oral images are direct exposure films.
-They are classified according to size; the larger the number the larger the size (0-4)
-Size 4 is the largest and is for occlusal radiographs and size 0 is a pediatric film. 3 is not commonly used



2. *Indirect Exposure films*
- These are more sensitive to visible light than x-ray photons
- Extra-oral films

- The x-ray beam passes through an **intensifying screen** which changes an x-ray photon into *multiple* visible light photons

-But why do we change x-ray to visible light? As we mentioned, we obtained multiple visible light photons from just one x-ray photon. This way we are reducing the dose of X-ray.

- The intensifying screens are placed above and below the film, to change x-rays to visible light.
They are made of a florescent material that releases light.
- previously they used *calcium tungestate*, and now they use *rare earth elements*.

-they release different colors of the visible light spectrum according to the material used in the intensifying screen. Therefore the film must be sensitive to the color of light released by the intensifying screen. (This is called a "*Film-screen combination"*)

- We have different intensifying screens according to the number of visible light photons that are released from one x-ray photon. We have Fine, Medium and Fast screens.

- The fast screen gives the largest number of visible light per x-ray photon.
This means it needs or uses the lowest dose of x-ray.
But the problem is that, as the number of visible light rays increase, more scattering of light would occur and would lead to decrease in spatial resolution of the image produced.

- low resolution doesn't mean not to use this type of screen. It's actually used when we don't need that much high quality of an image. So it's got its uses.
Ex: Panoramic Image doesn't need a high quality.

- On the other hand, Fine/slow screens or "film-screen combination", needs a higher dose and gives better spatial resolution.

Radiographic Film Components

1. Active component: Emulsion
(made of photosensitive crystals of Silver Halide- *bromide, chloride, and rarely iodide-* and trace amounts of sulfur containing compound- *imp for photosensitivity of silver halide*)
2. Base: plastic
3. gelatin coating (to join base and active components together)

-Photosensitivity is directly proportional to the size of the silver halide crystal,

but, the size of the crystal is indirectly proportional to the spatial resolution of the image to be produced.

Therefore, the size of the crystal must be large enough to increase photosensitivity and thus decrease the X-ray dose, and small enough to maintain good image resolution.

- Classification of films according to photosensitivity (aka: size of the crystal):
Are given letters from A to F.
A is the least sensitive and it's no longer used. Now F is used, yet some people might still be using the D-Films.

** So you must be using the most photosensitive film, because good collimation + high photosensitivity films = lower X-ray dose by 65%

How is an Image produced?

-First, the X-ray photon enters the Film, the energy in the photon is transformed into a *latent image* inside the crystals in the emulsion, where the silver ion changes into a silver atom.

The presence of absorbing material between the photons and the film, decreases the amount crystals that hold a latent image at areas adjacent to the absorbing material.
The absorbing material in this case represents the different types of tissues, which have different absorbing capacities leading to what-so-called "*differential absorption*".

-second, after X-ray exposure is over, we need to process the image.

There's manual processing (like the one we used to do in endo labs) and there's automatic processing.

steps of manual processing: 1.develop **2.**rinse **3**.fix **4**.rinse & dry **5**.mount and interpret

steps of automatic processing: 1.develop **2.**squeegee **3.**fix **4.**squeegee **5.**wash & dry **6.**mount & interpret

So they are basically the same steps, but one is done manually and the other by a machine.

1.The film is placed in the **Developer** which is made of:

-developing agent (hydroquinone)
-activator (sodium carbonate)
-Restrainer (potassium bromide)
-Preservative (sodium sulfite)
-Solvent (water)

** The developer develops the latent image in the crystals and softens the emulsion.
The developer, causes each crystal that holds even one silver **atom** (which was an ion and changed due to light exposure) to change all the silver ions in the crystals into silver atoms, so that the crystal turns into one grain of metallic silver, which is black in color.
The restrainer prevents the development of unexposed crystals.

2.Then the **Fixer,** which has:

- fixing agent (ammonium thiosulfate)
- hardening agent (aluminum chloride)
- preservative (aluminum sulfite)
-acidifier

-solvent

**The fixer washes away the unexposed silver halide crystals, and re-hardens the softened emulsion (*hardening agent).*

note: so what really creates the image is the developer; the fixer only preserves this image and removes the excess.

#Now, structures that allowed light through into the film and exposed silver crystals looks very dark (black) like the pulp tissue, unlike enamel which allows no light and doesn't expose any silver crystals looks white (the color of the plastic). And the shades of grey in between follow the same process according to the thickness and density of the tissue.

Finally, again, why don't we always go for intra-oral images if they're more sensitive and provide better image quality?

That's because of X-ray dose control. Why to use intra-oral X-ray if we don't need much details in our image?
So its according to what you need the image for, we eventually must decrease X-ray exposure as much as possible.

GOOD LUCK ^_^

أَفَحَسِبْتُمْ أَنَّمَا خَلَقْنَاكُمْ عَبَثاً وَأَنَّكُمْ إِلَيْنَا لاَ تُرْجَعُون ؟

لم نخلق عبثا :)