Al-Mustaqbal University
Radiological Techniques
Department

# Biological Radiation hazards

## Sixth Lecture

## Third Stage

**By**
Assistant lecturer

**Sarab Jabbar Musa**

## Radiation Injury

In diagnostic imaging, not all x-rays pass through the patient and reach the dental x-ray receptor some are absorbed by the patient's tissues. Absorption refers to the total transfer of energy from the x-ray photon to patient tissues.

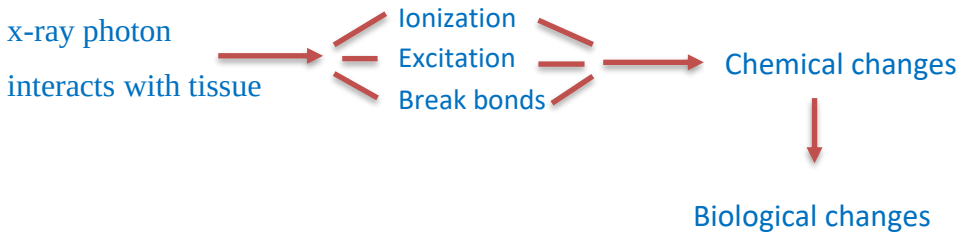
What happens when x-ray energy is absorbed by patient tissues?

Chemical changes occur that result in biologic damage

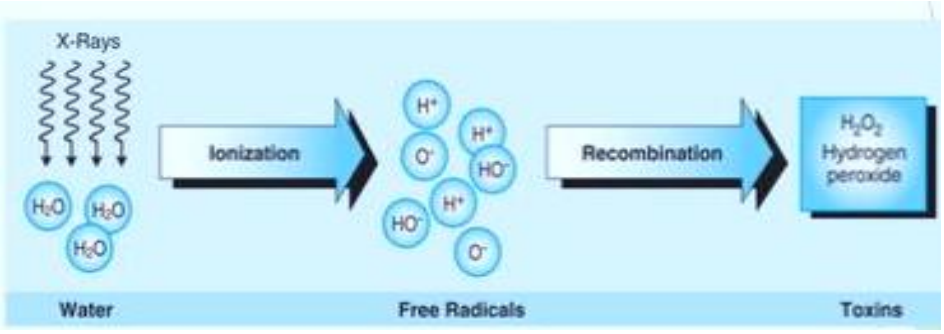
Two specifc mechanisms of radiation injury are possible:

I. ionization
II. free radical formation.

### Ionization




### Free radical formation



## Theories of Radiation Injury

**Direct Theory**: cell damage results when ionizing radiation directly hits critical areas, or targets, within the cell.

For example, if x-ray photons directly strike the DNA of a cell, critical damage occurs, causing injury to the irradiated organism.

Direct injuries from exposure to ionizing radiation occur infrequently; most x-ray photons pass through the cell and cause little or no damage

**Indirect Theory**: x-ray photons are absorbed within the cell and cause the formation of toxins, which in turn damage the cell.

For example, when x-ray photons are absorbed by the water within a cell, free radicals are formed.

The free radicals combine to form toxins (e.g., $H_2$ $O_2$), which cause cellular dysfunction and biologic damage.

An indirect injury results because the free radicals combine and form toxins, not because of a direct hit by x-ray photons.

Indirect injuries occur frequently because of the high water content of cells.

Two-thirds of biological alterations from x-ray radiation exposure result from indirect effects

### Sequence of radiation injury

- Latent period
- Period of injury
- Recovery period

**Latent period:** time that elapse between exposure to ionizing radiation and appearance of absorbable clinical science

Latent period may be short or long depended on total dose of radiation received and amount of a time of rate it took of the received

The more radiation received faster dose rate and shorter latent period

**Period of injury:** overtly of cellular injuries may result cell death, cellular dysfunction (change in cell function), break in chromosome, stopping mitotic activity or abnormal mitotic activity formation of gene cell

**Recovery period:** with each radiation exposure cellular damage followed by repair

Most of damage cause by low level radiation is repair with in the cell of the body

The effect of radiation exposure are addedef and a repair damage equmelate in the tissue

## Factors that determine Radiation injury

1. nothing-the cell is unaffected by the exposure;
2. the cell is injured or damaged but repairs itself and functions at preexposure levels;
3. the cell dies, but is replaced through normal biological processes.
4. the cell is injured or damaged, repairs itself, but now functions at a reduced level.
5. the cell is injured or damaged and repairs itself incorrectly or abnormally, resulting in a biophysical change (tumor or malignancy).

**Determining which of these five outcomes might occur depends on all the following:**

- **Total dose**
- **Dose rate**

- **Amount of tissue irradiated**
- **Cell sensitivity**
- **Age**

**Total dose:** equinity of radiation received or total amount of radiation injury observed

**Dose rate** :rate at which exposure to radiation occurs and absorption take place

**Dose rate= Dose per time**

More radiation damage take place with high dose rate because rapidly deliver doesn't allow for cellular damage to be rapier

**Amount of tissue irradiated:** area of the body exposed to radiation total body radiation produce more adverse sematic effect if small locales area of the body are exposed

**Cell sensitivity:** more damage occurs in the cell that are more sensitive to the radiation such as rapidly dividing cell and young cell

**Age**: Younger the patient greater the chances of recovery.

## Radiation Effects

Following the latent period, effects that are seen within minutes, days, or weeks are termed **short-term effects.**

Short-term effects are associated with large amounts of radiation absorbed in a short time (e.g., exposure to a nuclear accident or the atomic bomb). Acute radiation syndrome (ARS) is a short-term effect and includes nausea, vomiting, diarrhea, hair loss, and hemorrhage. Short-term effects are not applicable to dentistry.

The effects that appear after years, decades, or generations are termed **long-term effects.** Long-term effects are associated with small amounts of radiation absorbed repeatedly over a long period. Repeated low levels of radiation exposure are linked to the induction of cancer, birth abnormalities, and genetic defects.

## Somatic and Genetic Effects

• All the cells in the body can be classified as either somatic or genetic.

cells.

• Somatic cells are all the cells in the body except the reproductive

The reproductive cells (e.g., ova, sperm) are termed genetic cells Depending on the type of cell injured by radiation, the biologic effects of radiation can be classified as somatic or genetic.

Somatic effects are seen in a person who has been irradiated.

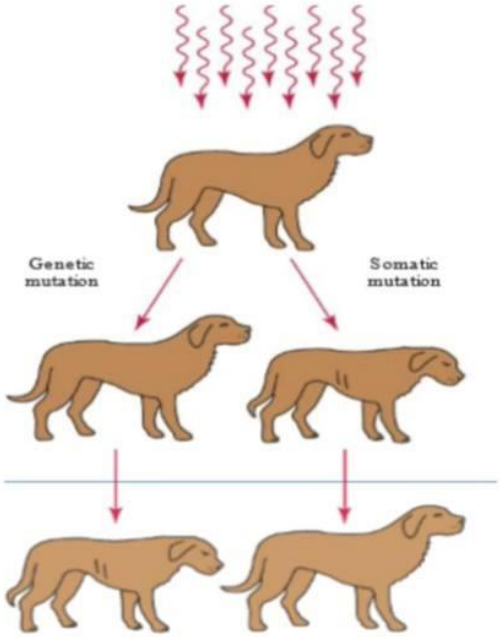
Radiation injuries that produce changes in somatic cells produce poor health in the irradiated individual.

Major somatic effects of radiation exposure include the induction of cataracts and cancer, including leukemia. These changes are not transmitted to future generations.

Genetic effects are not seen in the irradiated person but are passed on to future generations.

Radiation injuries that produce changes in genetic cells do not affect the health of the exposed individual. Instead, the radiation-induced mutations affect the health of the offspring.

Genetic damage cannot be repaired.




## Radiosensitivity of tissues and organs

- **high radiosensitivity:** bone marrow, spleen, lymphoid organs, intestine, stem cells, lymphocyte and reproductive cells.
- **intermediate radiosensitivity:** Young or growing bone, glandular tissue, growing cartilage, salivary glands, kidney, liver, lung and epithelium of alimentary canal.
- **low radiosensitivity :** Skin ,muscle and optic lens.
  least effect seen in nerve tissue and adult bone.