

Effect of Radiation on the Oral Cavity

Types of radiation

1. Non-Ionizing Radiation: Radiation that does not have sufficient energy to dislodge orbital electrons. ex. microwaves, ultraviolet light, lasers, radio waves, infrared light, and radar.
 2. Ionizing Radiation: Radiation that has sufficient energy to dislodge orbital electrons. ex. alpha particles, beta particles, neutrons, gamma rays, and x-rays.
- **Radiation biology** is the study of the effects of ionizing radiation on living systems.

Stochastic and Deterministic effects

Radiation injury to organisms results from either the killing of large number of cells (deterministic effect) or sublethal damage to the genome of individual cells (stochastic effect) that result in cancer formation of heritable mutations.

The difference depends on the dose threshold for its occurrence. Stochastic effects do not exhibit a dose threshold, whereas deterministic effects manifest only when the radiation dose exceeds a certain threshold.

Comparison of Stochastic and Deterministic Effects of Radiation

	Stochastic Effects	Deterministic Effects
Caused by	Sublethal DNA damage	Cell killing
Threshold dose	No	Yes
	There is no minimum threshold dose. Effect can be caused by any dose of radiation	Effect occurs only when the threshold dose is exceeded
Severity of clinical effects and dose	Severity of clinical effects is independent of dose; all-or-none response – an individual either manifests effect or does not	Severity of clinical effects is proportional to dose; the higher the dose, the more severe the effect
Relationship between dose and effect	Frequency of effect proportional to dose; the higher the dose, the higher the risk of manifesting the effect	Probability of effect independent of dose; most individuals manifest effect when threshold dose is exceeded
Caused by doses used in diagnostic radiology	Yes	No
Examples	Radiation-induced cancer	Osteoradionecrosis
	Heritable effects	Radiation-induced cataract formation
	Radiation-induced skin cancer	Radiation-induced skin burns

Radiation Effects on the Oral Cavity

Radiotherapy is a therapy that is largely used in head and neck cancer. It uses ionizing radiation that is used to kill or damage the cancer cells thereby stop them from growing and multiplying.

The specific treatment of choice for a lesion depends on many tumor variables such as radiosensitivity, histology, size, location, invasion into adjacent structures, and duration of symptoms.

Radiation therapy for malignant lesions in the oral cavity is usually indicated when the lesion is radiosensitive, advanced, deeply invasive and cannot be approached surgically.

- Some of the complications of radiotherapy are mucositis, xerostomia, infections, dental caries, loss of taste, trismus and osteoradionecrosis

Oral Mucosa

- a basal layer composed of rapidly dividing, radiosensitive progenitor cells.
- redness and inflammation (mucositis).
- the irradiated mucous membrane separates from the underlying connective tissue and forms a white-to-yellow pseudomembrane (the desquamated epithelial layer)
- Severe pain, discomfort, and food intake is difficult
- Good oral hygiene minimizes infection. Topical anesthetics may be required

Taste Buds

- Taste buds are sensitive to radiation.
- loss of taste acuity during the second or third week of radiotherapy
- Bitter and acid flavors are more severely affected when the posterior two-thirds of the tongue is irradiated
- salt and sweet flavors are affected more when the anterior third of the tongue is irradiated.
- Alterations in the saliva may partly account for this reduction.
- Taste loss is reversible, and recovery takes 2 to 4 months.

Salivary Glands

- Exposed during radiotherapy for cancer in oral cavity or oropharynx
- The loss of saliva production results in xerostomia.
- Tenderness, pain and difficult swallowing
- Patients need saliva substitutes to help restore function

Teeth

- Irradiation may induce disturbances in odontogenesis.
- Abnormally small teeth (microdontia)
- short or blunted roots
- Malocclusion
- incomplete calcification
- enlarged pulp chambers (taurodontism)
- premature closure of apices
- delayed or arrested development of teeth have been reported.
- enamel hypoplasia
- Incomplete calcification also can result.

Radiation Caries

- Radiation caries is a rampant form of dental decay that may occur in patients with radiation-induced xerostomia
- Caries results from changes in the salivary glands and saliva, including reduced flow, decreased pH, reduced buffering capacity, increased viscosity, and an altered flora
- Patients receiving radiation therapy to oral structures have increases in Streptococcus mutans, Lactobacillus, and Candida.

Bone

- The primary damage to mature bone results from radiation-induced damage to the vasculature of the periosteum and cortical bone.
- Osteoradionecrosis (ORN) is a late complication of radiation therapy and occurs when an area of irradiated bone becomes devitalized. ORN is formally defined as “an area of exposed irradiated bone tissue that fails to heal over a period of three months, without residual or recurrent tumor; and when other causes of osteonecrosis have been excluded

Trismus

- Trismus is a prolonged spasm of the jaw muscles by which normal opening of the mouth is restricted.
- Trismus patients may experience a marked restriction of jaw movements which can hamper overall physical and mental health of the patient.
- It may be a significant side-effect of radiotherapy, especially in combination with muscular tumor invasion and surgery.
- Following radio- therapy, trismus results mainly due to fibrosis of muscles of mastication.
- Severity of trismus is dependent on the radiation source, dose and number of fields radiated

Candidiasis

- Candida species are normal commensals of oral cavity.
- An overgrowth in the mouth is considered as pathology and should be treated promptly.
- Oral candidiasis is commonly associated with mucoisitis.
- Colonization of the yeast on damaged tissue can intensify the symptomatic effects of radiation.
- Antibiotics and steroid drugs are often used when a patient receiving chemotherapy. These drugs alter the balance of bacteria in the mouth, making it easier for a fungal overgrowth to occur

Conclusion

A complete and thorough understanding of the complications due to radiotherapy in the head and neck region is necessary, so as to prevent and treat the acute and chronic complications and to relieve the patients from any undue discomfort and suffering.