

原文題目(出處)：	Iatrogenic damage to the periodontium caused by radiation and radiotherapy. The Open Dent J 2015;9: (Suppl 1: M2)182-6
原文作者姓名：	International clinic Salmiya, Kuwait
通訊作者學校：	Najeeb Kassim , International clinic Salmiya, Kuwait
報告者姓名(組別)：	徐儀廷 (Intern A 組)
報告日期：	2015.08.10

內文：

Abstract

The radio-sensitivity of a tissue or organ is measured by its response to irradiation. The severity of this change depends on the dosage and thus the extent of cell loss.

Introduction

The somatic and genetic stochastic effects can develop with any dose of ionizing radiation.

In dentistry, the size of the doses used routinely is relatively small and well below the threshold doses required to produce the somatic deterministic effects.

How Do X-Rays Cause Damage

The precise mechanism is not yet fully known

1. Direct Damage

Specific targets within the cell, probably the chromosomal DNA or RNA in the nucleus, take a direct hit from an incoming X-ray photon, or an ejected high-energy electron, which breaks the relatively weak bonds between the nucleic acids.

- Inability to pass on information
- Abnormal replication
- Cell death
- Only temporary damage - the DNA being repaired successfully before further cell division.

Damage to:

1. somatic cells: effects on the DNA (chromosomes) => radiation-induced malignancy.
2. reproductive stem cells: radiation-induced congenital abnormality.

Several factors:

- The type and number of nucleic acid bonds that is broken
- The intensity and type of radiation
- The time between exposures
- The ability of the cell to repair the damage
- The stage of the cell's reproductive cycle when irradiated.

2. Indirect Damage

Water molecules: most likely to be ionized by the incoming X-rays.

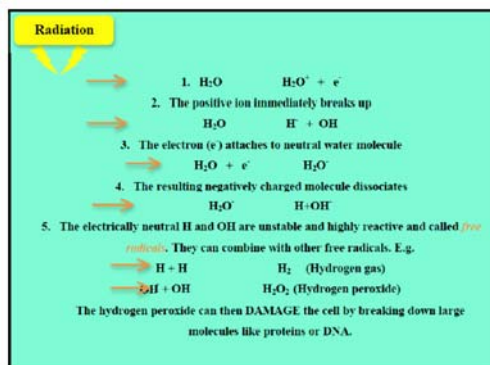


Fig. (1). A diagrammatic summary of the sequence of events following ionization of water molecules leading to indirect damage to the cell.

Effects of Radiation

- Short-Term Effects of Radiation

Determined primarily by the sensitivity of its parenchymal cells

1. Continuously proliferating tissues (bone marrow, oral mucous membranes) are irradiated with a moderate dose, cells are lost primarily by mitosis-linked death, and cause reduction in the number of mature cells
2. Tissues composed of cells that rarely or never divide (muscle) demonstrate little or no radiation induced hypoplasia

- Long-term Effects of Radiation

Depend primarily on the extent of damage to the fine vasculature

Irradiation of capillaries

=> swelling, degeneration, and necrosis

=> increase capillary permeability and initiate a slow progressive fibrosis around the vessels

=> deposition of fibrous scar tissue is increased around the vessels

=> narrowing and eventual obliteration of vascular lumens

=> impairs the transport of oxygen, nutrients, and waste products

=> death of all cell types

- net result: progressive fibro-atrophy of the irradiated tissue

=> loss of cell function and a reduced resistance to infection and trauma

Death of parenchymal cells after moderate exposure

=> mitotic-linked death of rapidly dividing cells in the short term

=> progressive fibro-atrophy on all cell types over time.

General Guidelines on Patient Care

- position, occlusal plane horizontal and parallel to the floor, minimize unwanted movement (supine position along with most other dental surgery procedures.)
- reassure, particular importance with children.
- explain, (can understand, warning not to move)
- spectacles, dentures, jewellery or orthodontic appliances should be removed.
- protective lead thyroid collar.
- control panel should be selected before positioning
- avoid trauma to the soft tissues taking particular care where tissues curve, e.g. the anterior hard palate, lingual to the mandibular incisor teeth and distolingual to the mandibular molars.
- avoid having to retake the radiograph
- patient should always be watched

Periodontal Changes in Patients Undergoing Radiotherapy

- Cancer: 12% of all deaths worldwide (more than 10 million new cases and 6 million deaths each year worldwide) , head and neck neoplasia (HNN) is a major form of cancer in India, 23% of all cancers in males and 6% in females
- 5 -year survival varies from 20% to 90%.
- Head and neck cancer Tx: surgical resection, radiotherapy and chemotherapy, either used singly or in combination.
- Direct damage to the oral structures commonly occurs from radio- and chemotherapy, and indirect damage may also occur from systemic toxicity.
- Oral pain and infection are common and a potentially serious sequence to RT
- Dental consultation at the earliest possible time. Pre-irradiation treatment depends on patient prognosis, compliance, and residual dentition, in addition to

fields, ports, dose and, immediacy of radiotherapy. Because oral problems that affect the quality of life, can cause interruption to cancer therapy.

These oral complications:

- acute: mucositis, xerostomia, dysphagia, dysgeusia, and opportunistic infections,
- chronic: trismus, irradiation caries, osteoradionecrosis(ORN), and changes in periodontal attachment.

Damage to oral mucosa is intensely associated with radiation dose, fraction size, volume of irradiated tissue, fractionation scheme, and type of ionizing radiation.

The severe mucosal reaction to radiotherapy is a result of mitotic death of epithelial cells, since the cell cycle time of the basal keratinocytes is about 4 days.

The inflammatory and degenerative changes of ionizing radiation on the salivary gland parenchyma, especially the serous acinar cells lead to xerostomia: affect mastication, speech, and patients overall quality of life.

Radiation-induced hypo-salivation and a concomitant increase in plaque accumulation and shift in oral micro flora the risk of periodontal infection is also increased.

Altered nature of microorganisms and reduced host defense mechanism toward plaque caused by radiotherapy may lead to attachment loss.

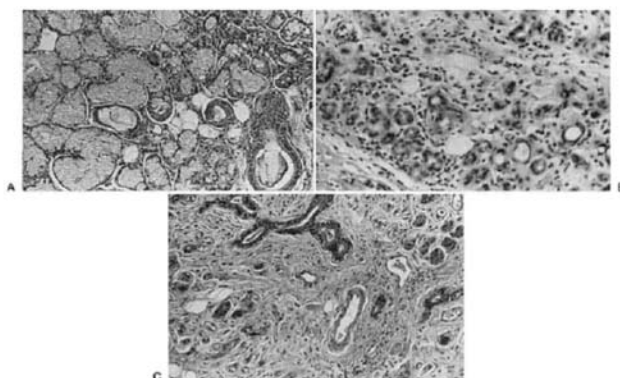


Fig. (2). Radiation effects on human submandibular salivary glands. A-Normal gland. B- A gland 6 months after exposure to radiotherapy. Note the loss of acini and presence of chronic inflammatory cells. C-A gland 1 year after exposure to radiotherapy. Note the loss of acini and extensive fibrosis.

Difficulty in swallowing is encountered because the reduction in salivary flow diminishes lubrication and liquefaction of food, and irritation of mucosa makes chewing painful.

Periodontium is sensitive to the effect of radiation at high doses.

Diminished vascularity and cellularity of the PDL membrane with widening of periodontal space, thickening, rupturing, disorientation of Sharpey's fibers.

Direct and indirect effects of high dose of radiotherapy on periodontium resulted in increased attachment loss and tooth loss and greater risk for the development of ORN.

Irradiation also causes fibrosis and atrophy of muscles in the pharynx.

The periodontal blood vessels are affected by radiation

- ⇒ widening of PDL space and destruction of bony trabeculae
- ⇒ increased risk of periodontal disease and altered healing with diminished capacity for bone remodeling and repair

Changes in vascularity and cellularity of periodontal ligament and hypovascular, hypocellular, and hypoxic changes in alveolar bone.

- ⇒ increased gingival recession
- ⇒ sensitivity, dental caries, and difficulty in maintenance of oral hygiene
- ⇒ rampant periodontal destruction may occur.

Generally increasing the doses of irradiation above 7000 rads carries the risk and severity of ORN.

Dosage can indicate potential irradiation injury. Smaller irradiation doses administered at higher dose rates may be more injurious than higher doses dispensed at lower dose rates.

Effects of Irradiation on Teeth

Irradiation of teeth with therapeutic doses during their development severely retards their growth. In general, the severity of the damage is dose-dependent.

- Before calcification, irradiation may destroy the tooth bud.
- After calcification has begun may inhibit cellular differentiation, causing malformations and arresting general growth.
- During development may complete calcification and erupt prematurely.

RT to the jaws may show deficiencies in the permanent dentition such as retarded root development, dwarfed teeth, or failure to form one or more teeth.



Fig. (3). Retarded development of the mandibular second premolar crowns with stunting of the mandibular incisor, canine, and premolar roots at 9 years.

- Irradiation of teeth may retard or abort root formation, but the eruptive mechanism of teeth is relatively radiation-resistant.
- Adult teeth are very resistant to the direct effects of radiation exposure.
- The increased rate of caries may be due to the indirect effect of radiation produced by reduced salivary flow rate and its associated consequences.



Fig. (4). Radiation caries. Note the extensive loss of tooth structure in both jaws resulting from radiation-induced xerostomia.

- The pain in TMJ may be due to edema, cell destruction, and fibrosis resulting from radiation. Limited mouth opening complicates oral hygiene procedures and provision of dental care.
- Anxiety or lack of physical and emotional motivation, as well as decreased salivary flow, trismus, and other important factors make oral hygiene more difficult and accelerate loss of attachment.

Conclusion

Diseases of teeth and supporting structures are a worrisome finding because oral pain and infections are common and possibly severe sequelae to RT for head and neck tumors. Increased oral hygiene maintenance can lead to reduction in post-radiation complications of periodontium.

題號	題目
1	下列何者在放射治療及化學治療為較少見的併發症? (A) Xerostomia (B) Hypogeusia (C) Trismus (D) Pulp necrosis
答案 (D)	出處：Oral and Maxillofacial Pathology, 3rd, chp.8, p.294-p.299
題號	題目
2	以下何項牙科治療是放射治療期中強烈建議不要進行的操作? (A) 塗氟 (B) 齲齒填補 (C) 拔牙 (D) 根管治療
答案 (C)	出處：Oral and Maxillofacial Pathology, 3rd, chp.8, p.297