Chemical and Radiation-Associated Jaw Lesions

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KEYWORDS

• Osteoradionecrosis • Medication-related osteonecrosis • Chemical • Radiation • Recreational drug • Damage • Diseases • Necrosis

KEY POINTS

- The role of radiographic imaging in diagnosis of osteonecrotic lesions cannot be overemphasized.
- Treatment options for jaw osteonecrosis include the use of local and systemic antibiotics, pain medications, debriding, sequestrectomy, hyperbaric oxygen treatment, and use of the antioxidants, tocopherol and Pentoxifylline. Surgical resection is usually a last resort, when all other forms of therapy fail.
- The effects on the quality of life in patients with jaw osteonecrosis, makes it an important area of research, especially to researchers interested in bone and tissue engineering.

INTRODUCTION

Bone is a unique connective tissue because it is functionally dynamic, consisting of different cells that continuously interact together. Unlike other connective tissues within the body, bone is physiologically mineralized. There is also an abundance of osteoprogenitor cells that reside within the bone microenvironment that can be activated to form different cell types.[1] The ability of bone to constantly remodel plays a vital role in the maintenance of mineral homeostasis, as old bone is removed by the activities of osteoclasts and new bone matrix is deposited by osteoblasts. Essentially, external and internal insults from radiation, drugs, or other chemical insults can induce a pathologic process that disrupts the bone microenvironment, turnover, and homeostasis. The outcome is dysregulation of the bone healing process that can potentially lead to loss of bone tissue, as in osteonecrosis.

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Osteonecrosis is characterized by tissue dehiscence, chronic bone devitalization, hypocellularity, and osteolysis. The term osteonecrosis is often used interchangeably with ischemic necrosis, avascular necrosis, or aseptic necrosis, but there are different types of osteonecrosis. Depending on the etiologic agent, osteonecrosis can occur in any bone including the orofacial, appendicular, and axial bones. Osteonecrosis may or may not be associated with exposed bone with delayed healing. Specifically, the femoral head and mandible are highly susceptible to osteonecrosis. In the orofacial region, jaw osteonecrosis can lead to significant loss of bone tissue, tooth loss, and facial disfigurement. The unfortunate outcomes are significant morbidity, debility, and diminished quality of life.[2] The high susceptibility of the femoral bone to osteonecrosis is associated with a variety of factors that include alcohol abuse and steroid therapy. However, jaw osteonecrosis is much more associated with complications of radiation therapy, and long-term therapy with bone antiresorptives used to control skeletal events of cancer metastasis and osteoporosis.[3,4] In a randomized controlled study that assessed 792 cases of osteonecrosis in general, 76% of the cases occurred in the hip, and 4.4% occurred in the jaw mainly as a result of bisphosphonate therapies. The remaining cases were associated with the wrist, knee, foot, or ankle.[5] Several pathophysiologic theories have been proposed for osteonecrosis based on correlations of clinical signs with histologic and radiologic analyses. Although many of these theories have not been conclusively established, radiographic imaging has played a major role in the diagnosis, management, and follow-up assessment of osteonecrosis. Even more importantly is the increasing use of the combination of functional imaging with planar images to fully understand the metabolic changes that lead to osteonecrosis.[6]

TYPES OF OSTEONECROSIS

Osteoradionecrosis

Osteoradionecrosis (ORN) of the jaw is defined as nonhealing bony exposure and necrosis that starts with a breach in the oral mucosa, and persists for at least 3 months, in a patient who has undergone previous radiation therapy. The necrosis, however, must be evidently different from a recurrent, vestigial, or metastatic tumor.[7,8] This definition, however, does not include cases of ORN in which the oral mucosa is intact, but osteonecrotic changes can be observed by diagnostic imaging.[9] ORN is a chronic condition that can last for months or even years after the initial radiation therapy. The incidence of ORN can range from 2.6% to 22.0%[10] and it develops when the radiation dose exceeds 50 Gy. Specifically, radiation doses between 50 and 70 Gy have been implicated in the etiology of ORN.[11] Within the orofacial complex, the mandible is commonly affected because the mandible is usually in the line of radiation delivery and it is believed that the mandible is less vascularized than the maxilla.[12,13] Radiation also affects teeth secondarily, due to pronounced xerostomia noted in patients receiving radiation therapy (**Fig. 1**). The extensive carious lesions can be readily noted on bitewing radiographs, as demonstrated in **Figs. 2** and **3**.

Pathogenesis

Osteoradionecrosis was first described in 1926.[14] It was not until 1970 that a triad of radiation, trauma, and infection was proposed as the mechanistic process in ORN. However, this theory was later replaced in 1983 by another proposal that radiation causes development of hypoxic-hypocellular-hypovascular tissue (3H theory),[15] when it was reported that microorganisms do not play any causative but rather a contaminant role in ORN. It was also reported that trauma mainly creates a portal of entry for microorganisms to invade the radiation-suppressed bone. The 3H theory