Osteoradionecrosis of the jaw

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ABSTRACT

Osteoradionecrosis (ORN) is a problem with bone healing, particularly in the jawbone. It can occur after high doses of radiation have decreased blood supply to the affected bone, causing the bone to die from lack of oxygen. Bones that have died are unable to heal properly after procedures or surgery involving them. The treatment of head and neck cancer remains a challenge. Despite advances in surgical reconstructive techniques, most patients will require adjuvant therapy in the form of radiotherapy or chemoradiation to improve locoregional control. The short- and long-term side effects of radiotherapy can be difficult to treat. In this review, the causative effects and pathogenesis of ORN of the mandible will be highlighted. In addition, preventive measures and clinical features of radiotherapy-induced damage will be presented. Finally, medical and surgical management of ORN, as well as, reconstructive surgery of the mandible will be discussed. At the end of this paper, the reader should have up to date knowledge concerning the etiology, prevention, diagnosis, and treatment of patients with ORN of the mandible.

KEY WORDS: Hyperbaric oxygen therapy, Osteoradionecrosis, Radiation

INTRODUCTION

Osteoradionecrosis (ORN) is a possible complication following radiotherapy. Irradiation of bones causes damage to osteocytes and impairs the blood supply. The affected hard tissues become hypovascular (reduced number of blood vessels), hypocellular (reduced number of cells), and hypoxic (low levels of oxygen). ORN is the term for when the area of bone does not heal from this damage. This usually occurs in the mandible and causes chronic pain and surface ulceration. Prevention of ORN is part of the reason why all teeth of questionable prognosis are removed before the start of a course of radiotherapy.¹

ETIOLOGY

Osteonecrosis occurs when part of the bone does not get blood and dies. After a while, the bone can collapse. If osteonecrosis is not treated, the joint deteriorates, leading to severe arthritis. Osteonecrosis can be caused by disease, or a severe trauma, such as a fracture or dislocation that affects the blood supply to the bone. Osteonecrosis can also occur without trauma or disease. This is called idiopathic which means it occurs without any known cause. Some of the most commonly seen causes are using oral or intravenous steroids, excessive alcohol use, sickle cell disease, radiation therapy, Gaucher disease, dislocation, or fractures around a joint.² Some diseases that are associated with the development of this condition include gout, atherosclerosis, and diabetes. When it occurs in the shoulder joint, it is usually due to a long-term treatment with steroids or a history of trauma to the shoulder.³ Persons at risk are survivors who received high doses of radiation to the jaw area. Survivors who received radiation doses of 50 Gy or higher to the jawbone have the highest risk for the condition. Radiotherapy gives a progressive injury to tissues at a cellular and subsequently humoral level. If the entire dose is given in a short period of time, this will prevent the remaining viable local non-tumor cells from recovering and, therefore, will cause more damage.¹,⁴

PATHOGENESIS

In simplistic terms, radiation produces its deleterious effects through the production of free radicals, which result in mitotic cell death. The effects will be greatest on...
rapidly dividing cells such as the mucosa. Remodeling cells such as fibroblasts, osteoblasts, and osteoclasts will show changes when they try to divide, such as during healing.\[^5\]\ Damage to the microvasculature results in initial hyperemia followed by endarteritis, thrombosis, and eventual obliteration. This results in hypocellularity, hypoxia, and hypovascularity.\[^6\]\n
**MANAGEMENT**

Microvascular reconstruction with its own blood supply seems to expedite bone healing and limit further ORN of the remaining mandible. Although prevention is the primary goal in radiation injury, our experience suggests that radical resection with free microvascular reconstruction offers significant advantages to selected patients with extensive ORN of the mandible.\[^7\]\ Patients diagnosed with head and neck cancer (HNC) who may need radiotherapy to the oral cavity in the course of their cancer treatment should undergo a thorough pre-treatment dental evaluation. The dentist who completes the evaluation must have experience with the management of patients with HNC.\[^8\]\n
**PREVENTIVE MEASURES BEFORE RADIOTHERAPY**

The patient should have a full dental evaluation. This should include radiographs to show all the teeth as well as the jaws to check for unerupted teeth and any bony pathology. A panoral radiograph should be a minimum, but ideally, periapical views of all the teeth should be taken.\[^9\]\ All the teeth should be meticulously charted for caries and periodontal pocketing. Each tooth should be given an individual prognosis and a treatment plan completed and discussed with the patient. It is important to educate the patient regarding meticulous oral hygiene and the need for lifelong regular follow-up.\[^9\]\ The patient’s motivation and compliance should be taken into account when assessing which teeth can be salvaged and which should be removed. All teeth should be cleaned and scaled. The patient should be encouraged to rinse with a fluoride and antibacterial mouthwash on a regular basis, and high-risk patients should have custom trays made to assist in regular fluoride treatment.\[^10\]\ Patients with no teeth are easier to treat but should still have a baseline radiographic evaluation to check for buried teeth. Dentures should be inspected for fitting to ensure minimal trauma to the tissues.\[^8,11,12\]\n
**ROLE OF A DENTIST IN ORN**

The dentist should perform prophylaxis, periodontal scaling, caries control, and fabrication of fluoride trays. Teeth that cannot be salvaged with conservative endodontic therapy should be extracted.\[^13\]\ Ideally, extractions should be performed 3 weeks before beginning radiation therapy.\[^14\]\ Extraction of teeth during radiation therapy should be discouraged and delayed until the completion of treatment with resolution of the oral mucositis. To prevent radiation caries, patients should begin daily fluoride treatment with 1% neutral sodium fluoride gel in prefabricated trays for 5 min each day. This practice should continue for life.\[^15\]\n
**Treatment**

ORN is an unusual complication from radiation therapy to the head and neck that unfortunately results in bone death. Radiation therapy is used to kill cancer cells, but the treatment also harms healthy cells at the same time.\[^16\]\ If enough of the healthy cells in your jawbones are damaged, it can result in a decrease of blood or essential nutrients to that area.\[^17\]\ Our bones require a constant supply of blood for nourishment and support so if this supply is compromised; it can lead to the death of that section of bone.\[^17\]\ Once a section of the jaw dies, it begins to deteriorate and weaken. Minor trauma such as dental surgery or other procedures to the head and neck may exacerbate the weakness and lead to further pain.\[^18\]\ The jawbones can become exposed in the mouth or through the facial skin, and the weakness may even lead to jaw fracture.\[^19\]\n
Hyperbaric oxygen (HBO) therapy is recognized as an adjunctive treatment for ORN. It may also be used prophylactically in patients who require dental extractions and is at high risk for developing ORN. This article reviews the treatment outcomes of patients treated with HBO. Patients who were at risk for developing ORN and had tooth extractions received HBO therapy with total oxygen time ranging from 1980 to 3390 min (6–21 pre-operative dives and 2–24 post-operative dives). These patients were surveyed for post-operative complications.\[^20,21\]\n
**POST-OPERATIVE COMPLICATIONS**

Surgical management of ORN patients is challenging and complex because previous surgery and irradiation result in obliterated tissue planes and higher risk for wound healing problems, respectively.\[^22\]\ In experienced hands, partial or total free flap loss which requires a second free flap or regional myocutaneous flap may range from 0% to 15%. Local wound healing problems resulting in dehiscence, plate exposure, or oro cutaneous fistula formation may occur in 8–43%. Most of these latter complications, however, can usually be managed successfully with conservative treatment.\[^23\]\n
**CONCLUSION**

HNC patients continue to pose a challenge for surgeons and oncologists. ORN can be a cruel blow to patients and their families who have already had
to endure treatment for cancer. Improved radiotherapy protocols, multidisciplinary preventive care, and reconstructive surgery can help to improve the quality of their lives.

REFERENCES


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