

Guidelines for Extraction in Irradiated Patients

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Abstract: Extractions in irradiated patients present high rates of complications due to less cellular, less vascular and less oxygenated tissues which lead to delayed healing. There is a controversy for dental extraction before or after radiation therapy as osteoradionecrosis is the most severe post radiotherapy sequelae. This article would be an attempt to understand the core of literature regarding dental extractions performed before and after radiotherapy, focusing on indications, contraindication, precautions (if any), criteria and special surgical techniques.

Keywords: Dental extraction, Radiation therapy, Osteoradionecrosis, Hyperbaric oxygen therapy, Pentoxifylline and Tocopherol.

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I. Introduction

Unreparable teeth in patients undergoing radiotherapy can lead to infection of bone, which might lead to osteoradionecrosis. Irradiated patients suffer from hypocellularity, hypo-vascularity and hypoxia of tissues. Extraction in such patients can lead to osteoradionecrosis. In 1922, Regaud published the first report about osteoradionecrosis (ORN) of the jaws after radiotherapy. Since then several theories have been propounded to explain its cause including the release of histamine, the theory of radiation, trauma and infection and until recently, the most widely accepted theory of hypoxia, hypovascularity and hypocellularity¹.

II. Definition

Attempts have been made several authors to define Osteoradionecrosis.

Marx (1983): "An area greater than 1cm of exposed bone in a field of irradiation that has failed to show any evidence of healing for at least six months."

Van Merkesteyn (1995): Bone and soft tissue necrosis of 6 months duration excluding radiation induced periodontal breakdown.

III. Discussion

With advent of modern technique of dose delivery, incidence of osteoradionecrosis after extraction I in patients with head and neck cancer, has decreased from 11.8% before 1968 to 5.4% from 1968-1992. The incidence of osteoradionecrosis since 1997 has reduced to mere 3% which can be further reduced if we follow the scientific guidelines and protocols while treating such patients².

Its incidence is three times higher in dentate than in edentulous patients, mainly as a result of injury from extractions and infection from periodontal disease¹. The risk of developing ORN after extractions is higher in posterior mandibular teeth with roots that lie below the mylohyoid line and when an atraumatic extraction was not possible³. The incidence of developing ORN after extraction in irradiated patients is higher in the mandible due to dense bone of mandible and irradiation induced obliteration of Inferior alveolar artery. Maxilla has blood supply from multiple blood vessels and the bone is comparatively less dense. Hence, incidence of ORN in maxilla is less than that of mandible.

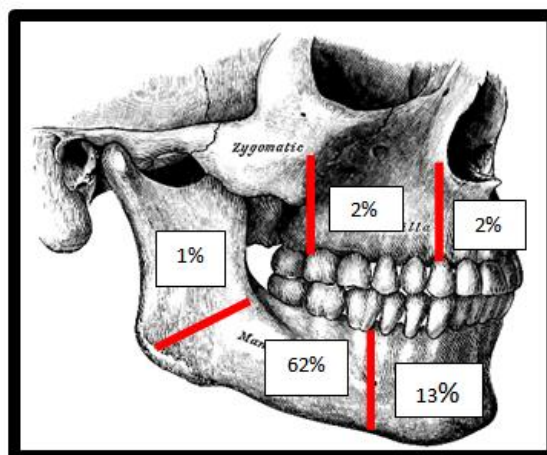


Figure 1: Incidence of osteoradionecrosis among various sites in maxilla and mandible⁴

Pathophysiology

Meyer in 1970 proposed that ORN was caused by the combined effect of Radiation, Trauma and Infection^[5]. However, in 1983 Marx challenged Meyer's theory based on the evidence that ORN occurred in cases with no sign of clinical infection and also occurred in cases without history of trauma. He gave his Hypoxia, Hypocellularity and Hypovascularity theory and said that ORN was the combined effect of:

- Radiation
- Formation of hypoxic-hypovascular-hypocellular tissue
- Tissue breakdown
- Chronic non healing wound

Radiation leads to irreversible cell change and dysfunction which causes endarteritis obliterans and thrombosis of vessels. The tissues thus become hypovascular that leads to gradual ischemia and hypoxia which leads to ORN.

Radiation-Induced Fibroatrophic Theory⁵

Radiation-induced fibrosis is a new theory that accounts for the damage to normal tissues, including bone, after radiotherapy. It was introduced in 2004 when recent advances in cellular and molecular biology explained the progression of microscopically observed ORN. The theory of radiation-induced fibrosis suggests that the key event in the progression of ORN is the activation and dysregulation of fibroblastic activity that leads to atrophic tissue within a previously irradiated area.

Clinical and Radiological features

In patients that have undergone extraction early ORN may be asymptomatic even though the main features of exposed devitalised bone through ulcerated mucosa or skin can be seen clearly. Pain is a common symptom and some patients have presented with intractable pain. Other associated symptoms include dysaesthesia, halitosis, dysgeusia and food impaction in the area of exposed sequestra [12, 13]. In severe cases, patients can present with fistulation from the oral mucosa or skin, complete devitalisation of bone and pathological fractures. The interval between radiotherapy and the onset of ORN can vary, but most occur between 4 months and 2 years. ORN usually develops during the first 6–12 months after radiotherapy.



Picture 1: Exposed devitalized bone through ulcerated mucosa

Source: Department of oral and maxillofacial surgery, Gurunanak institute of dental science and research



Picture 2: Fistulation from the oral mucosa

Source: Department of oral and maxillofacial surgery, Gurunanak institute of dental science and research

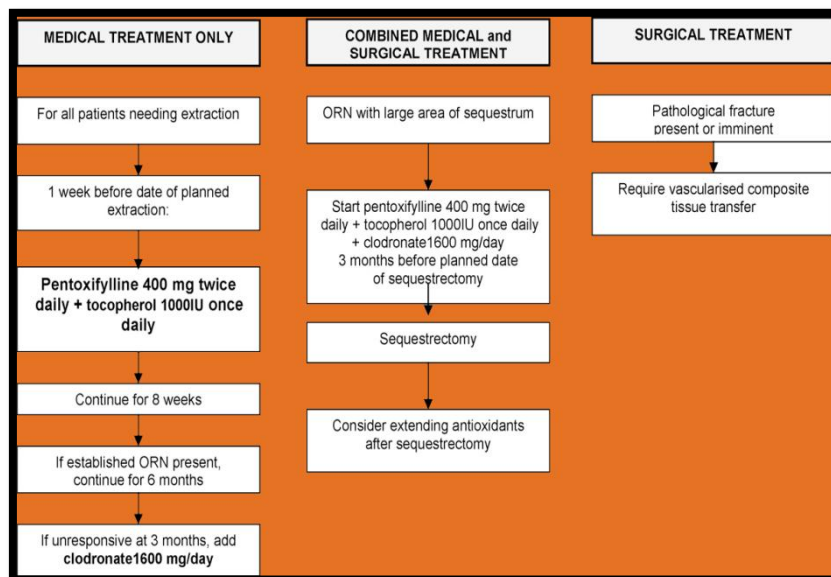


Picture 3: Reduced mouth opening

Source: Department of oral and maxillofacial surgery, Gurunanak institute of dental science and research

Treatment:

Protocol for patients who require dental extractions after Radiotherapy¹



Prevention: pre radiotherapy extraction

As we all know prevention is better than cure, mostly extraction is done before commencing radiotherapy. However, pre radiotherapy extraction is controversial.

Extraction of teeth done based on the belief that:

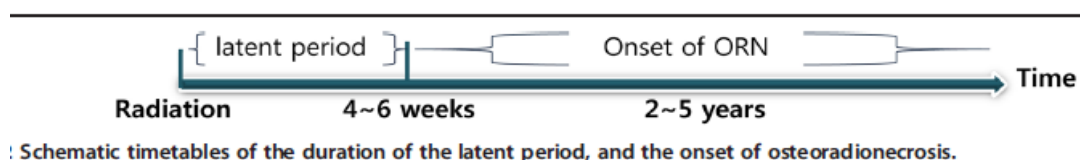
- Radiotherapy leads to untreatable periodontal disease
- Higher rates of ORN post radiotherapy
- Post radiotherapy extraction is difficult

The criteria used by Ben-David et al. -

- Teeth with non-restorable caries
- Caries that extend to the gum line
- Significant periodontal attachment loss (pocketing >5 mm)
- Severe erosion or abrasion

An accepted interval between extractions and radiotherapy is 10 days to three weeks^{12,13,14,15}

Post radiotherapy extraction: Osteoradionecrosis and extractions



Within the first 4 months (4-6 weeks) after radiation during the “golden window period” tooth extraction can be done without the need for HBO. During this time the tissues would have recovered from the hyperaemia and inflammation and would not have developed the 3H. During this period extraction can be attempted.

After the 4- month recovery time, the vascular damage and stromal damage advance at a faster rate so that, between 6 months and 2 years, the injury vector crosses the threshold. A minimal trauma technique is especially indicated in the irradiated patients.¹⁶

Post radiotherapy extraction: ORN, HBO Therapy, Antibiotics and PRP

HBO promotes angiogenesis, and therefore should reduce ORN¹⁷. A number of criticisms of HBO for the prevention and treatment of ORN exist. A recent systematic review found no benefit when prophylactic HBO is used in association with extractions¹⁸, and another pooled the overall complication rate for patients undergoing HBO, revealing a complication incidence of about 7.8%, including minor symptoms through to seizures, stroke and death^{13,20}. The only randomized, controlled trial was conducted by Annane et al. in 2004 and was stopped due to potentially worse outcomes in the HBO group²¹.

There is weak evidence to suggest that the use of antibiotics in general confers a 1% absolute risk reduction in ORN compared to no antibiotics²². Despite only weak evidence, prophylactic antibiotic use is still common following extractions.

Autologous PRP has been promoted for various applications, including bone grafts and various head and neck procedures. A recent randomized controlled trial showed no relationship between PRP use and development of ORN or improved pain scores²². It is reasonable to conclude that the use of PRP should be questioned in this setting.

ORN treatment: pentoxifiline and tocopherol⁵

Pentoxifylline is a Tri-substituted methylxanthine derivative chemically designated as 1-(5-oxohexyl)-3,7-dimethylxanthine. It exerts an anti-tumor necrosis factor (tnf)- α effect, increases erythrocyte flexibility, vasodilates, inhibits inflammatory reactions in vivo, inhibits human dermal fibroblast proliferation and extracellular matrix production increases collagenase activity in vitro. Extended-release tablet form is 400 mg, three times a day with meals effects within 2 to 4 weeks. Recommended that treatment for at least 8 weeks.

Tocopherol is a class of organic chemical compounds consisting of various methylated compounds, many of which has Vitamin E activity. It scavenges the reactive oxygen species generated during oxidative stress that escape the activity, protect cell membranes against lipid peroxidation and partly inhibit tgf- β 1 and procollagen Gene expression. Dose-1000 IU / day for 6-12 months.

IV. Conclusion

In an irradiated patient one faces the dilemma of whether to extract tooth before or after radiation. Extraction should be performed 10 days to 3 weeks before commencement of radiation. Extractions after radiotherapy should be done only if unavoidable and should be done during the **golden window period** with appropriate surgical techniques, adjuvant therapies and rigorous follow up.

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