

ONE PATIENT, TWO HEALING PATTERNS: A COMPARATIVE EVALUATION OF EXTRACTION SOCKET HEALING IN IRRADIATED AND NON-IRRADIATED BONE

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Abstract

Background:

Dental extractions in patients who have undergone radiotherapy for head and neck malignancies remain a significant clinical challenge because of radiation-induced hypovascularity, hypocellularity, and hypoxia, which impair tissue repair and increase the risk of osteoradionecrosis (ORN). Although extraction may be unavoidable in patients with severe dental disease, healing outcomes can vary considerably within irradiated tissues. This case report highlights the healing characteristics of extraction sites in irradiated and non-irradiated regions of the same patient undergoing full-mouth rehabilitation.

Case Presentation:

A male patient with a history of carcinoma of the hypopharynx treated with unilateral radiotherapy and chemotherapy two years earlier presented with multiple grossly decayed teeth and root stumps requiring full-mouth extraction prior to complete denture rehabilitation. Following oncologic clearance, extractions and alveoloplasty were performed in multiple appointments under local anesthesia using an atraumatic surgical approach. Primary wound closure was achieved, and the patient was closely monitored during the postoperative period.

Discussion:

Postoperative healing was uneventful, with no evidence of infection or osteoradionecrosis. However, a notable difference in healing

patterns was observed between irradiated and non-irradiated regions. Extraction sockets within the irradiated field demonstrated delayed soft tissue healing compared with corresponding sites on the contralateral non-irradiated side despite identical surgical technique, postoperative care, and systemic conditions. Furthermore, among the irradiated sites, the mandibular extraction sockets exhibited more pronounced healing delay than the maxillary sockets, consistent with the reduced vascularity and higher cortical bone density of the mandible.

Conclusion:

This case demonstrates the localized impact of radiotherapy on post-extraction wound healing and provides a unique intra-patient comparison between irradiated and non-irradiated tissues. The findings reinforce the importance of careful treatment planning, minimally traumatic surgical techniques, and prolonged follow-up in patients with a history of head and neck radiotherapy. Even in the absence of osteoradionecrosis, delayed healing should be anticipated in irradiated regions, particularly within the mandible. Such observations contribute valuable clinical evidence regarding the long-term effects of radiotherapy on oral wound healing and support the need for individualized management strategies in post-radiotherapy patients.

Key words

Oral surgery, radiotherapy, extraction, socket healing, osteoradionecrosis

Introduction

Radiotherapy remains a cornerstone in the management of head and neck malignancies, either alone or in combination with surgery and chemotherapy. Although it plays a vital role in tumor control, radiation exposure to the jaws can cause profound long-term complications that challenge oral and maxillofacial surgeons. One of the most severe and well-documented complications is osteoradionecrosis (ORN), a condition defined by necrosis of irradiated bone, often precipitated by trauma such as tooth extraction ^(1,2).

Ionizing radiation induces hypovascularity, hypocellularity, and hypoxia in bone and surrounding soft tissues, which collectively impair healing and reduce resistance to infection ^(1,3). These physiological alterations increase the susceptibility of irradiated bone to necrosis, particularly after invasive dental procedures. Consequently, any extraction in previously irradiated jaws requires meticulous planning, atraumatic technique, and appropriate prophylactic measures to minimize the risk of ORN ^(2,4,5).

Ideally, all necessary dental extractions should be completed before radiotherapy to eliminate potential foci of infection and reduce post-treatment complications. However, extractions may become unavoidable after radiotherapy due to progressive dental decay, periodontal disease, or periapical infections ^(6,7). In such circumstances, a multidisciplinary approach involving oncologists, radiation specialists, and

oral surgeons is crucial for safe management and prevention of complications.

This case report highlights the management of a patient requiring tooth extraction after head and neck radiotherapy, emphasizing preventive measures, surgical protocol, and postoperative care to achieve uneventful healing and avoid osteoradionecrosis.

Case report

A 60 years old male patient reported to the Department of Oral and Maxillofacial Surgery with a chief complaint of multiple decayed teeth and expressed a desire for full-mouth rehabilitation with complete dentures.

On intraoral examination, multiple grossly decayed teeth and root stumps were noted in both maxillary and mandibular arches. Based on these findings, a full-mouth extraction followed by alveoloplasty was planned to achieve a smooth and well-contoured alveolar ridge suitable for prosthetic rehabilitation.



Image 1- Pre op clinical image showing multiple root stumps present over the maxillary and mandibular arches

The patient's medical history revealed a previous diagnosis of carcinoma of the

hypopharynx, for which he had undergone radiotherapy and chemotherapy two years prior. He reported no other systemic illnesses or comorbidities.

Preoperative assessment included routine hematological investigations and an orthopantomogram (OPG) to evaluate the residual root morphology and alveolar bone condition. The patient was also advised to obtain medical fitness and clearance from his oncologist before proceeding with any surgical intervention.

Following oncologist clearance, extractions were performed in multiple appointments under strict aseptic precautions. Local anesthesia was achieved using 2% lignocaine hydrochloride with 1:80,000 adrenaline, ensuring adequate hemostasis and pain control during the procedure.



Figure 2- Clinical image of extracted socket of maxillary arch(Non Radiated site)



Figure 3- clinical image of healed sockets post 1 week of extraction. (Non radiated site)

Full-mouth extractions were carried out quadrant-wise, and alveoloplasty was performed simultaneously to remove sharp bony spicules and irregularities. The alveolar ridges were contoured to provide a smooth, rounded surface to facilitate the fabrication and retention of complete dentures. Hemostasis was achieved, and mucoperiosteal flaps were repositioned and sutured using 3-0 black silk.



Figure 4- Clinical image of immediate post extraction sockets (Irradiated site)



Figure 5- Non healed sockets after 1 week post extraction (irradiated site)

The patient's postoperative period was uneventful, with satisfactory healing noted on follow-up visits. Instructions on oral hygiene maintenance and follow-up for prosthetic rehabilitation were provided.



Figure 6- Delayed healing after two weeks post extraction (Irradiated site)

DICUSSION

Dental extraction in patients who have undergone radiotherapy for head and neck cancers presents a significant clinical challenge due to the compromised vascularity and cellularity of the irradiated bone, predisposing patients to delayed healing and osteoradionecrosis (ORN). The timing of extraction, anatomical location, and radiation dose are critical determinants of healing outcomes and complication rates. Although the optimal timing remains debated, extractions performed before radiotherapy are generally considered safer. Beaumont et al. reported no significant difference in ORN incidence between pre- and post-radiotherapy extractions (5.5% vs. 5.3%), while Koga et al. emphasized that allowing a healing period of 10–21 days before radiotherapy commencement minimizes complications.¹

When extractions after radiotherapy are unavoidable, Marx and Johnson proposed that trauma-induced ORN follows a bimodal risk pattern, with peaks around 12 months and again between 24–60 months post-radiation, suggesting relatively safer windows within the first six months post-treatment. Lajolo et al. noted a higher ORN incidence (5.8%) in post-radiotherapy extractions, particularly with prolonged latency, with affected patients averaging 33 months since radiotherapy compared to 24.7 months in unaffected individuals.⁶ Healing outcomes also vary by anatomical site, with the mandible being more susceptible due to its dense cortical bone and reduced vascularity; in Lajolo et al.'s review, 38 of 41 ORN cases occurred in the mandible, while the maxilla's richer blood supply offered relative protection. Nevertheless, even maxillary tissues exhibit delayed healing due to radiation-induced fibro-atrophic changes.

The primary complication following extraction is osteoradionecrosis, characterized by persistent bone exposure, fistula formation, or pathological fracture, with incidence rates ranging from 2–22% depending on factors such as radiation dose, surgical technique, and systemic comorbidities. Additional complications include delayed mucosal closure, infection, and chronic pain.⁷ Beaumont et al. identified mandibular molar extraction, doses exceeding 60 Gy, advanced tumor stage, xerostomia, and poor oral hygiene as major risk factors. Preventive strategies involve atraumatic extraction techniques, primary closure, antibiotic prophylaxis, and

occasionally hyperbaric oxygen therapy (HBO). Koga et al. demonstrated that HBO before and after extraction improves oxygenation and enhances fibroblast and capillary regeneration, though its universal benefit remains inconclusive.

Despite the associated risks, extractions in irradiated patients are often necessary, as radiation-induced xerostomia, caries, and periodontal disease can render teeth non-restorable or infected, potentially acting as foci for ORN if retained. Therefore, when indicated and performed with minimal trauma, extraction may reduce the likelihood of spontaneous ORN or secondary infection. A unique aspect of the present case report is that it involves a single patient who underwent unilateral radiotherapy limited to one side of the face providing a direct intra-patient comparison of socket healing between irradiated and non-irradiated regions.⁸ This rare clinical situation clearly demonstrated delayed healing on the irradiated side compared to the contralateral, non-irradiated side, despite identical surgical technique and postoperative care. Moreover, within the irradiated field, the mandibular extraction site exhibited more pronounced delay in healing compared to the maxillary site, further reinforcing the established understanding that mandibular bone, due to its denser cortical structure and reduced vascularity, is more susceptible to radiation-related healing complications.⁹ This observation adds valuable evidence to existing literature, highlighting the differential healing potential between irradiated and non-irradiated tissues within the same patient. It emphasizes

that even under uniform systemic conditions, radiation's localized effects significantly impair vascular and cellular repair mechanisms. Consequently, this case underscores the importance of individualized treatment planning and long-term follow-up in patients with partial head and neck irradiation. Overall,

a preventive approach remains essential, emphasizing comprehensive preradiotherapy dental assessment, timely removal of teeth with poor prognosis, and diligent long-term post-radiation surveillance to minimize the need for high-risk surgical interventions later.^{10,11}

CONCLUSION

This case report uniquely demonstrates differential healing of extraction sockets within the same patient who underwent unilateral radiotherapy. The delayed healing observed on the irradiated side, particularly in the mandible compared to the maxilla, reinforces the impact of radiation on bone vascularity and regenerative capacity. These findings add clinical evidence to existing literature, emphasizing that even localized radiation significantly affects post-extraction recovery. Early dental evaluation, careful treatment planning, and atraumatic extraction techniques remain essential to minimize complications and improve healing outcomes in irradiated patients

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