The Effect of Ionizing Radiation on the Oral Innate Immune Response, Oral Microbiome and the Quality of Life in Patients Undergoing Head and Neck Intensity−Modulated Radiotherapy for the Treatment of Head and Neck Tumours

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Abstract

Radiotherapy/Radiation therapy (RT) to the head and neck region has devastating and life altering effects. Using the Modified Delphi Technique, consensus guidelines were reached and developed in which radiation dose at which participants would prophylactically remove teeth to prevent osteoradionecrosis (ORN), a life−altering complication of RT, was established at 70 Grays (Gy) in the maxilla and 60 Gy in the mandible. Treatment pathways were developed for maxillary and mandible anterior/premolar and molar teeth receiving a dose at or above this threshold. Risk factors were established for carious, periodontally involved and third molar teeth. In general, periodontally involved teeth and mandibular molars were most frequently recommended for extraction. Only symptomatic third molars were recommended for extraction when adequate healing time was available prior to commencement of RT. Therefore, from a clinical perspective, clinicians can recognize, anticipate and possibly reduce the risk of oral complications associated to RT to the head and neck region. However, the use of potential biomarkers in the form of oral innate immune cells and oral microbiome to potentially predict the development and progression and possibly to treat RT induced oral complications has not

been thoroughly investigated and thus not well understood. Currently, the role of oral polymorphonuclear leukocytes (oPMNs), also known as oral neutrophils, and the oral microbiome before, during and post-RT and their interaction with one another has not been extensively studied in order to be used as a potential biomarkers in the development and progression of oral complications associated with RT treatment. When controlling for all relevant factors, ionizing radiation (IR) from intensity-modulated RT (IMRT) was found to decrease both the number of oPMNs post-RT as well as impair oPMN activation (priming) states through statistically significant decreases in the oPMN markers CD11b, CD16, CD18, CD64 and H3Cit. Exposure to IR can cause significant alterations in the oral microbiome by reducing the relative abundance of commensal Gram-negative microbes and increasing the commensal Gram-positive microbes. To assess the quality of life (QoL) of these patients before, during and post treatment, the University of Washington Quality of Life Questionnaire version 4 (UW−QoL) was administered prospectively before and during RT. Taste, saliva and swallowing domain scores dropped (worsened) during and post-RT treatment. The results of this study suggest that IR is impairing the load and function of critical oPMN markers as well as shifting the oral microflora and contributing to poorer patient self-reported QoL.