



ORIGINAL ARTICLE

Radiation caries in nasopharyngeal carcinoma patients after intensity-modulated radiation therapy: A cross-sectional study



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tooth loss

Abstract *Background/purpose:* The exact dose of intensity-modulated radiation therapy (IMRT) associated with tooth damage is mostly unknown. We aim to evaluate the severity of dental lesions after IMRT and the correlation with the radiation dose to the dentition in patients with nasopharyngeal carcinoma (NPC).

Materials and methods: This was a cross-sectional study of 42 patients with NPC who completed IMRT in 2011. Each premolar tooth was divided into 13 sites. Teeth were evaluated using a validated index and subsequently categorized at each divided site. The relationship between dose distribution and the caries severity score was analyzed using logistic models. The odds of developing caries damage were evaluated using odds ratios.

Results: A total of 4342 sites from 334 premolar teeth were evaluated. For sites exposed to 30–60 Gy, the odds of developing caries damage were 12–200 times greater compared with sites

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unexposed to IMRT. A new radiation caries lesion was likely to occur when the dose was >35.8 Gy after 17 days' radiation therapy ($P < 0.05$).

Conclusion: The findings suggest that new tooth damage was likely to occur at doses > 35.8 Gy, and care should be taken throughout the treatment planning process to limit tooth doses to < 50 Gy in NPC patients.

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Introduction

Head and neck cancers are diagnosed in more than 500,000 people each year in the world.¹ Radiation therapy (RT) is indicated for nasopharyngeal carcinoma (NPC) and is particularly effective in type III NPC.² However, RT in the head and neck region will affect oral function and has important influences on quality of life.³ Indeed, among other complications, irradiation of the head and neck area is accompanied by the development of radiation caries, which is a major cause of tooth loss and decreased quality of life.⁴

Clinically, rapid deterioration of the dental hard tissue is often observed.⁵ Previous studies investigated the effects of RT on the organic matrix and mechanical properties of the human teeth *in vitro*^{6–9} and *in vivo*,^{10,11} and have suggested that radiation caries could be caused by the alteration of the dental hard tissues and/or hyposalivation. Irradiation of the enamel and dentine of the teeth can influence their mechanical structure by decreasing their ultimate tensile strength¹² and decreasing their fracture resistance. In dental research, radiation exposure to the major salivary glands causes a change in the composition of saliva qualitatively and a permanent quantitative reduction in secretion; this process contributes to the carious process.¹³ Indeed, radiation-induced hyposalivation is considered to be the most important aetiological factor for dental caries.¹⁴ However, some scientists have suggested that direct radiation damage can ratchet up the progression of radiation caries—in their studies, morphological and physical changes in both human and bovine dentine were documented after radiotherapy.^{6,15}

After the completion of RT, patient quality of life may be drastically diminished as a result of numerous RT-induced oral complications including hyposalivation and severe breakdown of the dentition.^{5,16} In the past, full-mouth tooth extraction was prescribed prior to RT; however, because removable prostheses were not often well-tolerated by the irradiated oral mucosa, the current approach is to maintain as many healthy teeth as possible.¹⁷

Nevertheless, previous studies have devised some approaches that could help decrease the frequency of tooth-related toxicities, with more or less success.^{5,16} Intensity-modulated RT (IMRT) is a recent RT approach that is associated with improved survival and reduced toxicity in patients with NPC, compared with conventional two-field RT.¹⁸ However, the relationship between radiation dose and the severity of radiation caries at different tooth sites still remain unclear.

Therefore, the aim of the present study was to evaluate the severity of dental lesions after IMRT and the association

with the radiation dose to the dentition in patients with NPC. Results of the present study could help design better RT approaches to limit radiation exposure of the teeth, and to identify the teeth that would need further prevention and care.

Materials and methods

Study design

This was a cross-sectional study performed at the West China Hospital of Stomatology, Sichuan University, Chengdu, China. The study was approved by the Ethics Committee of the West China Hospital of Stomatology, Sichuan University. All patients provided a written informed consent and selected the inclusion/exclusion criteria in Table 1.

Oral examination

The patients' oral hygiene habits were evaluated using a questionnaire.¹⁹ Hygiene score was evaluated by the

Table 1 Inclusion/exclusion criteria of patients.

Inclusion criteria	Exclusion criteria
1) Patients diagnosed with NPC stage T1N0M0 according to the 2003 TNM classification	1) Psychiatric disorders
2) The IMRT regimen was completed between January 2011 & December 2011	2) Patient received chemotherapy or traditional Chinese medicine
3) Aged 18–60 y	3) History of drug abuse
4) Before IMRT, patients had all permanent, adult dentition (28 teeth) with/without the 3 rd molars	4) Treatment with any drug known to affect the salivary glands or mouth mucosa in the past 3 mo
	5) Chronic systemic diseases
	6) Congenital diseases
	7) Smoking
	8) Alcohol addiction
	9) Recurrent NPC
	10) Received dental management during RT
	11) No fluoride was taken during IMRT

IMRT = intensity-modulated radiation therapy; NPC = nasopharyngeal carcinoma.

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