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Dental extraction planning in head and neck cancer patients: a qualitative study to understand pre-radiotherapy management

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Original Article

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Abstract

Introduction: Dental management is critical prior to radiotherapy (RT) for head and neck cancer (HNC) but cumbersome and time intensive. This qualitative study investigates dentists' evaluative processes to identify areas for improvement.
Methods: Semi-structured interviews were conducted with dentists involved in the care of HNC patients. The interviews were guided by the Consolidated Framework for Implementation Research and the Theoretical Domains Framework to identify factors influencing pre-RT dental management.
Results: Five dentists were participated in the interviews. Key themes were identified through qualitative and quantitative evaluation and are as follows: Coordination among care providers, knowledge of the RT plan, visual depictions of dose distribution and understanding of the patient's dental history.
Conclusions: This study demonstrates the complexity of pre-RT management and identifies key elements. Knowledge of the RT plan and improved interdisciplinary coordination represents opportunities for improvement. Visual dose prediction methods may expedite and improve pre-RT management.

Introduction

Head and neck cancer (HNC) is a morbid illness affecting approximately 70,000 new patients in the United States annually.[1] This disease often necessitates multidisciplinary treatment including surgery, radiotherapy (RT) and chemotherapy. RT for HNC often consists of 60 to 70 Gy delivered in 30 to 35 daily fractions to the site of the primary tumour or surgical bed and the draining lymphatics.[2] To reduce the risk of osteoradionecrosis (ORN) of the mandible after RT, pre-RT management is critical.[3] The standard of care pre-RT workflow includes a dental evaluation for ORN risk assessment and risk-adapted extractions to areas deemed high-risk for complications after RT.[4] "High-risk" is not well-defined in the literature[5] but is determined by the examining dentist with information from the radiation oncologist (RO) including anticipated dose and target.[6,7] If extractions are necessary, many institutions perform them prior to RT planning, as anatomic changes after extractions may affect the dose distribution. This planning process takes one to two weeks, and only after this plan is finalized can the true dose be determined.

Since it is only after extractions occur that the RT planning process can begin, the RO is often asked to estimate mandibular exposure based on clinical information available at consult. Few studies have explored the accuracy of an ROs estimation of mandibular dose or have qualified strict criteria that define high-risk from the dental perspective.[8] Thus, there exist significant knowledge gaps. The consequences of inaccurate over- or under-estimation of mandible exposure may lead to a misinformed interpretation of risk and unnecessary or inadequate extractions, which delay care and impact quality of life. Since the time from HNC diagnosis to RT initiation is related to survival[9–12], more effective evaluation methods are needed.

As a foundation for enhancing pre-RT management for HNC patients, we sought to examine the dentists' approach, focusing on the factors influencing their decision-making. The information currently being used (i.e., various dose parameters) in practice by dentists evaluating HNC patients and the method by which this is communicated is highly heterogeneous.[13] We sought to study their process as a foundation for improving workflows

in radiation oncology and bridging the knowledge gap that exists between ROs and dentists during the complex and high-stakes pre-RT evaluation process.

Methods

Sampling and recruitment

Eligible participants included dentists who care for HNC patients from various backgrounds, including community dentists and quaternary care centre specialists, and regions, including the Southeastern and Midwestern United States. Dentists were selected based on institutional collaboration. They were contacted by the first and last authors (C.M. L. and R.T.H.) by email with a study description. If interested, they were sent a formal IRB approved document describing the study and their rights as participants. The Institutional Review Board of the Wake Forest University School of Medicine approved this study (IRB00096065).

Data collection

Interview data were collected from March 2023 to July 2023 over video teleconference. We obtained verbal consent for the interview and for the interview to be recorded. To gather comprehensive data surrounding the creation of a pre-RT dental evaluation and extraction plan, we employed the Consolidated Framework for Implementation Research (CFIR) and the Theoretical Domains Framework (TDF). The CFIR[14,15] and TDF[16,17] are comprehensive frameworks designed to guide the systematic assessment of factors influencing the implementation of evidence-based practices. The CFIR is tailored to identifying collective-level domains whereas the TDF is tailored to identifying individual-level determinants. Combined, these frameworks provide a broad platform for understanding the extraction planning process. The respective CFIR and TDF domains are listed in Table 1. The interviews were semi-structured. The interview guide and scripts were developed through collaboration with experts in head and neck radiation oncology, qualitative research and implementation science. The interviews were conducted by the first author (C.M.L.). The guide was loosely followed, and the interviews conducted conversationally. Interviews ranged from 30 to 60 minutes. They were transcribed by video-teleconference software. Thematic saturation was determined to have been achieved when no new insights emerged, indicating the data collected were sufficient to understand the process comprehensively. Once thematic saturation was reached, no further interviews were conducted.

Analysis

Interview transcripts were extracted from the teleconference software. The transcripts were reviewed by two independent reviewers (C.M.L. and S.E.G.) who organized and analysed the data. Reviewers utilized a directed content analysis method, applying predetermined codes from the CFIR and TDF constructs and domains. Specifically, reviewers focused on identifying any remarks related to their decision-making process within a relevant construct. Every comment was analysed to determine relevance relating to the predetermined constructs and organized accordingly. After data extraction was complete, the lead author reviewed the entirety of the coding to assess for consensus and determine discrepancies. Once consensus was achieved, researchers identified key domains qualitatively and quantitatively. Subthemes were identified and described.

Table 1. Quantification of domain strength within Pre-RT dental extraction interviews

Quotes attributed per domain and reviewer	Quotes attributed by coder 1	Quotes attributed by coder 2	Average number of quotes attributed	Variance
CFIR domains				
Intervention characteristics	6	3	4·5	4·5
Outer setting	8	5	6·5	4·5
Inner setting	13	8	10·5	12·5
Process	19	20	19·5	0·5
Characteristics of individuals	9	3	6	18
TDF domains				
Knowledge	19	17	18	2
Skills	3	3	3	0
Social/ professional role and identity	6	5	5·5	0·5
Beliefs about capabilities	7	3	5	8
Optimism	2	0	1	2
Beliefs about consequences	20	10	15	50
Reinforcement	5	4	4·5	0·5
Intentions	6	2	4	8
Goals	3	6	4·5	4·5
Memory, attention and decision processes	12	1	6·5	60·5
Environmental context and resources	6	8	7	2
Social influences	2	1	1·5	0·5
Emotion	8	3	5·5	12·5
Behavioural regulation	6	0	3	18

Results

Of the five dentists approached to participate in the interview, all five agreed and ultimately enrolled and participated. All interviewees were female. The mean number of years in practice was 12.6 (range 3—35). Three participants worked in academic referral centres and two participants worked in community-based practices.

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Multiple domains were identified as integral to the pre-RT extraction planning process. Key domains included *process* (CFIR), *knowledge* (TDF) and *beliefs about consequences* (TDF). Key domains were determined qualitatively and quantitatively.

Qualitative assessment

Qualitatively, key domains were identified based on the strength, valence and emphasis placed on the subjects discussed within these domains by the interviewed dentists. Strength was measured by the frequency of mentions and detailed discussions within a domain during the interviews and is further explored in the quantitative analysis. Valence was assessed through the positive or negative sentiments expressed by dentists within a domain. Emphasis was determined by detail and priority given during the interview. Within the *beliefs about consequences* domain, one interviewee described a patient's prior dental health as "the most critical thing to look for." Detailed descriptions were often found within the context of the process domain, indicating its critical role in process. Similarly, material within the knowledge domain was emphasized for its importance in guiding clinical decisions and management. These qualitative findings correlated well with the quantitative data to follow.

Quantitative assessment

Key domains were quantified by calculating the sum of quotes attributed to a domain by each coder and calculating the average quotes per domain. The average number of quotes attributed to each domain was 6.9 (SD 5·7). Those domains with ten or more quotes attributed to them by each reviewer were identified. The average number of quotes attributed to each of the key domains was at least one standard deviation above the average. The *process* domain was found to be the most integral with an average of 19·5 quotes attributed to it. *Knowledge* had the second most quotes attributed to it, with an average of 18. *Beliefs about consequences* was third with an average of 15 quotes attributed to it. This alignment between qualitative and quantitative data reinforces the significance. Additional details regarding the number of quotes attributed to each domain by each coder can be found in Table 1.

Process domain

Within the process domain, coordination among providers and a thorough pre-treatment consultation were identified as significant themes. Important stakeholders include the otolaryngologist, the RO, the patient and the patient's dentist (if they had a dentist prior to their cancer diagnosis). As described by one interviewee, 'there's three, really maybe four, main people I'm getting all my information from: It's the ENT surgeon, the folks over in radiation, the patient themselves, and of course, if they've seen a dentist, the patient's dentist'. Collaboration and information sharing among stakeholders is crucial for effective care coordination. Multidisciplinary conferences and communication channels help to facilitate collaboration and ensure comprehensive care and planning.

Another important part of the dentist's process is their consultation before which they gather information from various resources, including previously identified stakeholders, the medical record and a thorough review of radiographic imaging. During the initial pre-RT dental consultation, dentists assess the patient's dental status through a thorough review of their dental history, a comprehensive dental exam and same day radiographs. Dentists are self-reported visual providers; radiographs and physical exams are crucial parts of their process. The initial consultation helps dentists assess the impact RT will have on the patient's dental health such that they can make the appropriate recommendations.

Knowledge domain

Within the knowledge domain, the dentists' understanding of the radiation plan was revealed as an important theme. It is important for dentists to understand the plan, including the dose distribution and target areas, to anticipate dental complications and tailor recommendations accordingly. One interviewee describes the utility of a visual aid depicting anticipated RT dose maps: 'ideally, we would have some type of drawn-out map'. Currently, they are left guessing: 'I have to guess the radiation map and then make the recommendations from there . . . which is not the best'.

Dentists must also be aware of the impact radiation has on a patient's global dental health, including its effects on salivary glands and its ability to compromise blood supply and decrease healing. Knowledge of the patient's comorbidities influences treatment decisions and the risk assessment for complications. Dentists must tailor their recommendations based on a patient's dental health including their dental history and even factors such as tooth morphology which could impact ease of extraction. As one interviewee noted, radiation 'changes the number of cells you have to grow new bone . . . the blood supply that supplies those cells to grow new bones . . . their ability to rebound from extractions afterwards is very compromised'. Knowledge of these key factors are crucial for optimizing outcomes.

Beliefs about consequences domain

Within the beliefs about consequences domain, the impact of a patient's dental and medical health was identified as highly significant. Subjective assessments of patient habits and their oral health history crucially guide a dentist's beliefs about the necessity of extractions to prevent complications. As described by one interviewee: 'I think [a patient's dental habits], to me, are the most critical thing to look for . . . because they don't, they can't change that habit during their cancer therapy, it's just an unreasonable expectation'. Patients can have pristine dentition but if they have previously not prioritized their dental health, they may still go on to develop complications: 'My experience has been that if they don't floss and they're only brushing episodically, but they've been resistant to decay before, all bets are off'. Thus, dentists prioritize a patient's prior dental health maintenance when making extraction plans over the appearance of their dentition on the day of consultation.

Additional health history informs their beliefs and extraction plans. Behaviour-related risk factors for their disease such as smoking and alcohol consumption shape dentists' expectations. Each of these domains and their relevant subthemes play a significant role in the dentist's decision-making process, with no one determinant being the deciding factor. Further relevant quotations can be found in Table 2. As aptly described by one interviewee, 'it's hard to say, you know, what one thing [is most important], because they're all so interconnected for us . . . we don't make these decisions willy nilly'.

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Table 2. Relevant quotations by domain

Domain	Key quotations
Process	'Typically, the referral will either come from radiation oncology or from the head and neck surgery team . . . we look at the diagnosis, we look at the timing of anticipated care, if there's surgical intervention'. 'If the patient has any imaging, typically CT imaging, we will also evaluate that to get an idea if there's any obvious areas of odontogenic infection or areas that we know have a poor prognosis from a dental alveolar perspective'. 'At the time of the patient's consultation with our service, we typically have the patient obtain a panoramic radiograph and that is a dental specific radiograph that shows the entire head area so that we can have a more global view. We look at intraoral structures before we look at teeth and that's once again to get a global perspective and then go more local to confirm radiographic findings or to find new findings clinically that might be indicators to us that this patient has either a better prognosis from a dental standpoint or a poor to questionable prognosis'.
Knowledge	'Typically in our literature . . . 50 Gy is the amount of dose that we know is more conducive to causing ORN as an adverse complication'. 'It's not the tooth that is affected directly by radiation, it's all the other structures. It's the saliva glands. It's the bone, the vascularity . . . if the bone has had radiation, it doesn't have the same quality of vascularity for the granulation tissue, the clot and all of that to happen so that that area can fill up and heal'.
Beliefs about consequences	'If the patient does not have the motivation, nor do they have the dental home to have follow up care, I tend to be more aggressive with taking out more teeth, even if it's not in an area that's involved. And that's just because preemptively, I understand that this patient will probably eventually follow that same pattern in terms of having significant loss of tooth structure or further progression of their ondontogentic infection.' 'So that past history really will impact us when we start making decisions about recommendations because you know, we've had patients that have had lots of crowns put on in the last couple of years and root canals done on back teeth and they are stable. But those are very risky teeth to keep because historically they've not been able to take care of them. You know, they went from a filling to a bigger filling to a root canal, to a crown. So all of that past history impacts our decision making process about what we ultimately recommend'.

Discussion

The current pre-radiotherapy dental evaluation process is nuanced and time-consuming, yet crucial for optimizing patient outcomes in radiation oncology[11,18]. A generic pre-RT flowchart is shown in Figure 1, demonstrating the multiple steps that must be taken before a patient can begin their treatment. Efforts to improve upon this process may improve patient quality of life and cancer outcomes. One step in this process is the dental evaluation and extractions (if necessary). Little is known about how dentists evaluate head and neck patients prior to radiation and if there is anything radiation oncologists can do to assist in streamlining and improving their process. Through qualitative interviews with dentists, several key determinants were identified. Specifically, dentists navigate a multi-step process involving collaboration with key stakeholders and a comprehensive pre-extraction evaluation. Communication among providers and thorough data gathering are essential for informed decision making. Understanding the proposed RT plan, is vital for anticipating dental complications and tailoring recommendations. Dentists must also consider the impact of radiation on various aspects of dental and overall health. Subjective assessments of patient habits, oral health history and health status significantly influence the need for extractions to prevent complications.

Specific challenges must be overcome to prevent delays in pre-RT dental care, given the importance of rapid initiation of RT on cancer outcomes[10]. ROs may recognize that one of the key determinants in the dentist's pre-RT evaluation process is knowledge about the radiation plan[8]. The above interviews demonstrate that visual depictions of an anticipated RT plan could potentially be helpful, but a streamlined framework for that to occur does not exist. Radiographs and physical exam were emphasized as part of their initial evaluation. Visual depictions of radiation doses were directly requested. Dentists want to see where the radiation is going.

There is precedent in the literature for predicting radiation dose to the mandible ahead of the actual treatment planning scan. One prior study retrospectively examined clinical factors to create predictive models of maximum RT dose to the mandible[19]. This study demonstrated the feasibility of a clinical model approach, though it had limitations. For instance, this model was built upon an older dataset and modern RT techniques will result in different dose distributions. Additionally, when they designed their model, only a few clinical factors were evaluated, and RT target and planned dose were not included.

Another case series created mandibular RT dose maps for 18 common HNC clinical scenarios[20]. This provided a representation of mandible exposure for patients with HNC of various primary sites treated with either definitive or postoperative RT, as both factors (location of primary tumour and treatment intent) substantially affect the magnitude and distribution of mandible dose. These dose maps are a useful visual reference but are limited by their small sample size, presenting individual, representative cases for each scenario.

A more recent study trained an artificial intelligence (AI)-guided tool to predict mandibular dose. This required target volumes to be manually delineated on a diagnostic computed tomography (CT) scan before making the prediction. This is a time-consuming task that necessitates duplication of work after any dental extractions occur. There were strong correlations between the AI-based prediction and that of the expert physician and the AI model's predictions showed higher concordance with the true value than the expert physician's[21].

These preliminary studies demonstrate an interest in and a need for better estimation of radiation dose prior to RT planning. Any predictive tool would benefit from being larger in scale in terms of retrospective clinical input. Visual representations created in preliminary studies proved useful. Based on our findings, a visual representation of dose would likely play an important part of the dentist's process and a valuable resource prior to their consultation with the patient and when planning dental extractions. A flowchart demonstrating where in the process a dentist would be likely to utilize the radiation dose maps can be found in Figure 2.

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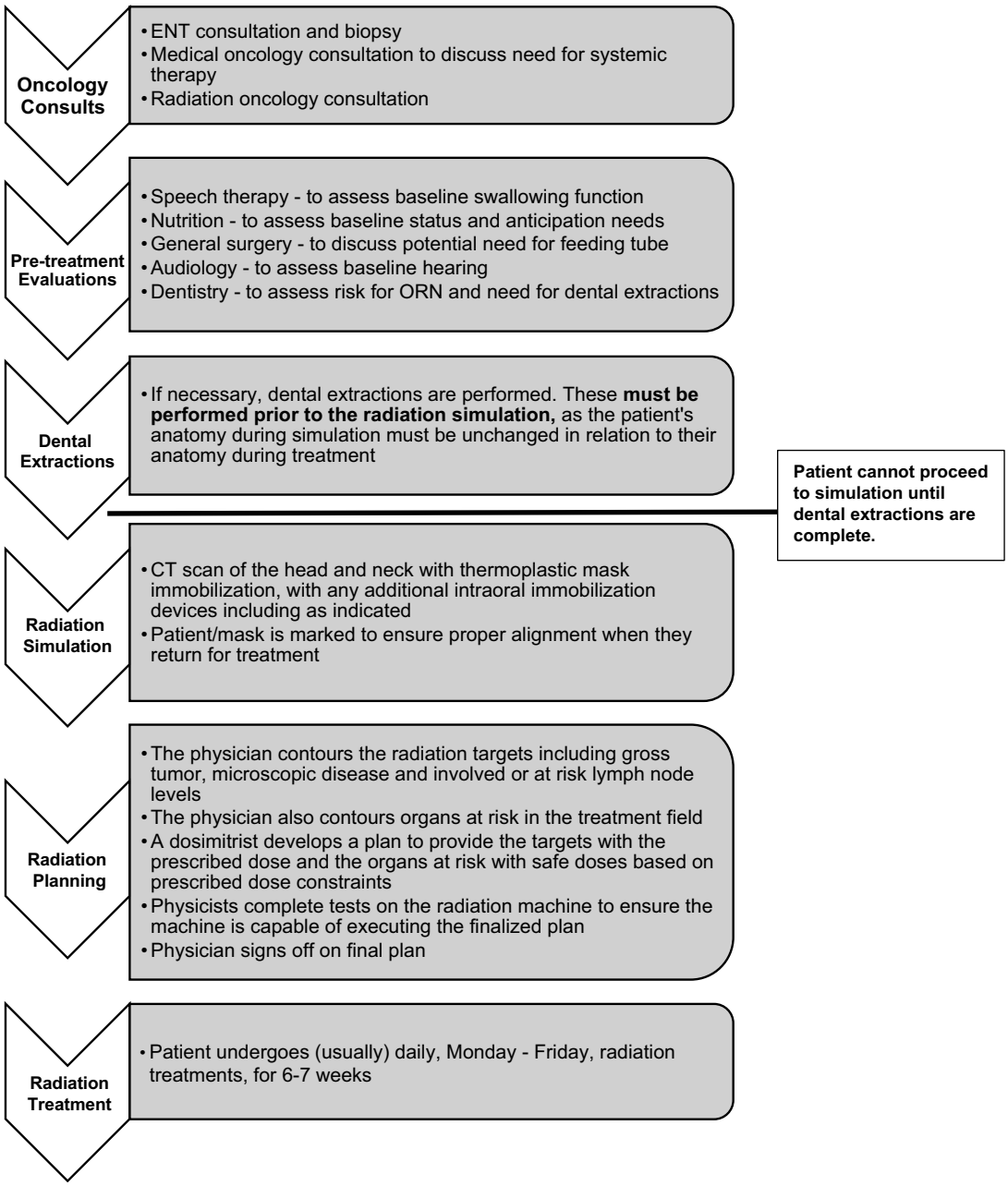

Figure 1. Flowchart depicting the pre-radiation workup and radiation planning process.

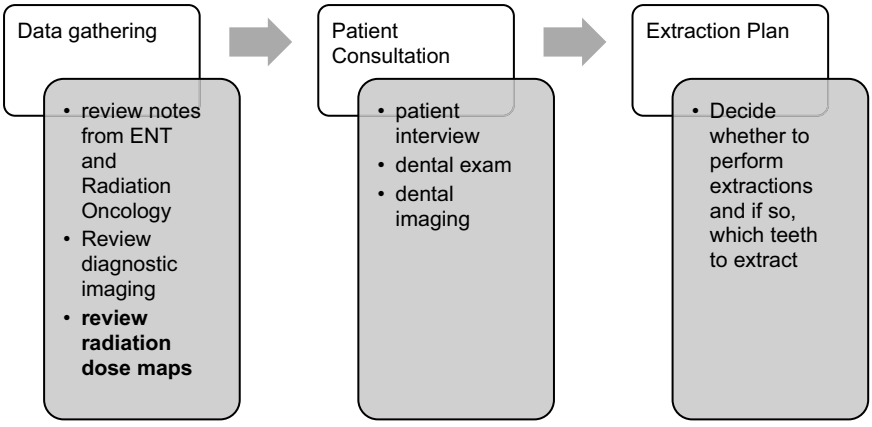

Figure 2. Flowchart depicting the pre-radiation dental evaluation and extraction planning process.

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The most recent preliminary study suggests that AI can serve as an accurate tool in closing this crucial information gap. Taking our findings from the current study in the context of the available literature, methods for predicting the dose to the mandible prior to RT planning should be based on several factors including but not limited to primary tumour site, treatment intent (definitive versus postoperative), tumour and nodal classification, anticipated RT target volumes and doses and the pre-RT diagnostic imaging. The output should include multiple mandibular dosimetric parameters (e.g., maximum point dose, volumes receiving at least 50 or 60 Gy), and a visual representation of isodose distributions relevant to dental planning (e.g., isodose lines representing volumes of tissue/mandible receiving at least 50, 60 and 70 Gy)[22,23]. These visual aids could either be projected onto a single axial image, or as a 2- or 3-dimensional representation to facilitate multimodal communication.

This study has limitations. Our sample was comprised of dentist in the authors' practice network. Thus, it is possible that our findings have limited relevance to dentists in other settings. Further, we included very few participants, even for a qualitative study. Future studies should include a larger and more diverse cohort. Additionally, ideally, we would have gathered other data (e.g., observational) to triangulate interview data to enhance confirmability. Nevertheless, our participants had diverse clinical backgrounds, and their input was consistent in theme, suggesting that our findings are reasonably credible and transferrable.

Conclusion

Pre-RT dental management is critical in HNC patients. It is a complex, nuanced task that must be completed expeditiously to avoid treatment delays. A more streamlined process may enhance the quality and efficiency of pre-RT dental management. As the first study to qualitatively explore pre-RT dental evaluations using an implementation science framework, we demonstrate that there are key determinants that are ripe for innovation and improvement. Specifically, development of clinically useful RT dose prediction processes that facilitate multi-modal communication of predicted dose to dental colleagues is direly needed.

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Ethics Approval Statement. All activities performed in studies involving human participants were in accordance with the ethical standards or the institution and with the Helsinki declaration.

Patient Consent Statement. All involved persons gave their informed consent prior to study inclusion.

References

1. Head and Neck Cancers. American Association for Cancer Research, 2024
2. Grégoire V, Evans M, Le QT, et al. Delineation of the primary tumour Clinical Target Volumes (CTV-P) in laryngeal, hypopharyngeal, oropharyngeal and oral cavity squamous cell carcinoma: AIRO, CACA, DAHANCA, EORTC, GEORCC, GORTEC, HKNPCSG, HNCIG, IAG-KHT, LPRHHT, NCIC CTG, NCRI, NRG Oncology, PHNS, SBRT, SOMERA, SRO, SSHNO, TROG consensus guidelines. Radiother Oncol 2018; 126: 3–24,
3. Watson E, Dorna Mojdami Z, Oladega A, et al. Clinical practice guidelines for dental management prior to radiation for head and neck cancer. Oral Oncology 2021; 123: 105604,
4. Lajolo C, Gioco G, Rupe C, et al. Tooth extraction before radiotherapy is a risk factor for developing osteoradionecrosis of the jaws: a systematic review. Oral Dis 2021; 27: 1595–1605.
5. Yang F, Wong RJ, Zakeri K, et al. Osteoradionecrosis rates after head and neck radiation therapy: beyond the numbers. Practical Radiation Oncology 2024; 14: e264–e275,
6. Morrish RB, Jr., Chan E, Silverman S, Jr., et al. Osteonecrosis in patients irradiated for head and neck carcinoma. Cancer 1981; 47: 1980–1983.
7. Devi S, Singh N. Dental care during and after radiotherapy in head and neck cancer. Natl J Maxillofac Surg 2014; 5: 117–125,
8. Studer G, Glanzmann C, Studer SP, et al. Risk-adapted dental care prior to intensity-modulated radiotherapy (IMRT). Schweiz Monatsschr Zahnmed 2011; 121: 216–229.
9. Ang KK, Trotti A, Brown BW, et al. Randomized trial addressing risk features and time factors of surgery plus radiotherapy in advanced head-and-neck cancer. Int J Radiat Oncol Biol Phys 2001; 51: 571–578.
10. Shaikh T, Handorf EA, Murphy CT, et al. The impact of radiation treatment time on survival in patients with head and neck cancer. Int J Radiat Oncol Biol Phys 2016; 96: 967–975,
11. Rosenthal DI, Liu L, Lee JH, et al. Importance of the treatment package time in surgery and postoperative radiation therapy for squamous carcinoma of the head and neck. Head Neck 2002; 24: 115–126.
12. Mackillop WJ, Bates JHT, O'Sullivan B, et al. The effect of delay in treatment on local control by radiotherapy. Int J Radiat Oncol Biol Phys 1996; 34: 243–250.
13. Lee IJ, Koom WS, Lee CG, et al. Risk factors and dose-effect relationship for mandibular osteoradionecrosis in oral and oropharyngeal cancer patients. Int J Radiat Oncol Biol Phys 2009; 75: 1084–1091.
14. Damschroder LJ, Aron DC, Keith RE, et al. Fostering implementation of health services research findings into practice: a consolidated framework for advancing implementation science. Implement Sci 2009; 4: 50,
15. Safaeinili N, Brown-Johnson C, Shaw JG, et al. CFIR simplified: Pragmatic application of and adaptations to the consolidated framework for implementation research (CFIR) for evaluation of a patient-centered care transformation within a learning health system. Learning Health Systems 2020; 4: e10201.
16. Atkins L, Francis J, Islam R, et al. A guide to using the theoretical domains framework of behaviour change to investigate implementation problems. Implementation Science 2017; 12: 77.
17. Cane J, O'Connor D, Michie S: validation of the theoretical domains framework for use in behaviour change and implementation research. Implementation Science 2012; 7: 37,
18. Graboyes EM, Garrett-Mayer E, Ellis MA, et al. Effect of time to initiation of postoperative radiation therapy on survival in surgically managed head and neck cancer. Cancer 2017; 123: 4841–4850.
19. Tsai CJ, Verma N, Owosho AA, et al. Predicting radiation dosimetric distribution in different regions of the jaw in patients receiving radiotherapy for squamous cell carcinoma of the tonsil. Head Neck 2019; 41: 3604–3611.
20. Polce S, Gogineni E, Antone J, et al. Dental radiation dosimetric maps from intensity-modulated radiation therapy planning for head and neck cancers. Head Neck 2021; 43: 1428–1439.
21. Chan JW, Hohenstein N, Carpenter C, et al. Artificial intelligence-guided prediction of dental doses before planning of radiation therapy for oropharyngeal cancer: technical development and initial feasibility of implementation. Adv Radiat Oncol 2022; 7: 100886.
22. Levi LE, Lalla RV: dental treatment planning for the patient with oral cancer. Dent Clin North Am 2018; 62: 121–130.
23. Treister NS, Brennan MT, Sollecito TP, et al. Exposed bone in patients with head and neck cancer treated with radiation therapy: an analysis of the observational study of dental outcomes in head and neck cancer patients (OraRad). Cancer 2022; 128: 487–496.

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