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Case report: Rapid dental deterioration following radiotherapy for oral cancer

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Abstract

Radiotherapy to the head and neck region has oral side effects and can lead to catastrophic dental deterioration, but this is largely preventable. This article describes the case of a patient whose dentition was irreparably compromised after radical radiotherapy for a soft palate cancer. The patient had a fairly well maintained dentition at the pre-radiotherapy dental screen, but the side effects of radiotherapy – notably dry mouth and reduced access to the mouth for cleaning – coupled with a high-sugar diet intended to aid recovery, led to the rapid progression of dental caries and tooth wear. Additionally, service restrictions due to the coronavirus disease 2019 pandemic meant that his dental care was delayed. Eight months after completion of radiotherapy, all his teeth were deemed unrestorable. The authors discuss the importance of frequent and regular dental reviews to prevent rapid dental deterioration in patients undergoing radiotherapy for head and neck cancer.

Background

EVERY YEAR around 12,400 people in the UK are diagnosed with head and neck cancer (Cancer Research UK 2022) and a large proportion undergo external radiotherapy as part of their treatment. The radiotherapy may be standalone or combined with surgery or chemotherapy, and may be of curative or palliative intent. Radiotherapy may be used to eradicate or shrink the primary tumour as well as to target local or distant metastases and micrometastases (Kalavrezos and Scully 2016). It employs high-energy particles or waves that disrupt deoxyribonucleic acid (DNA) and ultimately cause cell death. It affects normal cells as well as cancer cells, so if normal tissues are exposed to radiation, significant side effects can occur.

In the head and neck region, side effects of radiotherapy include reduced saliva production, trismus (limited mouth opening), dysphagia, oral mucositis and radiation skin burns (Rahman et al 2013). These side effects can result in xerostomia (dry mouth), sore mouth and reduced access to the mouth for cleaning, which, in conjunction with a high sugar diet, can lead to the rapid development of dental caries (Butterworth et al 2016, Restorative Dentistry UK 2016, Kumar 2019). In the longer term, radiation can cause endarteritis obliterans (inflammation of the inner lining of an artery causing occlusion and reduced blood flow) resulting in reduced vascularity of bone. Subsequently, any trauma to irradiated bone, including from dental extractions, may result in incomplete healing and osteoradionecrosis (necrotic bone caused by radiotherapy), a difficult-to-treat chronic condition (Nabil and Samman 2011, Rice et al 2015, De Felice et al 2016, Wang et al 2017, Chronopoulos et al 2018).

Furthermore, patients undergoing radiotherapy may lose their appetite due to altered taste and difficulty chewing and swallowing, and may therefore experience weight loss and be prescribed high-calorie, sugar-rich nutritional supplements to aid recovery. The use of such supplements, coupled with painful or difficult access to the mouth for cleaning and reduced protection of the oral cavity against pH changes because of reduced saliva flow, means that patients are at high risk of developing rapidly progressing dental caries, periodontal disease and erosive tooth wear (Butterworth et al 2016, Restorative Dentistry UK 2016, Kumar 2019).

This article discusses the case of a 55-year-old man whose dentition was rapidly compromised by caries and tooth wear after he received radical radiotherapy for a soft palate cancer. In addition to the case report, the article draws on the literature and on the authors' clinical experience. The patient gave written consent for the details of his case and anonymised photographs and radiographs to be used in the article.

Pre-radiotherapy dental screen

UK national guidelines recommend that all patients who are due to undergo radiotherapy to the head and neck region have a dental screen, overseen by a specialist in restorative dentistry, to eliminate active dental disease, promote a healthy oral environment during and after treatment, and minimise the risks of oral side effects (Butterworth et al 2016, Restorative Dentistry UK 2016, Wang et al 2017, Kumar 2019). This pre-radiotherapy dental screen should include giving patients:

Information on the possible side effects of radiotherapy.

Instructions for intensive oral hygiene.

A prescription for high-fluoride mouthwash and toothpaste for ongoing use.

Advice on the management of acute oral side effects of radiotherapy.

Advice on any dental treatment that may be required, for example treatment of gum disease, dental restorations or fillings to ensure the patient's mouth is as healthy as possible before the start of radiotherapy.

Furthermore, to minimise the risk of osteoradionecrosis of the jaws, the extraction of teeth of questionable prognosis is recommended before the start of radiotherapy (Butterworth et al 2016, Restorative Dentistry UK 2016, Kumar et al 2018).

The pre-radiotherapy dental screen, through practical necessity, often takes place soon after the patient has been diagnosed with head and neck cancer. Information on how to minimise the oral side effects of radiotherapy may therefore become lost among all the other information given to patients, while their emotional state and anxiety as they adjust to their diagnosis may compromise the absorption of information (Gorman 2006, Gil et al 2012). Even if patients can absorb all the information and endeavour to follow all the advice they receive, it may become challenging for them to maintain a low-sugar diet and optimal oral hygiene as treatment progresses and side effects accumulate.

Case report

A 55-year-old man presented to an oral and maxillofacial surgery unit in August 2019 for a pre-radiotherapy dental screen after being diagnosed with a P16-negative squamous cell carcinoma of the left soft palate and uvula. His TNM (tumour, node, metastasis) staging was T2 N0 M0 – that is, a cancer of 2-4 cm in diameter with no spread to lymph nodes and no distant metastases.

The patient's oral health was acceptable, with minimal soft plaque deposits but some early dental caries on his upper anterior teeth. He was advised to seek dental care in primary care to address these as soon as possible. None of his teeth was deemed of questionable prognosis so no extractions were recommended.

The patient was given advice regarding oral hygiene and diet, and the side effects of radiotherapy on the oral cavity were discussed with him. Sodium fluoride 1.1% toothpaste was prescribed for twice-daily use, as per national guidelines (Butterworth et al 2016, Restorative Dentistry UK 2016, Kumar 2019).

Figure 1 shows the orthopantomogram radiograph (panoramic, single-image radiograph of the mandible, maxilla and teeth) taken at the pre-radiotherapy dental screen showing good dental health with no obvious dental caries or other disease, and impacted lower wisdom teeth.

Radiotherapy treatment (65Gy to soft palate, 54Gy bilaterally to lymph nodes in 30 fractions) was completed by October 2019. The patient first noted 'chipping' of his teeth in February 2020 and attempted to see a dentist in primary care but was unable to do so. He subsequently brought this to the attention of his clinical nurse specialist (CNS), who referred him to the oral and maxillofacial surgery team.

The patient was seen by the oral and maxillofacial surgery team in June 2020 and reported generalised tooth sensitivity and a deep throbbing ache from his teeth on the lower right side. Additionally, he was experiencing a burning sensation in his gingivae and had stopped brushing his teeth because of it. The patient explained that he had been struggling to resume a solid diet after treatment completion. His diet consisted of coffee with sugar in the morning and oral nutritional supplement drinks in the evening. These drinks were high calorie, with a total sugar content of approximately 22g per 330mL serving.

Clinical and radiographic examinations showed that his dentition had deteriorated significantly over the eight months since treatment completion, with severe tooth wear and caries affecting every erupted tooth. No acute infections were noted but nearly all teeth were tender. Advice on oral hygiene and diet was reinforced and more sodium fluoride 1.1% toothpaste prescribed.

Information was obtained regarding the radiotherapy doses to the patient's jaws to assess the risk of osteoradionecrosis before likely dental extractions. The patient was referred urgently to a secondary care restorative dental service for advice and treatment planning. After the assessment, the patient had two telephone reviews with dietitians to discuss his diet.

Figure 2 shows the orthopantomogram radiograph taken eight months after completion of radiotherapy showing severe tooth wear and caries affecting all erupted teeth.

Approximately one month later (that is, nine months after completion of radiotherapy), the patient was seen at the restorative dental service and underwent another assessment. Soft caries remained throughout his dentition and the patient's oral hygiene was inadequate. The patient explained that he was still struggling to brush his teeth due to generalised soreness and sensitivity and that he had used the sodium fluoride 1.1% toothpaste only intermittently. All his teeth, apart from the unerupted lower third molars, were deemed unrestorable.

Figure 3 shows photographs of the patient's dentition nine months after completion of radiotherapy.

Given the patient's ongoing symptoms, the unrestorable condition of his teeth and his difficulties in maintaining optimal oral hygiene and diet, it was clear that all erupted teeth would need to be extracted. Radiotherapy dosimetry maps, which show the radiation dose delivered to one region, showed that the tooth-bearing areas of the patient's maxilla and mandible had received a radiation dose of approximately 24-40Gy. This suggested that the patient was at moderate risk, rather than high risk, of developing osteoradionecrosis after dental extractions (Curi and Lauria 1997, Reuther et al 2003, Tsai et al 2013, Kubota et al 2021). The extractions and the risk of osteoradionecrosis were discussed with the patient, who agreed to the surgery. It was planned that full upper and lower dentures would be made for him after the extractions.

To minimise the risk of osteoradionecrosis, the extractions were planned to be staged as follows:

1. Remove teeth causing the most pain.
2. Remove teeth in areas of lower radiation dose.
3. Remove teeth in areas of higher radiation dose as they become symptomatic.

The patient was referred to the oral and maxillofacial surgery team for extraction of all his teeth except the lower third molars. However, before the extractions could be carried out, the patient developed other acute medical conditions for which he was admitted to intensive care and he died shortly afterwards.



Figure 1. Orthopantomogram radiograph taken at the pre-radiotherapy dental screen showing good dental health with no obvious dental caries or other disease, and impacted lower wisdom teeth

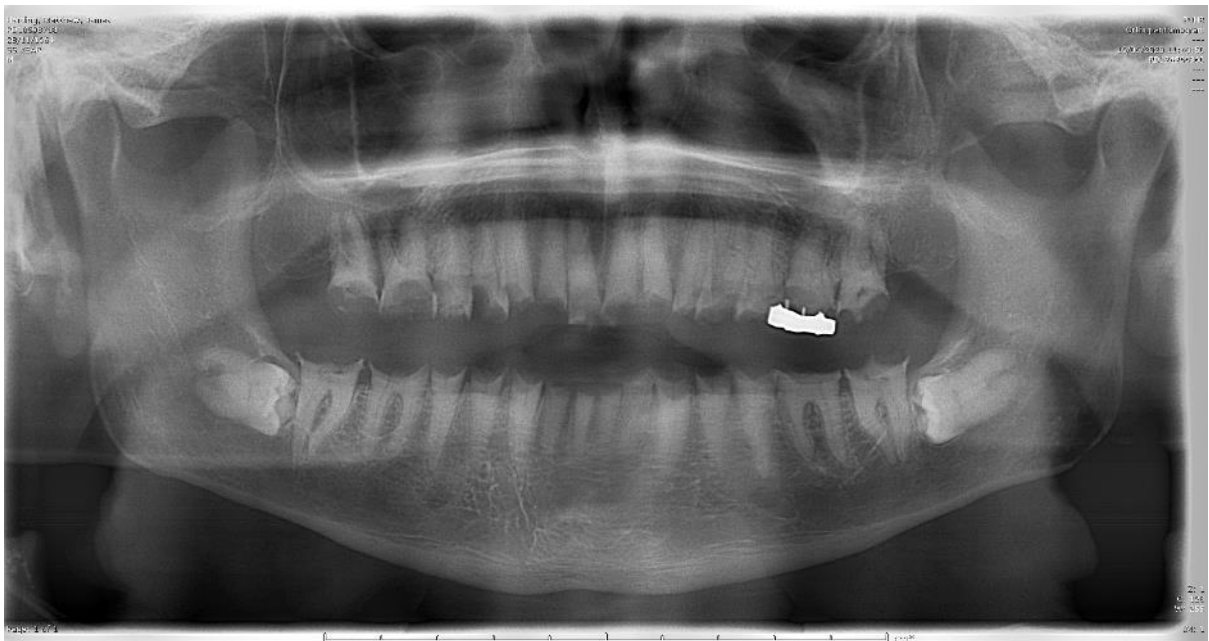


Figure 2. Orthopantomogram radiograph taken eight months after completion of radiotherapy showing severe tooth wear and caries affecting all erupted teeth

Discussion

This case report emphasises how rapidly dentition can deteriorate after radiotherapy to the head and neck region if there is reduced saliva flow, reduced access to the mouth for cleaning, a high-sugar diet and no adequate preventive dental care. These circumstances are common after radiotherapy for head and neck cancer and all patients who undergo this type of treatment are at high risk of rapid progression of dental caries and tooth wear.

Support from a primary care dentist

The patient had regular contact with his CNS during and after radiotherapy and did not mention issues with his teeth until February 2020, four months after completion of treatment. He had initially tried to see his primary care dentist but had been unable to do so for reasons that are not known. Support from a primary care dentist during and after treatment for head and neck cancer is critical (Butterworth et al 2016), although it requires patients to be under the care of a dentist at the time. In this patient's case, an added challenge was that dental practices were closed, and dental services limited to the treatment of urgent conditions in a small number of urgent care centres, between 26 March 2020 and 8 June 2020 due to coronavirus disease 2019 (COVID-19) restrictions.

Timely post-treatment dental review

It took another four months before the patient was assessed, in June 2020, by the oral and maxillofacial surgery team, by which time his dentition had deteriorated so badly that the extraction of all erupted teeth was the only option. Disruptions to hospital services due to COVID-19 restrictions probably explain the delay. If the patient had been seen more promptly, root canal treatment of some of his teeth may have prevented or slowed down further deterioration of his dentition. The scheduling of a timely post-treatment dental review is important and should be included in patients' post-treatment care pathway. A dental check by an appropriately trained specialist for all patients 6-16 weeks after completion of radiotherapy would seem a pragmatic way of identifying those at high risk of dental deterioration at an early stage. A specialist would subsequently take measures to prevent the catastrophic consequences described in the case report. Additional staff and funding may be required to make this possible. For patients under the care of an oral and maxillofacial surgery team, the post-treatment dental check could be carried out by dentally qualified staff from that team.



Figure 3. Photographs of the patient's dentition nine months after completion of radiotherapy.

A - Photograph of patient smiling with mouth slightly open, showing disintegration of teeth and angular cheilitis at the corners of the mouth

B - Photograph of patient's upper teeth (from below), showing severe tooth wear and active soft caries affecting all teeth

C - Photograph of patient with mouth open and teeth clenched, showing complete loss of tooth crown height and form

D - Photograph of patient's lower teeth (from above), showing severe tooth wear and active soft caries affecting all teeth and frothy saliva indicating xerostomia

Written information on oral hygiene and diet

Assessing patients' motivation to adhere to the oral hygiene and dietary advice given to them at the pre-radiotherapy dental screen can be challenging. Several healthcare professionals have a role in supporting optimal oral hygiene and diet during and after treatment, but the primary responsibility for this lies with patients – or their carers. Even if they have the best of intentions at the start of radiotherapy, many patients find it challenging to keep to a low-sugar diet and brush their teeth twice a day once they start experiencing acute side effects of radiotherapy and while they are trying to maintain a healthy weight.

It is important to discuss diet and oral hygiene with patients at the pre-radiotherapy dental screen and signpost them to sources of support should they start to struggle. Such discussions would enable earlier recognition and treatment of dental issues, which ultimately could support better outcomes for patients.

A practical way of emphasising the importance of maintaining oral hygiene and supporting patients to adhere to advice would be to provide written information, at the preradiotherapy dental screen, on oral hygiene and diet as well as the contact details of an appropriately trained clinician – for example, a head and neck cancer CNS with dental training – in case issues arise. Dental checks during

radiotherapy can be challenging due to the acute side effects of treatment and oral soreness, but they are possible should there be any concerns.

Flexibility when planning dental treatments

The case report shows that patients with a history of head and neck cancer may develop medical comorbidities that can delay or complicate planned dental treatments such as dental extractions. Flexibility when planning post-radiotherapy dental treatments may be required so that other medical issues can be addressed as a priority.

Training for non-dental healthcare professionals

Head and neck cancer CNSs are highly trained healthcare professionals who coordinate patients' care. They may also be the healthcare professionals who have the most frequent contact with patients diagnosed with head and neck cancer and to whom patients turn when they encounter issues (Dempsey et al 2016). Head and neck cancer CNSs are therefore well placed to identify and refer patients with dental issues at an early stage, although this relies on patients knowing that they can discuss dental issues with their CNS and on the CNS having received appropriate training. Many head and neck cancer CNSs do not receive formal dental training, yet health promotion and preventive advice are central aspects of their role (Dempsey et al 2016).

Recognition of an acute or urgent dental issue and appropriate referral could make a significant difference to patients' care. Additional training in performing simple mouth checks to assess oral hygiene and observe for signs of dental caries or tooth wear, and in reinforcing oral hygiene and dietary advice to patients, could result in the more rapid detection of serious dental issues, leading to more timely treatment and potentially better patient outcomes. Such training could be based on existing guidance on the oral care of patients undergoing cancer treatment (UK Oral Management in Cancer Care Group 2019).

Other healthcare professionals who are in regular contact with patients, for example radiographers, dietitians and speech and language therapists, could also be considered for dental training aimed at supporting them to identify potential oral or dental issues early.

Recommendations for practice

Recommendations for practice To minimise the risk of rapid dental deterioration in patients with head and neck cancer receiving radiotherapy, the following is recommended:

Written information should be provided to patients, at the pre-radiotherapy dental screen, on the side effects of radiotherapy, the importance of optimal oral hygiene and diet, and the use of high fluoride toothpaste – plus details of who to contact should they experience dental issues

Post-treatment pathways for patients with head and neck cancer should include, for all patients, a prompt for a dental review 6-16 weeks after the completion of radiotherapy to enable early identification and support of patients at high risk of dental deterioration. This prompt could be incorporated into the appointments system at the time of the pre-radiotherapy dental screen

Dental training should be provided to all head and neck cancer clinical nurse specialists and other healthcare professionals involved in the care of patients with head and neck cancer. Training could include how to conduct simple mouth checks, how to reinforce oral hygiene and dietary advice and how to action an appropriate referral for patients with dental issues

Conclusion

This case report described how a patient who originally had a fairly well maintained dentition experienced rapid and significant dental deterioration following radiotherapy for a soft palate cancer. This occurred due to a combination of factors including inadequate oral hygiene, delayed post-treatment dental review, radiotherapy-induced hyposalivation and trismus, and closure of dental practices and restrictions on hospital services due to the COVID-19 pandemic. Minimising the risks of rapid dental deterioration in patients who receive radiotherapy to the head and neck region requires improved communication and information at the pre-radiotherapy dental screen, post-treatment dental reviews embedded in patient pathways, and dental training for healthcare professionals who care for patients with head and neck cancer.

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