

Oral complications and dental management of childhood cancer: how does the dentist support integrated care?

Précis: Cancer is one of the leading causes of childhood mortality. Dentists should be aware of the orofacial complications and management of children who receive a cancer diagnosis or have a history of cancer. Complications of cancer treatment can carry life-long morbidity. Thus, this paper is relevant for all members of the dental profession.

Abstract: Childhood cancer is one of the leading causes of childhood mortality. Cancer treatment carries significant orofacial morbidity.

Objective: The reader should understand the acute and long-term implications of cancer treatment on oral health.

Background: Cancer treatment can cause acute and long-term oral complications. Many of these complications are irreversible and dental effects can be seen into the permanent dentition. The severity of dental complications is dependent on the child's age and stage of dental development at the time of cancer treatment, as well as the type and duration of cancer treatment.

Conclusion: Dental care for children with cancer is important. All dentists must have an awareness of the oral complications of oncology treatment and should be ready to provide appropriate care, including enhanced preventive care, for these patients.

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Introduction

Childhood cancer is one of the leading causes of childhood mortality. The National Health Service (NHS) reports 1,400 new cases of childhood cancer in the United Kingdom (UK) every year.¹ The incidence rate of childhood cancers in Ireland is similar to the European average.² Leukaemia and lymphoma account for most childhood cancers, followed by solid tumours and brain tumours. Head and neck tumours account for approximately 12% of childhood cancers.³ Mortality rates for childhood

cancers were at their highest in Ireland in the 1950s and 1960s. However, with advances in diagnostic techniques and treatments, mortality rates have decreased by 60-70%.² Treatment of childhood cancer can involve:

1. Radiation therapy (involves a high-energy beam of radiation to destroy cancer cells).
2. Chemotherapy (involves cytotoxic drugs, which target rapidly dividing cancer cells).



Aisling Cant

BA BDentSc DipPCD (RCSI) MFD (RCSI) MSc
Specialty Registrar in Paediatric Dentistry
Guy's and St Thomas' NHS Foundation Trust,
London, UK

Nabina Bhujel

BDS MFDS (RCPS Glas) MPaedDent (RCPS Glas) DCLinDent (Paed Dent) FDS (Paed Dent RCS Eng)
Consultant in Paediatric Dentistry
Guy's and St Thomas' NHS Foundation Trust, London, UK

Corresponding author: Aisling Cant E: aisling.cant@nhs.net

3. Surgery.
4. Bone marrow transplantation.
5. Combination of the above.

Cancer treatment has significant orofacial morbidity.⁴ Anti-neoplastic treatments lack specificity and can have adverse effects on healthy tissues.⁵ In a study of paediatric oncology patients, 93% had oral complications.⁶ A recently published systematic review demonstrated that children with a history of childhood cancer had double the risk of a dental defect compared to healthy subjects.⁵

Children may develop acute and long-term oral complications of cancer treatment.⁷ These complications can have a profound impact on the child's quality of life.⁸ All dentists should be aware of the importance of timely dental review and treatment prior to commencing cancer therapy, and should be ready to provide enhanced preventive care for these patients.

Method

A literature search was carried out to identify relevant literature via the electronic database PubMed. Relevant studies, literature reviews and case reports were considered. A hand search of reference lists was also carried out to identify further literature. Studies published in the English language were included in this narrative review.

Acute complications of cancer treatment

Management of cancer can lead to various acute oral complications:

Oral mucositis

Ulceration and painful mucositis are commonly reported acute complications of radiation therapy and chemotherapy. Mucositis is an inflammatory process caused by exposure to radiation therapy and chemotherapy agents.⁹ Oral mucositis initially presents as an area of soft tissue erythema, which can progress to ulceration with a sloughy fibrous membrane.¹⁰ Oral mucositis can have a detrimental effect on nutritional intake, oral care and quality of life.¹⁰ Superimposed viral and fungal infections can occur on areas of oral mucositis. Infection of the ulcerated tissues may carry a risk of sepsis.

Infection

During cancer treatment, patients are immunocompromised and can be susceptible to secondary opportunistic infection, e.g., herpes simplex virus and *Candida albicans*.⁷

Pain

It has been reported that some children treated with chemotherapy may complain of mandibular neuropathic pain.⁷ This may mimic dental pain symptoms.

Xerostomia

Xerostomia is also a common complication of cancer treatment. Radiation therapy can directly damage salivary tissue, with higher doses of radiation causing increased risk of salivary gland dysfunction. Chemotherapy agents may also compromise salivary flow.⁹ Patients may complain of transient or permanent oral dryness. Xerostomia may aggravate painful oral mucositis



FIGURE 1: Intra-oral photograph of a 13-year-old female with a history of cancer treatment. Dental anomalies include an enamel defect on UL6 and microdontia of UR4 and UL45.

and may prevent good dietary habits.¹⁰ Saliva has a number of protective functions in the oral cavity.⁹ Lack of protective saliva increases the risk of enamel demineralisation and makes these children particularly at risk of dental caries.⁹

Oral petechiae

Cancer treatment may lead to thrombocytopaenia. In patients with thrombocytopaenia, oral petechiae may be seen on the buccal mucosa.⁶

Taste dysfunction

Cancer treatment may also lead to changes in taste. Taste disturbance may be due to hyposalivation, damage to cranial nerves, presence of oral infection, and other changes to the oral environment, including poor oral hygiene or changes in dietary intake.⁹

Long-term complications of cancer treatment

Treatment of cancer can also lead to long-term oral complications. Some complications are irreversible, especially in children who are growing.¹¹ Most dental anomalies occur when children are treated for cancer under the age of six.¹² The severity of dental complications is dependent on the child's age and stage of dental development at the time of cancer treatment, as well as the type and duration of cancer treatment.^{5,7} Children who are young at the time of treatment, and those that are treated with higher doses of radiation or total body irradiation, tend to be at higher risk of developing dental complications.⁵

Enamel defects

Developing odontoblasts and ameloblasts can be affected by cancer treatment and this may lead to crown defects. Radiation therapy inhibits odontoblast mitotic activity and develops osteodentine, which prevents enamel mineralisation.¹³ One study compared the dental health of children with a history of childhood cancer to the dental health of their siblings.⁴ The prevalence of enamel defects was higher in children with a history of cancer. Reported prevalence of enamel defects among groups of children with a history of cancer range from 36%¹⁴ to 69.8% (Figure 1).¹⁵



FIGURE 2: Orthopantomograph of a 13-year-old female with a history of cancer treatment. Dental anomalies include arrested root development, v-shaped roots, microdontia, hypodontia, atypical restorations, and enamel defects.

Hypodontia/microdontia

These dental anomalies often present as late complications of cancer treatment.¹⁶ One study assessed the dental health of a group of children with past malignant disease.¹⁴ Some 19% of these children had hypodontia. A systematic review reported an increased risk of tooth agenesis by 147% (RR 2.47) in children who have been treated with chemotherapy.¹⁷ Microdontia has been shown to be the most common crown defect (**Figure 1**).⁵

Root disturbances

Apical blunting and change in shape and length of roots are complications of cancer treatment.¹⁵ Root defects are reportedly more common than crown defects.⁵ A Swedish study assessed the radiographic dental changes in children who were treated with radiation therapy and chemotherapy.¹¹ Short, v-shaped roots were seen in 94% of children treated with radiation therapy and chemotherapy (**Figure 2**).

Dental caries

Children with cancer have been shown to have more teeth with dental caries.⁴ One cross-sectional study assessed the prevalence of dental caries among a group of childhood cancer survivors compared to age and sex-matched controls.¹⁸ This study reported a significantly higher prevalence of primary teeth with active caries in the cancer group. They also reported a higher decayed, missing, filled (DMF) score among cancer survivors compared to the control group. A large-scale Danish study reported a higher prevalence of dental caries in children who were diagnosed with cancer at age five to six years.¹⁹ This increased prevalence of dental caries reduced over time and appeared to be diminished at age 15 years. Duggal *et al.* reported a higher prevalence of untreated dental caries in a group of childhood cancer survivors compared to their siblings.⁴ The main reasons for increased caries rate may include:

1. Type of cancer treatment

Children who are treated with radiotherapy have been shown to have higher DMF scores.¹⁸ Radiotherapy can alter salivary gland secretion

and lead to production of acidic saliva.¹³ Chemotherapeutic agents may also affect saliva secretion, although the evidence is conflicting.^{13,20}

2. Saliva

Saliva acts as a buffer to counteract the acidic environment created by oral bacteria.²¹ Saliva also plays a role in oral clearance. Disruption to saliva flow favours a cariogenic environment.

3. Medications

Children with a history of cancer are likely to be taking oral medications to maintain remission or for the treatment of confounding disease.²¹ In children, solutions are flavoured to improve compliance. It is important to realise that these solutions may be sugar based. Medication-related xerostomia may also promote a more acidic oral pH, which also is conducive to caries.²²

4. Diet

Xerostomia may lead to children requesting 'mouth-moistening' drinks to improve oral comfort.¹⁵ These drinks are often flavoured and sugar based.

5. Associated socioeconomic factors

Parental education and frequency of dental attendance are also related to caries risk.¹⁸ Families of children with cancer may not understand the significance of oral health and may not prioritise dental visits due to other medical commitments.

Gingival health

There is conflicting evidence on the quality of gingival health among children with cancer compared to controls. One study reported no differences between the gingival index and plaque index of children with cancer and controls.²³ Another study showed that the prevalence of gingivitis increased during treatment phases and with treatment with methotrexate in children with acute lymphoblastic leukaemia.²⁴ This may not be directly related to the anti-neoplastic treatments.¹⁷ During treatment phases some children may be reluctant to brush teeth in view of mucositis and thrombocytopaenia, which carries a bleeding risk. In this case, it is important to instruct patients to maintain good oral hygiene. Soft toothbrushes and sponges may be helpful during treatment phases.

Tooth discolouration

Certain chemotherapeutic agents have been shown to cause intrinsic tooth discolouration, e.g., vincristine, vinblastine.¹⁷

Malocclusion/jaw asymmetry

The developing oral structures are sensitive to radiation. Developing facial bones may be affected by radiation, leading to asymmetry and occlusal disturbances.^{7,11}

TMJ and muscle dysfunction

Radiation therapy can lead to trismus and muscular pain.⁹

Salivary gland dysfunction

Salivary glands may also be in the beam of radiation treatment. Altered function can lead to reduced saliva and complications including dental caries and opportunistic infections.

Oral graft vs host disease

This condition is a complication of bone marrow transplantation. It leads to multi-system symptoms including fever, rash, diarrhoea, intra-oral white patches, erythema, ulceration and trismus.⁹

Dental management of children with cancer

Some side effects of childhood cancer are unavoidable. Many of these side effects can have a profound impact on the child's oral health. Dental caries and gingival disease are preventable. Dentists play a key role in sharing the importance of good oral health and preventive measures to improve these children's quality of life.

The Royal College of Surgeons published a guideline in 2018, which is a useful resource for dentists in the management of oncology patients.¹⁶ Although not strictly based on the treatment of paediatric patients, the guideline provides an excellent summary of optimal dental care of all oncology patients. The authors recommend that readers refer to these guidelines for more information.

Prior to cancer treatment

A comprehensive oral examination is recommended prior to commencing cancer treatment. The pre-treatment assessment involves identification of existing disease, classification of future disease risk, and removal of possible sources of infection. This is usually carried out by a specialist in paediatric dentistry.

This process allows the dentist to discuss future dental implications of cancer treatment and allows the development of a tailored prevention plan. The general dental practitioner (GDP) has a role in education of the family and provision of enhanced preventive care.

During cancer treatment

The GDP also has an important role during the treatment stages of childhood cancer. The dentist should reinforce the importance of good oral hygiene, offer dietary advice, and should be able to give advice about how to manage oral discomfort from mucositis and ulceration. The primary symptom of oral mucositis is pain. Management of oral mucositis is symptom relief via saline mouth rinses, ice chips and topical local anaesthetic agents.¹⁰ Fluoride application is also recommended. Elective dental treatment should be avoided.¹⁶ Nutritional support and monitoring of dietary intake is essential. Support from a dietician or the patient's general medical practitioner is advisable.

Following cancer treatment

The GDP should maintain regular follow-up care for these patients. Each follow-up appointment should include an emphasis on oral hygiene and fluoride use. Limited mouth opening following radiation therapy may make dental treatment challenging.¹⁶ Regular jaw exercises may improve access. Dental extractions should be avoided where possible. Should the GDP need to arrange dental treatment for these children, advice from a specialist in paediatric dentistry may be required.

Orthodontics

When children have a diagnosis of cancer, orthodontic treatment is usually discontinued. Authors have recommended that fixed appliances should be

removed.¹⁶ Xerostomia and oral ulceration may cause oral discomfort and fixed appliances can exacerbate this. Attendance and compliance with dental appointments can be affected. An increased risk of poor gingival health may also compromise oral hygiene around fixed appliances.¹⁶ There is also a risk that developmental root disturbances may increase susceptibility to root resorption. For this reason, it is recommended that orthodontic treatment should be postponed until two years following completion of cancer therapy.²⁵ Following radiation therapy and antiresorptive therapy, dentists should also consider the risk of osteonecrosis if orthodontic extractions are indicated.¹⁶

Following childhood cancer, a decision to commence orthodontic treatment requires careful consideration. As for all orthodontic patients, they should be informed of the risks of orthodontic treatment. Long-term complications of childhood cancer can impact on orthodontic treatment. Pre-treatment radiographs should be taken to assess root morphology. Modification of the orthodontic treatment plan should be considered and treatment duration may vary depending on the child's medical background.²⁶

Discussion

Although childhood cancer is uncommon, it is a significant cause of childhood mortality. Head and neck tumours are also uncommon. However, unusual swellings, bone pain, systemic illness, and tooth mobility or displacement should warrant further investigation.²⁷

The GDP plays an important role in improving the quality of life for children with cancer. The GDP should play an active role in vigilant identification of oral complications of childhood cancer treatment. Caries and gingival disease are preventable; the GDP should be able to reinforce preventive care and advice for these patients. The GDP should be able to recognise and acknowledge the risk of acute and long-term complications of cancer treatment.

Many of the published studies on childhood cancer survivors are retrospective and cross-sectional in design. Some studies are limited by selection bias as there are no control groups and they are from single centres.⁵ Many of the reported dental defects are not validated, and indices are not used to classify severity.⁵ The aetiology of oral complications is also multifactorial, and lack of recognition of confounding factors is a flaw in many studies. It is also difficult to compare the effect of chemotherapeutic agents as many treatments have different dosing regimens and protocols, which makes comparison between studies challenging. Future research within this patient group is required.

Conclusion

Improved survival rates for children with cancer mean that more children are living long into adulthood.⁴ This means that dentists are likely to meet children who are about to start or have completed cancer treatment.¹⁶ All dentists must have an awareness of the oral complications of oncology treatment, and should be ready to recognise risk and provide enhanced preventive care for these patients.

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CPD questions

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CPD

1. What is the most common form of childhood cancer?

- ☐ A: Leukaemia
- ☐ B: Neuroblastoma
- ☐ C: Osteosarcoma

2. Oral mucositis is a commonly reported complication of:

- ☐ A: Radiation therapy
- ☐ B: Chemotherapy
- ☐ C: Both radiation therapy and chemotherapy

3. When do GDPs play a role in treating a child with a background of childhood cancer?

- ☐ A: Before treatment
- ☐ B: After treatment
- ☐ C: At all stages of treatment