

**The Oral Management of Oncology Patients
Requiring
Radiotherapy, Chemotherapy
and / or Bone Marrow
Transplantation**

Clinical Guidelines

Updated 2012

**The Royal College of Surgeons of England /
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INTRODUCTION

In the United Kingdom, there are over 300,000 newly diagnosed cases of cancer each year, with the overall age-standardised incidence rate higher among males, at 421 cases per 100,000 compared with 365 per 100,000 for females.¹ Although cancer is predominantly a disease of the elderly, there are over 1,200 cases of childhood cancer diagnosed every year.¹

The oral cavity is a site where complications frequently develop either as a direct result of the malignancy or as an unwanted effect of the treatment.²⁻⁶ Up to 90% of paediatric oncology patients may suffer oral complications with implications both for longevity and quality of life during and after therapy.⁷

Adults with malignant disease, particularly of the head and neck, are more likely to be from deprived socio economic backgrounds, to smoke and to consume greater than average amounts of alcohol.⁸ They are unlikely to avail themselves of health services except in an emergency.⁹ In common with the general population they will increasingly keep their natural teeth to a greater age but they are likely to have more untreated dental disease.^{10,11}

Child cancer patients largely reflect the child population in general since they represent a cross section of the population. They may have untreated dental caries¹² and, since many are under five years of age, a significant proportion may not have previously had a dental examination. The outlook, following treatment for malignant disease, has significantly improved in the last three decades. In the future, dentists are increasingly likely to find that they have children and adults in their care who may present before or after cancer treatment requiring urgent dental care. Appropriate preventive regimens and timely oral care can minimise complications and improve quality of life.^{13,14}

The Calman report on cancer care emphasised the need to focus treatment and management regimens on both longevity and quality of life and much progress has been made since.¹⁵ The patient's oral care and function is an important contributor to post-treatment social adaptation and life quality.¹⁶

AIM OF THE GUIDELINE

To improve the quality of life for patients with malignant disease, who are receiving cancer therapy that has implications for oral comfort and function, by promoting consistent high standards of oral care through a co-ordinated team approach.

TARGET GROUP

Cancer therapy that will normally result in oral complications includes:

- Chemotherapy
- Radiotherapy to the head and neck
- Bone marrow transplantation – involves chemotherapy alone or with total body irradiation

HOW TO USE THESE GUIDELINES

These guidelines provide an overview of the oral management of both children and adults receiving radiotherapy, chemotherapy, combinations of both or in combination with surgery.

The recommendations must be seen as a contribution to total patient care and as such should always be implemented in conjunction with the care priorities agreed with the oncology team.

An **Overview** of the recommendations with regards to oral management is summarised at the beginning of the document, with the following **Explanatory Notes** section providing the reader with further information where available.

A list of **References** accessed to support the recommendations is provided. The search strategy used is as per NICE: www.biomedcentral.com/1472-6963/6/47/table/T3. The NICE grading system has been listed within the body of the text where the document has been updated.

There are also **Tables**, **Appendices** and a template for a **Patient Information Leaflet** at the end of the document.

ORAL MANAGEMENT - OVERVIEW

1. Pathways of Care

A clear pathway of care is necessary to prevent or minimise oral complications.

1.1. Pre-treatment Assessment

- 1.1.1 Every relevant oncology protocol should include an early pre-treatment oral assessment.
- 1.1.2 A permanent member of the oncology team is responsible for arranging the oral assessment.
- 1.1.3 A designated permanent member of dental staff is responsible for organising oral care.



1.2. Acute Phase of Cancer Therapy

- 1.2.1. The Oncology Team must include a dental hygienist responsible for the patients' oral care.
- 1.2.2. The dental hygienist is responsible to the designated member of dental staff.
- 1.2.3. The designated member of dental staff is responsible for arranging or carrying out any active dental treatment required.
- 1.2.4. There are specific written nursing guidelines for routine oral care (Appendix 1).



1.3. Discharge Following Acute Phase of Cancer Therapy

- 1.3.1. The oncology discharge protocol includes a procedure for ensuring continuing oral care.
- 1.3.2. The designated member of dental staff is responsible for organising and monitoring appropriate continuing oral care.
- 1.3.3. Following the receipt of a bone marrow transplant and discharge home, children are reviewed to continually monitor the oral condition.
- 1.3.4. There is an agreed patient-specific minimum period of oral health monitoring post-treatment.
- 1.3.5. Children are monitored during their period of growth and development.

2. Preventive and Clinical Regimen

PRIOR TO CANCER THERAPY

2.1. Prior to Cancer Therapy - at initial diagnosis

- 2.1.1. Oral care information is provided as an integral component of the general care philosophy.⁵ Oral care should be seen as a contribution to total patient care and implemented in conjunction with the care priorities agreed with the oncology team.³
- 2.1.2. Realistic simple preventive advice is given emphasising its value in maintaining oral comfort during therapy.

2.2. Prior to Cancer Therapy - oral/dental care

- 2.2.1. A comprehensive oral assessment is undertaken.^{4,17} This will help:
- i. Identify existing oral disease and potential risk of oral disease.
 - ii. Remove infectious dental/oral foci before the start of cancer therapy.
 - iii. Prepare the patient for expected side effects of cancer therapy.
 - iv. Establish an adequate standard of oral hygiene to meet the increased challenge.
 - v. Develop a plan for maintaining oral hygiene, providing preventive care, completing oral rehabilitation, and follow-up.
 - vi. Establish the necessary multidisciplinary collaboration within the cancer centre to reduce/alleviate oral symptoms and sequelae before, during and after cancer therapy.

Each centre should have a multidisciplinary team to accomplish these goals; the exact methods used may vary between cancer centres.¹⁸

- 2.2.2. Detailed oral hygiene instruction with reinforcement and elaboration of diet advice is provided in cooperation with the dietician.⁴
- 2.2.3. Oral hygiene practices are supplemented with the use of an alcohol free chlorhexidine mouthwash or dental gel, if there is gingival disease diagnosed.¹⁹
- 2.2.4. Impressions of the mouth are taken for study casts to construct applicator trays and where appropriate for obturator planning.
- 2.2.5. Carious teeth that can be restored are stabilised with appropriate restorations.
- 2.2.6. All sharp teeth and restorations are suitably adjusted and polished.
- 2.2.7. The patient is counselled about denture wear during therapy. If a removable prosthesis is worn, it is important to ensure that it is clean and well adapted to the tissue. The patient should be instructed not to wear the prosthesis during cancer therapy treatment, if possible; or at least, not to wear it at night.²⁰
- 2.2.8. Wherever possible, teeth with a dubious prognosis are removed no less than ten days prior to cancer therapy.²¹
- 2.2.9. Orthodontic treatment is discontinued.²²

DURING CANCER THERAPY

2.3. During Cancer Therapy

- 2.3.1. The patient receives appropriate support from a dental hygienist.
- 2.3.2. A high standard of oral hygiene is encouraged, including denture hygiene.
- 2.3.3. The use of an alcohol free chlorhexidine mouthwash is recommended if toothbrushing is likely to be inadequate for plaque removal; it can be used in addition or as a short-term alternative to tooth brushing
- 2.3.4. Those patients receiving radiotherapy, or total body irradiation prior to bone marrow transplantation are at high risk of dental caries and should receive dietary advice and fluoride supplements appropriate to their age.^{23 - 26}
- 2.3.5. Children and adults receiving bone marrow transplants often receive aciclovir as a prophylaxis if there is a high risk of viral infections. This is usually prescribed by the oncology team.^{27,28,29}
- 2.3.6. Antifungal medication is used following detection of oral candida. For children this may be used routinely as a prophylaxis in some cancer centres.
- 2.3.7. Every effort is made to reduce the severity of the mucositis.
- 2.3.8. Every effort is made to reduce the effect of the xerostomia for quality of life and prevention of oral disease.
- 2.3.9. Patients are advised that removable prostheses may become difficult to wear and may be left out. If there is any discomfort they should be examined by a member of the dental team and adjusted to ensure they are atraumatic.
- 2.3.10. If the mouth is too painful for cleaning with a soft toothbrush, the tissues can be cleaned with oral sponges if available or gauze moistened with alcohol-free chlorhexidine mouthwash.
- 2.3.11. Certain food, drinks and mouthwashes, which irritate the oral mucosa, should be avoided to maintain oral comfort.
- 2.3.12. Dental treatment is avoided wherever possible during therapy.

FOLLOWING CANCER THERAPY

2.4. Following Cancer Therapy – Prevention and Monitoring

- 2.4.1. Growth and development should be closely monitored. For children there should be a dental review at least every six months. For patients with xerostomia, trismus, severe graft-versus-host disease or severe

mucositis a three month review is recommended.

- 2.4.2. Regular and appropriate oral healthcare monitoring is provided by the designated member of dental staff. This should include regular radiographs, oral health advice and preventive regime reinforcement.
- 2.4.3. Strategies for dealing with xerostomia continue.
- 2.4.4. Fluoride supplements appropriate to age should be used.
- 2.4.5. Chlorhexidine gel can be applied with applicators every three months.
- 2.4.6. In the event of trismus, jaw exercises are implemented.
- 2.4.7. Orthodontic considerations – orthodontic treatment can start once the patient has been free of cancer for one year. Any developmental disturbances that may have occurred due to their medical treatment must be assessed to decide on their suitability for orthodontics. Where extensive root damage/lack of root development has occurred, serious consideration must be given to not providing orthodontic treatment. Bisphosphonate treatment is not necessarily a contraindication to orthodontic treatment.

2.5. Following Cancer Therapy – General Considerations

- 2.5.1. In the event of uncontrolled periodontal disease, vigorous treatment is initiated. This may involve identification of atypical pathogens.
- 2.5.2. Herpes labialis can be a chronic problem. Topical aciclovir is effective.
- 2.5.3. Restorations are kept simple ensuring acceptable aesthetics and function.
- 2.5.4. Dental extractions, if essential, must be performed with appropriate precautions.
- 2.5.5. Dentures should be avoided wherever possible.
- 2.5.6. Implant stabilisation of prostheses and obturators may be feasible in some patients.

2.6. Following Cancer Therapy – Requirements for Denture Wearers

- 2.6.1. Removable prostheses are left out at night.
- 2.6.2. Glandosane saliva substitute should be used for edentate patients only.
- 2.6.3. Antifungals are used if a candidal infection is diagnosed.
- 2.6.4. Appliance wear is discontinued if the mouth becomes painful. Advice must be sought.
- 2.6.5. Obturators are reviewed regularly. They may require frequent attention with adjustment or remake.

2.7. The Management of Osteoradionecrosis

- 2.7.1. Establish the diagnosis of osteoradionecrosis (ORN) and stage, ensuring that the bony changes are not due to malignancy. Following a

diagnosis of ORN it is recommended that:

- 2.7.2.** Oral trauma is minimised, and a high standard of oral hygiene is established.
- 2.7.3.** Local measures are employed to relieve symptoms including topical/systemic analgesia.
- 2.7.4.** New therapeutic use of Antioxidant medications may be beneficial in ORN lesions identified early.
- 2.7.5.** High dose systemic antibiotics are prescribed.
- 2.7.6.** Localised surgical excision of exposed necrosed bone with primary mucosal closure may become necessary.
- 2.7.7.** Evidence suggests that ultrasound may be useful as an adjunct to healing.
- 2.7.8.** In severe cases the use of hyperbaric oxygen therapy (HBOT) may be necessary.
- 2.7.9.** In advanced chronic cases the extent of involvement of bone necrosis must be established followed by radical ablative surgery to remove necrotic bone and soft tissue, and reconstruction with either a pedical or microvascular free flap.

ORAL MANAGEMENT - EXPLANATORY NOTES

These explanatory notes refer to the paragraph numbers indicated in the Pathways of Care and the Preventive and Clinical Regimen (see above)

1. Pathways of Care

1.1 Pre-treatment Assessment

There is no universally accepted pre-cancer therapy dental protocol because of the lack of clinical trials evaluating the efficacy of a specific protocol. A systematic review of the literature revealed only two articles on oral care protocols prior to cancer therapy.³⁰

The time period between diagnosis of cancer and commencement of treatment is usually short. Ideally, a comprehensive oral evaluation should take place 1 month before cancer treatment starts to allow adequate time for recovery from any required invasive dental procedures. The pre-treatment evaluation includes a thorough examination of hard and soft tissues, as well as appropriate radiographs to detect possible sources of infection and pathology.²⁷

Time must be made available during the pre-treatment phase for a dental assessment and necessary emergency care, especially when radiotherapy is planned. The Oral Assessment Guide has been consistently judged to be user-friendly and appropriate for everyday clinical practice with adults and children, as well as a useful research tool.³¹

Often, there is insufficient time before cancer treatment commencement for complex dental treatments. The likelihood that a tooth will require extraction within the next few years has to be assessed. It should also be remembered that not all patients are well motivated, and in such cases, keeping teeth may lead to complications later. Oral problems that already exist, such as periodontitis, caries, failing restorative work (such as leaking crowns or fillings), and ill-fitting dentures may increase the risk of infection.

Elimination of dental disease by judicious restorative dentistry, periodontal treatments and extraction of teeth with questionable prognosis are important preventive strategies to avoid future dental extractions, an important risk factor for ORN. Teeth in direct association with the tumour, in the direct path of the radiation beam or teeth with doubtful prognosis (deep caries, deep periodontal pockets, non-vital teeth) should be extracted as soon as possible before radiotherapy, ideally to allow three weeks for maximal healing time before radiotherapy.³² Any sharp edges of teeth or restorations should be removed to reduce the risk of trauma to the mucosa and severity of mucositis and attendant discomfort. A thorough debridement of plaque and

calculus should decrease gingival inflammation and has the potential to decrease the severity of oral mucositis.³³

Patient education is an integral part of the pre-treatment evaluation and should include a discussion of potential oral complications. It is very important that the dental team impress on the patient that optimal oral hygiene during treatment, adequate nutrition, and avoiding tobacco and alcohol can prevent or minimise oral complications and reduce recurrence / further cancers. To ensure that the patient fully understands what is required, provide detailed instructions on specific oral care practices, such as how and when to brush and floss, how to recognise signs of complications, and other instructions appropriate for the individual. Patients should understand that good oral care during cancer treatment contributes to its success.¹⁹

For children the following recommendations have been made:³⁴

- **Recommendations for oral care at the time of diagnosis:**
 - All children diagnosed with cancer should have access to or be registered with an NHS general dental practitioner or Community Dental Service. Registration should be maintained during and following cancer treatment
 - The routine dental care provider in community or general dental practice should be notified of the cancer diagnosis and arrangements for care during cancer treatment as directed by the hospital dental team.
 - For paediatric dental units working with a cancer centre, there should be a mechanism of notification for new patients.
 - All children should undergo a dental assessment at the time of diagnosis, if possible before cancer treatment commences.
 - If invasive dental treatment is required, this should be undertaken either by a consultant or a specialist in paediatric dentistry as appropriate.
 - If there is no paediatric dental unit liaising with the cancer centre, there should be clear communication between the cancer centre and routine care provider.
 - Appropriate training in oral assessment should be available for the oncology nurses within the cancer centre, ideally in collaboration with a member of the dental team.
- **Recommendations for oral hygiene at diagnosis & during cancer treatment:**
 - Oral hygiene advice should be given to children and parents prior to commencing cancer treatment and this should be provided both verbally and in writing.
 - Oral hygiene advice should be given by a designated member of the dental team or, in the absence of a dentally trained individual, a member of the medical or nursing team who has received appropriate training.
 - Advice should be to brush at least twice a day, with a fluoride toothpaste appropriate for the age of the child.
 - The toothbrush should be for the sole use of the child and changed on a three monthly basis, or when bristles splay, if earlier. A child's toothbrush should be changed following an oral infective episode.
 - If the child has a sore mouth a soft brush with a small head should be used.

- Children need to be helped or supervised by an adult until at least 7 years of age, parents/carers should be instructed on how to brush their child's teeth.
 - For babies without teeth, parents/carers should be instructed on how to clean the mouth with oral sponges if available. The sponge should be moistened with water. Some units have discontinued the use of oral sponges due to the risk of inhalation if the sponge becomes detached. In this situation, a soft brush or gauze may be used.
 - For children where it is not possible to brush teeth, parents/carers should be instructed on how to clean the mouth with oral sponges/gauze, as a temporary measure. The sponge/gauze should be moistened with water or an antimicrobial agent such as diluted alcohol-free chlorhexidine.
 - Additional aids, such as flossing and fluoride supplements should only be prescribed according to risk assessment by a member of the dental team. The need to restrict sugary food and drink to meal times only should be emphasised.
- **For adults, the following factors should additionally be considered:**
- Adults will require input from a specialist in restorative dentistry particularly when post-treatment reconstruction may be necessary. A dental hygienist should work with the patients to achieve high standards of oral hygiene to reduce problems after treatment. Those who are to undergo surgery to the jawbone should be assessed by the restorative dentist who works with the surgeon in the multidisciplinary team.³⁵
 - Guidelines for dental extractions, endodontic management, and related interventions (Table 1) can be used as appropriate.^{36,37} Antibiotic prophylaxis prior to invasive oral procedures may be warranted in the context of central venous catheters; the current American Heart Association (AHA) protocol for infective endocarditis and oral procedures is frequently used for these patients.³⁸
 - It has been reported that 78% of patients experience severe difficulties in mastication following major head and neck surgery with implications for normal social adaptation.³⁷
 - The difficulties can be improved by carefully planned oral and dental reconstruction.³⁸
 - Depending on the specialty availability and the urgency, treatment may be provided either within the hospital service, the Community Dental Service or the general dental service.
 - Where there is any doubt about rapid efficient treatment, or the patient's general health status dictates, dental care should be undertaken within the specialist centre.

The member of dental staff responsible for organising oral care will need to ensure that dental treatment is provided rapidly, taking into consideration the patient's existing continuing care arrangements. Oral surgery should be performed at least seven to ten days before the patient receives myelosuppressive chemotherapy. Medical consultation is indicated before invasive procedures.¹⁹

1.2 Acute Phase of Cancer Therapy

- 1.2.1 Oral care must be seen as an integral part of patient care. A dental hygienist should be responsible for the patient's oral care during therapy.⁴⁰ However, dental hygienists may be difficult to recruit. In such circumstances an appropriately trained member of nursing staff can undertake this role.⁴¹
- 1.2.4 It is particularly important for specific nursing guidelines to be available for oral care in the period leading up to and following bone marrow transplantation (Appendix 1).

1.3 Discharge Following Acute Phase of Cancer Therapy

- 1.3.4 In the absence of recurrent disease oral health monitoring should at least be equivalent to the period of monitoring by the Oncology team. Oral examination should be at least biannual. Patients with unstable oral health will require more frequent monitoring. In circumstances of stable oral health, monitoring should be agreed with the primary care dentist with an appropriate procedure for urgent re-referral.
- 1.3.5 Children who have received bone marrow transplants should have a strict follow-up for preventive oral care at four month intervals.

2 Preventive and Clinical Regimen

PRIOR TO CANCER THERAPY

2.1 Prior to Cancer Therapy - at initial diagnosis

When presented with a diagnosis of cancer a patient will be unlikely to consider the oral implications as a high priority. However, it is important that patients and carers are counselled about oral care procedures, diet and the oral implications of the proposed treatment.⁴¹

It is recommended that diet advice is given in liaison with the dietician and presented with the emphasis upon ensuring oral comfort during therapy. Information at this stage must be supported by an appropriately designed information leaflet.

2.2 Prior to Cancer Therapy - oral/dental care

2.2.1 The oral assessment must include a radiographic survey for both dentate and edentate patients. There should be a careful assessment of any prosthesis worn.

2.2.2 Preventive care introduced at the initial diagnosis should be expanded both for the patient and where appropriate the parent or carer. The advice needs to be set within the overall framework of care set by the oncologist and their support staff. Since many children and some adults need a frequent high calorific intake during therapy, this usually translates into an increased and frequent intake of refined carbohydrate (sugar) which, if sustained, can lead to dental caries.

2.2.3 The use of an aqueous alcohol free chlorhexidine mouthwash or dental gel will contribute to the treatment of gingival disease in combination with improved oral hygiene practices. There is some evidence to suggest that it also reduces the incidence of oral complications.¹⁹ Use either a mouthwash or dental gel twice daily for at least one week prior to commencing treatment. The following are appropriate:

- i. 10ml of 0.2% aqueous alcohol free chlorhexidine gluconate mouthwash or dental gel (Corsodyl: SmithKline Beecham)
- ii. 18ml of 0.12% aqueous chlorhexidine gluconate solution (Peridex: Proctor and Gamble).

In children chlorhexidine is rarely used unless toothbrushing cannot be performed. There is often poor compliance because of the taste.

2.2.4 When maxillary surgery is to be combined with radiotherapy, study casts should be used for obturator planning in liaison with the surgical team. If multiple casts are required applicator trays can always be made on duplicate casts to avoid repeated impressions. The applicator trays are used for fluoride or chlorhexidine gel delivery later in the management process.

- 2.2.5** Where time permits it is preferable to restore teeth with a permanent restorative material. When time is limited glass ionomer cements make an effective provisional restoration.
- 2.2.6** Sharp teeth or restorations can be particularly uncomfortable during the period of mucositis. They can contribute to soft tissue damage and ulceration. They should be appropriately adjusted.
- 2.2.7** Dentures or obturators are uncomfortable during the period of mucositis. The patient may wish not to wear dentures during this time. Those who discontinue the use of their dentures often experience problems with denture stability when they return to them, probably as a result of adaptation loss. They should be counselled in advance so that they can make an informed choice and relatives can be prepared for any change in appearance. Obturators must be worn since wound contraction can occur within hours of removal. They must be examined by a member of the dental team if painful.
- 2.2.8** Patients are particularly at risk of ORN when tooth extractions are undertaken both immediately before and after radiotherapy.
- i. The implications of any dental extractions subsequent to radiotherapy must be sensitively explained to the patient.
 - ii. Extractions should preferably be undertaken up to three weeks prior to commencement of treatment. Ten days should be considered a minimum period.²¹
 - iii. Patients about to undergo bone marrow transplantation should have any appropriate teeth removed at the time of the bone marrow harvest.
 - iv. Children should have all primary teeth within three months of exfoliation and those with any risk of pulpal involvement removed.⁴
 - v. Permanent teeth with a doubtful prognosis should be removed. It should be borne in mind that permanent teeth with non-symptomatic periapical lesions are rarely exacerbated by cancer therapy.⁴² Judgement needs to be made on overall prognosis.
 - vi. All teeth in direct association with an intra-oral tumour should be removed.
 - vii. Teeth should be removed with a minimum of trauma and if possible primary closure achieved.
- 2.2.9** Children undergoing orthodontic therapy should have their orthodontic appliance removed and treatment discontinued until one year after completion of cancer therapy.²²

DURING CANCER THERAPY

2.3 During Cancer Therapy

2.3.1 The period of mucositis is extremely unpleasant. The patient should be constantly reassured during this acute phase about the limited period of this side effect of treatment.

2.3.2 Normal daily toothbrushing by the patient, carer or parent, with a powered or manual medium brush should be undertaken, with supplemental use of floss or interdental brushes.^{43(IIIC).44(IA).45(IA)} If brushing becomes very painful a very soft brush (e.g. TePe Special Care Toothbrush) can be substituted but normal toothbrushing should be resumed at the earliest opportunity.^{46(IIIB)}

Dentures should be rinsed after meals and cleaned at least once daily by brushing with a toothbrush and soaked in chlorhexidine mouthwash overnight. An alternative is dilute sodium hypochlorite solution (Milton's diluted 1 in 80) provided there are no metal components.^{47(IIIB)} Dentures should not be worn at night.

2.3.3 Chlorhexidine is an effective antibacterial and is available in concentrations 0.12-0.2% mouthwash. It is important to use the alcohol free preparations. 10ml should be rinsed round the mouth for 1 minute then spat out, twice daily. Thirty minutes should be allowed between use of chlorhexidine and toothbrushing. The 0.2% concentration may be diluted 1:1 with water if it causes mucosal discomfort.^{48.49(IIIC)}

2.3.4 The importance of preventing dental caries cannot be overemphasised.

The need to maintain nutrition and body weight and difficulty with chewing often necessitates highly calorific and cariogenic food supplements (e.g. Fortisips, Nutricia). The dental team should work with the dieticians to keep the length of time these are used to a minimum, use sugar free medicines wherever possible and rinse the mouth after intake.^{50(IIIC)}

Adults should use an alcohol free fluoride mouth rinse at least once daily (0.05% NaF) at a different time from brushing. In addition they should be prescribed 5,000ppm fluoride toothpaste for use twice daily and fluoride varnish (2.2% fluoride) should be applied twice a year.^{45(IA)} Children and young adults should have fluoride toothpaste, prescription of systemic supplements (drops or tablets, according to local water fluoride concentration), application of fluoride varnish and fissure sealants and fluoride mouthwashes appropriate to age.^{48.45(IA)}

An alternative for adults is 1% sodium fluoride gel or 0.4% stannous fluoride

gel application in custom made trays for ten minutes daily.^{51(III C)} This may be difficult for patients with trismus or after surgery and is not suitable for children.

The mode of delivery of fluoride is less important than compliance to supplements.^{50(III C)}

2.3.5 Children and adults receiving bone marrow transplants often receive aciclovir as a prophylaxis if there is a high risk of viral infections. This is usually prescribed by the oncology team.^{27(111 C), 28(111 C), 29(111 C)}

2.3.6 There is increased risk of oral fungal infection in patients receiving chemotherapy and/or radiotherapy.^{52(III C).53(IA)} Antifungal medication should be used following detection of oral candida.^{53(IA).54(IA).55(III C).56(IA)} In some oncology centres, antifungal prophylaxis may be used routinely for children.^{57(III C)}

Topical agents may be preferred to systemic agents due to lower risk of side effects.^{50(III C).53(IA)} However there are inconsistent results of efficacy of topical agents and some oncology centres advise that systemic antifungal agents are preferable and each patient's risk should be identified before they are prescribed.^{53(IA)}

The following are recommended:

- i. Nystatin sugar free oral suspension 100,000 units per ml four times daily for at least 7 days and 48 hours after resolution.^{56(IA).53(IA).50(III C).58} Pastilles are difficult to dissolve in a dry mouth.^{53(IA)} Compliance may be poor due to unpleasant taste.^{48.53(II B)}
- ii. Miconazole oral gel 24mg/ml 10ml applied four times daily continued for 48 hours after resolution is an alternative.^{48.58}
- iii. Systemic agents have more consistent efficacy and fluconazole is recommended for moderate or severe oropharyngeal candidiasis or unresponsive infection.^{56(IA).58} The regime is 50mg capsules or suspension daily for seven to fourteen days.

Miconazole and fluconazole are contraindicated in patients taking warfarin or statins.^{58.59(III C)}

For children appropriate recommended doses should be used as per the British National Formulary.^{60(III C)}

Denture hygiene is very important if there is fungal infection; dentures should be cleaned with a toothbrush and soaked in chlorhexidine mouthwash or dilute sodium hypochlorite.⁴⁸ Miconazole oral gel should be applied to the fit surface prior to re-insertion, provided it is not contraindicated.^{48.50(III C)}

2.3.7 Several interventions for mucositis have been found to have some benefit for mucositis, although there is limited evidence for their efficacy in children. The strength of evidence is variable and may be specific to cancer type and

treatment.^{61(A)}

The use of mucosal shields and intensity modulated radiotherapy is to be encouraged since there is decreased severity of mucositis.^{62(III C)}

Intensive oral hygiene reduces mucositis.^{62(III C).63(II B).64(I A)}

Poorly fitting dentures or sharp teeth may exacerbate symptoms and should be corrected.^{62(III C)}

Diffiam (benzylamine hydrochloride mouthwash 15%) reduces the frequency and severity of mucositis and is recommended.^{65(I A)} A regime of 15ml four to eight times daily starting before radiotherapy and continuing during and for two to three weeks afterwards is recommended.^{66(II B).64(I A)}

Chlorhexidine has not been shown effective in preventing mucositis and is not recommended for prevention or treatment.^{63(II B).65(I A)}

Topical application of antimicrobial pastes or lozenges shows some evidence of reduced severity of ulceration ^{61(I A).63(II B)} however they are not recommended.^{65(I A)}

The following are not recommended as there is lack of consistent evidence for efficacy: prostaglandins, corticosteroids, sucralfate, allopurinol, aciclovir.^{63(II B).64(I A).65(I A)}

Chemotherapy specific recommendations:

Oral cooling for 30 minutes prior to chemotherapy is recommended where mucositis inducing chemotherapeutic agents are used (e.g. 5-FU).^{61(I A).63(II B).65(I A)}

Patients receiving high dose chemotherapy or total body irradiation for stem cell transplantation are recommended intravenous keratinocyte growth factor-1 (palifermin) since there are promising effects on preventing mucositis.^{63(III C).65(III C)} There is no benefit with palifermin taken as a mouthwash.^{63(III C)}

Amifostine given by intravenous or subcutaneous route has been shown to reduce mucositis in a small number of chemotherapy and radiotherapy patients.^{61(III C).63(III C)} However there is concern that this cell-protection mechanism may reduce the efficacy of therapy to cancer cells.^{67(III C)} Although there is no evidence that amifostine affects survival, data is only available to 24 months.^{68(II B).61(II B)}

Other palliative management recommended is 2% lidocaine mouthwash used prior to eating^{62(III C)} and systemic pain relief with morphine may be used in

severe cases.

2.3.8 Prevention of xerostomia:

- Parotid function can be partially maintained by radiotherapy delivery that spares the contralateral gland.^{69(III C)} Minimising the dose of radiotherapy to the parotid glands, either by IMRT or 3-dimensional conformal radiotherapy, is encouraged as has been shown to improve xerostomia-related quality of life.^{64(IA).70(III C).71(III C).72(IA)}
- Amifostine given with radiotherapy has been shown to protect the salivary glands, with patients experiencing benefits, largely in acute and later stages.^{73(II B).72(II B)} However the improvements were sometimes minor and there is lack of long term data, therefore its use is only recommended with caution.^{74(III C).76(IA).64(IA)}

Salivary stimulation:

- Pilocarpine is recommended after radiotherapy where some salivary function remains, provided there is no medical contraindication.^{75(II B).64(IA).70(III C).72(II B)} However a Cochrane review found that only half of patients respond.^{77(II C)} The dose is 5-10mg orally three times a day.^{78(III C).79(II B).80(III C).64(IA)} Side effects can be problematic so dose should be kept to a minimum.^{77(IA)} It may take more than two months to reach maximum effect.^{81(III C)} There is insufficient evidence to recommend pilocarpine during radiotherapy.^{72(II B)}
- Stimulation by chewing gum may be recommended where there is some salivary function although there is a limited evidence base.^{72(II B)}
- Acidic pastilles are not recommended other than for edentulous patients as these may cause tooth erosion and sensitivity (e.g. Salivix (Provalia); SST (Medac)).
- Acupuncture has minimal side effects and potential to increase salivary flow after radiotherapy where there is some residual function and is recommended.^{72(II B)}

Saliva substitution:

For many patients saliva replacement is the only option. Many use frequent sips of water, or a spray bottle of water.

Saliva is difficult to replicate and there are several substitutes with little indication of which is most effective.^{82(III C)} It is recommended patients sample alternative therapies to assess which suits them best. Improvement is only short term. Products may contain fluoride, or electrolytes to reduce

demineralisation or antibacterial components.^{81(IIIC).72(IIIB)} The following are suggested:

- Saliva orthana (ASPharma)
- Biotene Oral Balance saliva replacement gel and Biotene toothpaste (Anglian Pharma).^{84(IIIC).83(IIIB)}
- BioXtra (Molar)^{85(IIIB)}

2.3.9 If dentures are left out during the period of mucositis they should be cleaned and kept moist.^{86(IIIC)} If candidal infection has been diagnosed this should be treated (see 2.3.6).

Obturator should not be discontinued. If painful a clinical examination and adjustment is indicated.

2.3.10 Foam swabs are not as effective as a toothbrush but there may be times, for example post-surgery or in advanced disease, when either foam swabs if available (Polygon oral swabs, Rochaille Medical Limited, Cambridge, U.K) or gauze, are necessary. Use soaked in chlorhexidine three to four times daily.^{87(IIIC).88(IIIC).89(IIIB)} Care should be taken with oral care if patients are at risk of aspirating following surgery/radiotherapy. Patients should be sitting up and minimal amount of fluid used and aspiration should be available. Nursing staff should be trained in oral care and family and carers may be involved.^{90(IIIB)}

2.3.11 Avoidance of certain food, drinks and mouthwashes can help to prevent discomfort.

The following should be avoided:

- i. Hard food, spicy food, strongly flavoured toothpaste: these traumatise the tissues
- ii. Alcohol (especially spirits), tobacco: these exacerbate xerostomia
- iii. Fizzy drinks, acidic fruit and fruit drinks: these contribute to erosion and sensitivity, especially in the dry mouth where there is reduced saliva buffering.

2.3.12 Dental treatment should be avoided during the period of cancer therapy because the mouth may be very sore and there is risk of systemic infection during the period of mucositis. If the patient is having chemotherapy the suppressive effect on the bone marrow may cause low platelets, low white cells and anaemia. Therefore special care needs to be taken and timing of interventional dental treatment should be agreed with the haematologists or the oncology team. Pulp treatment of primary teeth during the course of chemotherapy is contra-indicated.^{88(IIIC)} Extractions are always contraindicated after radiotherapy to the head and neck area, careful patient pre-treatment assessment and planning should avoid the need.

FOLLOWING CANCER THERAPY

2.4 Following Cancer Therapy – Prevention and Monitoring

The risk of uncontrolled dental disease following cancer treatment can continue for at least twelve months following chemotherapy, radiotherapy or total body irradiation prior to bone marrow transplantation.

Susceptibility to dental disease can be lifelong.

2.4.1 In children general growth and development including facial growth and dental development should be closely monitored.^{106(1B)} Studies of combined radio and chemotherapy show that oral complications are three times more common in children than adults.^{91(11B)} Damage to developing teeth is a frequent complication following radiotherapy^{92(11B)} or total body irradiation.^{93(1B)} Chemotherapy appears to have little permanent effect on oral health, but there is some evidence to suggest that chemotherapy alone may result in an increased incidence of dental developmental disturbances^{94(1B)} Sequelae risk is dependent on treatment received, age of patient at diagnosis and time since completion of treatment.^{95(1A)}

It is the dental care professional's responsibility to emphasise good oral care. Explanation must be carried out to ensure understanding of the long term dental and cranio-facial adverse effects that can follow treatment for malignant disease.^{96(1A)}

Patients who have suffered from severe mucositis or severe graft-versus-host disease will require close monitoring due to increased risk of malignant transformation of the mucosa.^{97(11B)}

2.4.2 Following treatment, and as taste returns, there is an unpleasant period of altered taste. Many patients will seek comfort in sweet food and drink. Diet counselling needs to be rigorously reinforced at regular intervals particularly with regard to sugar and acid consumption. Due to weight loss, introduction of dietary supplements may occur by a dietician – the high cariogenic potential of such supplements must be conveyed to the parent/patient.^{96(1A)} Plaque and gingival scores need to be carefully monitored by the dental hygienist or dental professional looking after the patient.

Teeth must be brushed two to three times daily with a fluoridated toothpaste (at least 1000ppm for children under three years of age, 1350-1500ppm for children over three years of age and up to 5000ppm for adults) and a non-cariogenic diet encouraged.⁴⁵

Bone marrow transplant patients on cyclosporin may need more frequent

hygienist support to help maintain health in the presence of gingival hyperplasia.^{98(IIB)}

Regular oral healthcare monitoring should be undertaken by a designated member of dental staff in close liaison with the dental hygienist.

Where continuing care is provided within the Community Dental Service or General Dental Service there should be liaison with the dentist responsible for that care.

- 2.4.4** The role of fluoride in the continuing prevention of dental caries is essential to the maintenance of oral health. Sometimes a fluoride mouthwash is advised to increase the amount of available fluoride – this depends on co-operation and is not recommended for very young children.^{99(IA)}
- 2.4.5** Chlorhexidine gel can be applied every three months using an applicator. The gel should be placed in the applicator and seated in the mouth for five minutes each night over a two week period to try and help the reduction of intraoral bacteria.^{100(IIB)}
- 2.4.6** Despite better focused radiation dose and improved screening, progressive jaw stiffness and limitation of opening remains a common complication.^{101(IIB)} In the event of limitation, a strict regimen of mouth exercises are advisable to minimise the problem. A simple wedge made by stacking and taping together tongue spatulas can be used by the patient both as a guide to improved opening and as a target at least 3-4 times daily.^{102(IIB)} Trigger point injections, analgesics and muscle relaxants can also be used.^{103(IIB)} Patients who received treatment for a tumour of the masticatory muscles or temporomandibular joint should use exercises routinely post-treatment. Increasing levels of trismus should be investigated for potential local recurrence.^{104(IIB)}
- 2.4.7** There should be a year delay post- cancer treatment before orthodontic treatment is commenced.²² This is a recommended time following which the risk of relapse is decreased (and the patient is no longer taking immunosuppressants). Consideration must be given to the forces to be used and length of time that the patient will be in active orthodontic treatment. This is due to possible damage/effects that may have occurred previously to the roots of the teeth. When roots have either been damaged or not developed properly, orthodontic work can have detrimental effects on the root structure so the pros and cons of such treatment must be explained carefully to the patient. Bisphosphonate treatment has been shown to inhibit tooth movement in animal studies but this has not been shown in humans for a particular dose or length of therapy.^{106(IIB)} Embarking on orthodontic therapy must be discussed with the patient's medical team in advance.

2.5 Following Cancer Therapy – General Considerations

Patients on maintenance chemotherapy should have a full blood count performed within the 24-48 hour period prior to any proposed dental treatment that might result in bleeding/bacteraemia. The results of such blood tests should be discussed with the patient's medical team and appropriate precautions taken.

2.5.1 Patients who have received radiation therapy to the head and neck region are at increased risk of progressive, uncontrolled periodontal tissue breakdown and/or ORN.^{107,108(III)} This is likely due to reduced repair capacity of the periodontium following direct irradiation with progressive widening of the periodontal ligament, destruction of the lamina dura and progressive loss of attachment having been reported.^{109(II)} Furthermore, the risk of periodontal infection is increased because of radiation induced hyposalivation, the concomitant increased plaque accumulation, and the shift in oral microflora.^{108(II)} There would not, however, appear to be any significant long-term changes to periodontal pathogens following head/neck radiation therapy (where treatment of the periodontium had included irrigation with chlorhexidine).^{111(II)}

Poor oral health status post-radiotherapy has been found to increase the risk of ORN.^{112(II)} As such any evidence of periodontal disease should be treated rigorously but nonetheless causing minimal damage to the adjacent structures; trauma to the soft tissues can also predispose to ORN.^{108(II),113(II),114(II)}

In the few instances of cyclosporin induced gingival hyperplasia, oral hygiene instructions, supra- and subgingival scaling, polishing, and gingival curettage should be carried out in the first instance with this having been found to reduce the need for gingivectomy.^{115(II)} For those patients where this is not successful then gingival surgery may be required.¹¹⁶

2.5.2 Herpes labialis can be a chronic problem. Topical aciclovir (5% cream applied five times daily for five to ten days, starting at first sign of attack) is effective.^{117(I),118(I)}

2.5.3 Restorations should be simple, functional and provide acceptable aesthetics.

Where appropriate, a restorative material with fluoride release should be used. Of note, conventional glass ionomer restorations have been found to perform more poorly than resin modified glass ionomer, composite resin, and amalgam restorations in patients who have been treated with radiotherapy.^{119(II)}

In those patients who have xerostomia related to radiation therapy, cervical caries is problematic and particularly so in those patients who fail to comply with preventive measures. Conservative restorative management of cavitated lesions is to be recommended in the first instance. Full/partial coverage crowns should be provided only when the patient can demonstrate good oral hygiene; caries can quickly progress around the margins of full/partial coverage crowns with the potential for eventual 'cariou amputation' of the crown. Should a full coverage restoration be warranted, the margins should be subgingival.^{120(II)}

Routine restorative treatment must be delayed until the patient is in remission,

when a careful study of the medical history should be made. Some children may have developed other medical complications as the result of cancer treatment (e.g. cardiomyopathy) with possible implications for restorative care.

2.5.4 Where possible, dental extractions should be avoided in irradiated patients due to the risk of ORN. A recent systematic review has estimated the total incidence of ORN after tooth extraction in irradiated patients to be 7%. When extractions were performed in conjunction with prophylactic hyperbaric oxygen therapy (HBOT), the incidence was 4% while extraction in conjunction with antibiotics gave an incidence of 6%.^{121(I)} Cancer patients who have received bisphosphonate therapy are also at increased risk of osteonecrosis.^{122(II)}

Although there is no conclusive evidence regarding pre-extraction antibiotic prophylaxis to prevent ORN, the general consensus would recommend antibiotic prophylaxis and continued antibiotics until completion of healing. Co-amoxiclav / amoxicillin (metronidazole in those allergic to penicillins) are generally the drugs of choice.^{122(II).123(II)}

Alcohol free 0.2% chlorhexidine gluconate mouthwash is also recommended prior to extractions and the use of low-adrenaline/adrenaline free local anaesthesia may also reduce the risk of ORN and as such their use is recommended.^{124(II)} Any extractions completed should be performed with minimal trauma and, where possible, soft tissue primary closure obtained.^{121(I)}

Where extractions are required HBOT is recommended both before and after tooth removal.^{125(III).126(I)} However the significant number of “dives” involved and limited local availability can lead to poor compliance.

Patients are at particular risk of ORN when:

- i. The total radiation dose exceeded 60Gy.^{121(I).127(II)}
- ii. The dose fraction was large with a high number of fractions.
- iii. There is local trauma as the result of a tooth extraction (especially mandibular extractions), uncontrolled periodontal disease or an ill-fitting prosthesis.
- iv. The person is immunodeficient.
- v. The person is malnourished.

Where there is a high risk of ORN and where it is clinically feasible, serious consideration to root canal therapy and restoration/crown amputation should be made.^{114(II).120(II).122(II)}

2.5.5 Dentures should be avoided wherever possible. Appliances will contribute to plaque retention and oral disease, particularly when there is xerostomia. When dentures are essential to ensure good function following cancer treatment, their construction will aid the ability to chew solid food and, by extrapolation, promote social adaptation and weight gain.^{129(II)}

2.5.6 Osteointegrated implants are a useful adjunct to fixed or removable prosthesis provision to improve prosthesis stability.

Regarding zygomatic implants, there is limited high quality evidence available at present. As such, the routine use of zygomatic implants is not to be

encouraged.^{130(I)}

There is limited evidence available regarding the use of HBOT prior to implant placement in irradiated patients. HBOT may not offer any appreciable clinical benefits with respect to implant success.^{131(I)} Its use, however, should be considered and offered where it is available until further clinical trials have been completed.

The placement of implants in patients who are being treated with bisphosphonates is not recommended with implant placement increasing the damage to the bony structures and increasing the risk of osteonecrosis.^{122(II)}

The provision of implants should take into consideration both the patient's prognosis and the published national guideline on their use.^{132(II)}

2.6 Following Cancer Therapy – Requirements for Denture Wearers

2.6.1 Appliances should be removed and left out of the mouth overnight and subject to the cleansing regimen indicated previously (para 2.3.9).^{135(I)} Obturators should not be left out at night for the six months following treatment.

2.6.2 For those edentulous patients who have xerostomia, Glandosane can be applied to the fit surface of their prosthesis prior to reinsertion; this may help to alleviate xerostomia.^{136(I)}

Artificial saliva reservoirs, incorporated into complete or partial prostheses, have been shown to relieve xerostomia symptoms temporarily.^{137(III).138(III)}

2.6.3 In the event of oral candidal infection, antifungals should be prescribed for at least two consecutive weeks:

- i. Miconazole varnish or gel applied to fit denture surface. This should be avoided if the patient is taking warfarin; the anticoagulant effect is enhanced by miconazole.^{139(II)}
- ii. Nystatin powder- 500,000-1000000 units per application of Viscogel can be incorporated into a denture soft lining material. The nystatin powder is added when the powder and liquid of the liner are mixed. The fungicidal activity of such modified lining materials reduces with time and as such requires to be changed on a regular basis e.g. between seven and fourteen days.^{140(II).141(II).142(II).143(II).144(II)}
- iii. Amphotericin B should be avoided since its antifungal properties are inactivated by Viscogel.^{141(II)}
- iv. Tea tree oil (*M. Alternifolia*) mixed with the Coe Comfort tissue conditioner has an anti-fungal effect and could be used as an alternative therapy for denture stomatitis which is resistant to traditional therapies.^{145(II)}
- v. Microwave disinfection of maxillary complete dentures has also been found to be effective.^{146(II)}

vi. Fluconazole may be indicated for resistant infections.^{147(l)}

2.6.4 Appliance wear should be discontinued if the mouth becomes painful and advice must be sought. New dentures may be required to alleviate symptoms.

2.6.5 Obturators should be reviewed regularly. They may require frequent attention with adjustment or remake.

2.7 The Management of Osteoradionecrosis

ORN may be a major complication following surgery or trauma to a previously irradiated maxilla or more commonly mandible, in the proven absence of tumour. Radiation induced vascular insufficiency rather than infection contributes to bone death.

Risk factors include the total radiation dose, modality of treatment, fraction size and dose rate, oral hygiene, timing of tooth extractions or other invasive procedures the continued use of tobacco and alcohol may further increase the incidence of ORN.

This condition is characterised by deep seated bone pain often with a purulent discharge which may include sequestered bone and may result in significant bone loss. If treated inadequately or left untreated it can be majorly debilitating and significantly impair quality of life.¹⁵⁰

2.7.1 Basic criteria for staging of ORN:

- Stage 0: mucosal defects only;
- Stage I: radiological evidence of necrotic bone with intact mucosa;
- Stage II: positive radiographic findings with denuded bone intraorally;
- Stage III: clinically exposed radionecrotic bone, verified by imaging techniques, along with skin fistulas and infection. Radiological evidence of bone necrosis within the radiation field, where tumour recurrence has been excluded.¹⁴⁹

2.7.2 Strenuous efforts should be made to avoid ORN by careful oral health monitoring and ensuring prevention compliance, timely dental treatment and dealing promptly with oral trauma.¹⁵¹

2.7.3 Oral trauma can be reduced by implementation of a soft diet and adjustment or removal of any denture that could be contributing to trauma. Extractions are to be avoided where possible, particularly in the mandible

2.7.4 Antioxidant agent, pentoxifylline (PTX), facilitates microcirculation, and inhibits the inflammatory mechanisms, promotes fibroblast proliferation and the formation of extracellular matrix. Tocopherol (vitamin E) protects the cell membrane against peroxidation. A synergic effect has been observed between PTX and tocopherol in the treatment of ORN. These are accessible, well tolerated and safe drugs at a suggested daily dosage of: PTX dose of 800mg/day and vitamin E 1000 IU/day (5 days a week), (More clinical trials are required to validate this treatment).¹⁵²

2.7.5 High dose antibiotic regimes should be instigated when symptomatic ORN is

diagnosed and continued until a definitive treatment outcome or symptom relief is achieved. In more chronic cases the presence of Actinomycoses must be considered as this will alter the dynamics of treatment protocols.

The antibiotic of choice should be broad spectrum with a wide field of action such as amoxicillin with clavulanic acid, antibiotic prophylaxis prior to extraction or sequestrectomy should be given and continued until mucosal integrity has occurred

It is recommended that antibiotic treatment is initiated prior to HBOT and continued through the surgical phase of ORN management, and post-surgery HBOT.^{151.153-156}

- 2.7.6** Localised disease control to remove sequestra and other debris from intra-oral defects in combination with adjunctive antibiotics is completed to gain pain relief. This treatment also facilitates sampling of material for culture and histopathology to establish both the non-malignant potential of diseased tissue and specificity and the sensitivity of microbial population to antimicrobial therapy.
- 2.7.7** There have been promising results with ultrasound at frequencies of 3MHz pulsed one in four at an intensity of $1\text{W}/\text{cm}^2$ applied to the mandible for ten minutes daily for fifty days.^{157.158}
- 2.7.8** There is a risk of serious complications developing after radiation cancer treatment due to late radiation tissue injury (LRTI). HBOT involves breathing oxygen under increased atmospheric pressure in a specially designed chamber. It is used as a treatment to improve oxygen supply to damaged tissue and stimulate healing. For patients with LRTI affecting tissues of the head, & neck, HBOT is associated with improved outcome. HBOT also appears to reduce the chance of ORN following tooth extraction in an irradiated field. There is an increased risk of tumour recurrence in patients who receive HBOT.¹⁵⁹⁻¹⁶⁵
- 2.7.9** In advanced chronic cases the extent of involvement of bone necrosis must be established. This can be via imaging "Cone Beam CT" or via chemical markers such as tetracycline to establish the healthy bone margins at surgery. This is then followed by radical ablative surgery to remove necrotic bone and soft tissue, including hemi-mandibulectomy and reconstruction with either a pedical or microvascular free flap. This procedure aims to achieve closure of orocutaneous fistulae and restore function and aesthetics.¹⁶⁶⁻¹⁷⁰

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5 Tables 2 and 3- Acute and Chronic Changes During and After Therapy

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TABLES

TABLE 1: MANAGEMENT GUIDELINES RELATIVE TO INVASIVE DENTAL PROCEDURES

Medical Status	Guidelines Available	Comments
Patients with indwelling venous access lines (e.g., Hickman).	American Heart Association (AHA) prophylactic antibiotic recommendations: low risk	There is no clear scientific proof detailing infectious risk for these lines following dental procedures.
Neutrophils Order FBC (full blood count) with differential.		
>2,000/mm ³	AHA prophylactic antibiotic recommendations: No prophylactic antibiotics.	
1,000–2,000/mm ³	AHA prophylactic antibiotic recommendations: low risk.	Liaise with the oncologist Clinical judgment is critical. If infection is present or unclear, more aggressive antibiotic therapy may be indicated.
<1,000/mm ³	AHA prophylactic antibiotic recommendations: Amikacin 150mg/m ² 1 h pre-surgery; ticarcillin 75 mg/kg IV ½ h pre-surgery. Repeat both 6 h postoperatively.	The antibiotic regimen suggested by AHA is not used widely in the U.K. where amoxicillin / clindamycin are more often used. Liaise with the oncologist If organisms are known or suspected, appropriate adjustments should be based on sensitivities.

Table 1 contd.

Medical Status	Guidelines Available	Comments
<p>Platelets * Order platelet count and coagulation tests.</p>		
<p>>60,000/mm³</p>	<p>National Cancer Institute guidelines (www.cancer.gov) No additional support needed.</p>	<p>Major surgery may require platelet supplementation</p>
<p>30,000–60,000/mm³</p>	<p>Platelet transfusions are optional for non-invasive treatment For surgical treatment (e.g., dental extractions), consider administering platelets preoperatively and 24 h later</p>	<p>Liaise with the oncologist Platelet requirements will also depend on the extent of the surgery required / need for block injections Utilise techniques to promote establishing and maintaining control of bleeding (i.e. sutures, pressure packs, minimise trauma).</p>
<p><30,000/mm³</p>	<p>Platelets should be transfused 1 h before procedure Obtain an immediate post-infusion platelet count; transfuse regularly to maintain counts >30,000–40,000/mm³ until initial healing has occurred. In some instances, platelet counts >60,000/mm³ may be required.</p>	<p>In addition to the above, consider using haemostatic agents (i.e., microfibrillar collagen, topical thrombin). Tranexamic acid may help stabilise nondurable clots. Monitor sites carefully.</p>

* Assumes that all other coagulation parameters are within normal limits and that platelet counts will be maintained at or above the specified level until initial stabilization/healing has occurred

TABLE 2: ACUTE CHANGES DURING THERAPY

Acute Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
<p>1. Mucositis^{171.172}</p>	<ul style="list-style-type: none"> • Acute inflammation of the mucosa • White/yellow fibrinous slough, often with ulceration • Painful to speak/eat/swallow • Portal for microbial entry • Healing complete 2-3 weeks post-completion cancer therapy 	<ul style="list-style-type: none"> • Onset 12-15 days after treatment commenced 	<ul style="list-style-type: none"> • Onset usually one week after treatment commencement • Ulceration often severe 	<ul style="list-style-type: none"> • Onset usually one week after treatment commencement • Ulceration often severe
<p>2. Blood Changes¹⁷¹</p>	<ul style="list-style-type: none"> • Anaemia • Neutropenia • Thrombocytopenia • Present from commencement of cancer therapy until up to 4 weeks post therapy 		<ul style="list-style-type: none"> • Spontaneous gingival/mucosal bleeding • Crusting of lips 	<ul style="list-style-type: none"> • Spontaneous gingival/mucosal bleeding • Crusting of lips

Table 2 contd.

Acute Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
3. Immuno-suppression 173-176	<ul style="list-style-type: none"> • Increases susceptibility to bacterial/candidal/viral disease • Exacerbates pre-existing periodontal disease 		<ul style="list-style-type: none"> • Periapically involved teeth can become a medical emergency • Acute herpetic gingivostomatitis and candida with systemic involvement in children 	<ul style="list-style-type: none"> • Periapically involved teeth can become a medical emergency
4. Changes in Salivary Flow/Composition 171	<ul style="list-style-type: none"> • Saliva becomes thick, viscous, acidic • Xerostomia results but is less common in children • Onset within 14 hours of cancer therapy 	<ul style="list-style-type: none"> • Xerostomia can be prolonged • Can last up to 2 years post therapy • Often permanent 	<ul style="list-style-type: none"> • Salivary flow usually returns to normal within 2 months 	<ul style="list-style-type: none"> • Salivary flow rarely returns to normal
5. Acute Ascending Sialadenitis 171	<ul style="list-style-type: none"> • Can occur in children as a complication of xerostomia 			

Table 2 contd.

Acute Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
6. Loss of Taste ^{175.176}	<ul style="list-style-type: none"> Onset on treatment commencement Related to xerostomia and direct damage to taste buds Sense of taste often returns with an unpleasant interim period of altered taste 			
7. Dysphagia ^{176.177}	<ul style="list-style-type: none"> As a result of mucositis and xerostomia 			<ul style="list-style-type: none"> Can be very severe due to severe ulceration
8. Changes in Oral Flora ^{178.179}	<ul style="list-style-type: none"> Due to reduced buffering action and antibacterial action of saliva Increase in cariogenic organisms within 2 weeks of cancer therapy Increased susceptibility to candidal/viral infections 	<ul style="list-style-type: none"> Oral candidiasis more likely Implications for increased dental caries 	<ul style="list-style-type: none"> Oral Candidiasis: - pseudomembranous candidiasis with ulceration and perioral inflammation 	<ul style="list-style-type: none"> Oral candidiasis: - severe with ulceration - if persistent, indicative of systemic involvement Acute herpetic gingivostomatitis Cytomegalovirus and Varicella zoster virus infections

Table 2 contd.

Acute Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
9. Periodontal / Gingival Disease¹⁸⁰	<ul style="list-style-type: none"> Can be exacerbated by oral flora changes, mucositis, xerostomia and immunosuppression 	<ul style="list-style-type: none"> Acute gingivitis 	<ul style="list-style-type: none"> Acute gingivitis Pericoronitis in children Gingival hyperplasia in acute myeloblastic leukaemia 	<ul style="list-style-type: none"> Acute gingivitis Pericoronitis in children
10. Tooth Sensitivity¹⁷²	<ul style="list-style-type: none"> Increased risk of toothwear and/or gingival recession present prior to cancer therapy 			
11. Dental Pain	<ul style="list-style-type: none"> Related to leukaemic infiltration of dental pulp tissue and direct jaw infiltration 		<ul style="list-style-type: none"> Toothache -like pain related to vincristine administration 	
12. Trismus	<ul style="list-style-type: none"> Must exclude posterior invasion of carcinoma into pterygomasseteric muscles as a cause 		<ul style="list-style-type: none"> Can occur in children Jaw Pain related to vincristine administration 	
13. Graft Versus Host Disease	<ul style="list-style-type: none"> Can occur in an acute form after bone marrow transplantation and be followed by a chronic form 			

TABLE 3: CHRONIC CHANGES FOLLOWING THERAPY

Chronic Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
1. Progressive endarteritis	<ul style="list-style-type: none"> • Occurs in irradiated bone, especially the mandible • Can occur in muscle and cause trismus 3-6 months post therapy • Uncommon in children 	<ul style="list-style-type: none"> • Implications for dental extractions / surgery (see management guidelines) 		<ul style="list-style-type: none"> • Implications for dental extractions / surgery (see management guidelines)
2. Blood Changes	<ul style="list-style-type: none"> • Anaemia • Neutropenia • Thrombocytopenia • Prolonged by maintenance chemotherapy 		<ul style="list-style-type: none"> • Implications for dental treatment (Table 4) 	<ul style="list-style-type: none"> • Implications for dental treatment (Table 4)
3. Trismus	<ul style="list-style-type: none"> • Must exclude posterior invasion of carcinoma into pterygomasseteric muscles as a cause • Predominantly due to fibrosis as a direct effect of radiotherapy, but also related to endarteritis 			

Table 3 contd.

Chronic Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
4. Prolonged Oral Flora Changes³	<ul style="list-style-type: none"> • Increase in cariogenic organisms and candida 	<ul style="list-style-type: none"> • Increased susceptibility to dental caries • Candidiasis more likely especially in denture wearers 		<ul style="list-style-type: none"> • Increased susceptibility to dental caries • Candidiasis more likely
5. Xerostomia¹⁴⁸	<ul style="list-style-type: none"> • May last up to 2 years post therapy • It is often considered permanent although this can be subjective • Predisposes to dental caries 	<ul style="list-style-type: none"> • More prolonged if parotid glands are in the irradiation field • Salivary output can be maintained by ipsilateral parotid sparing during radiotherapy⁶⁹ 		

Table 3 contd.

Chronic Change	Explanatory Notes	Radiotherapy	Chemotherapy	Bone Marrow Transplantation (Chemotherapy and Total Body Irradiation)
6. Tooth Erosion ¹⁸¹	<ul style="list-style-type: none"> • Due to prolonged xerostomia, removing protective action of saliva 			
7. Periodontal / Gingival Disease ¹⁷⁶	<ul style="list-style-type: none"> • Can continue to be exacerbated by xerostomia and oral flora changes • Gingival recession 	<ul style="list-style-type: none"> • Rapid progression of periodontal disease 		<ul style="list-style-type: none"> • Rapid progression of periodontal disease can occur in children
8. Adrenal Suppression	<ul style="list-style-type: none"> • Can occur as a result of corticosteroid therapy 			

TABLE 4: NURSING ORAL CARE GUIDELINES

1. PRIOR TO CANCER THERAPY

Objective	Nursing Action
<p>1. Referral of all patients for a comprehensive assessment by a Dental Surgeon prior to cancer therapy</p>	<ul style="list-style-type: none"> • Complete Oral Health Screening Chart (Appendix 1) and forward to dental team • Liaise with the Dental team to develop and implement an individual care plan
<p>2. Advice on the oral side effects of treatment</p>	<ul style="list-style-type: none"> • Provide written information on side effects of treatment (Appendix 3) • Give support and encouragement
<p>3. Preventive advice</p>	<ul style="list-style-type: none"> • See Practical Oral Care (Appendix 2) • Ensure oral hygiene equipment is available • Give support and encouragement with smoking cessation and alcohol problems • Give dietary advice in liaison with the Dietician • Provide written information (Appendix 4)*

* Advise About Support Groups: Cancer BACUP : Changing Faces : Let's Face It; Macmillan Cancer Support

2. DURING CANCER THERAPY

Objective	Nursing Action
1. Maintenance of oral hygiene	<ul style="list-style-type: none"> • Provide advice and assistance where appropriate • Follow Practical Oral Care (Appendix 2)
2. Inspection of the oral cavity should be carried out daily	<ul style="list-style-type: none"> • The Oral Assessment Guide (Appendix 3) should be completed daily and placed in the patient's individual care plan: contact the dental team for guidance prior to completion if required • Document findings in the patient's individual care plan to monitor any changes • Refer to the dental team when indicated
3. Monitor compliance in performing oral care	<ul style="list-style-type: none"> • Supervise and provide assistance; give instructions to carers where appropriate • Give support and encouragement
4. Pain control	<ul style="list-style-type: none"> • Give topical / systemic analgesia, as directed • Refer to main clinical guideline: Explanatory notes para 2.3.7
5. Oral candidal infections (Thrush)	<ul style="list-style-type: none"> • Give topical / systemic antifungal agents, as prescribed • If chlorhexidine gluconate mouthwash and nystatin suspension are prescribed, stagger their use by one hour • Refer to main clinical guideline: Explanatory notes para 2.3.6
6. Manage xerostomia	<ul style="list-style-type: none"> • Give advice to help with a dry mouth • Refer to main clinical guideline: Explanatory notes para 2.3.8 • Ensure recommended saliva substitute is prescribed and used when appropriate

3. AFTER CANCER THERAPY

Objective	Nursing Action
1. Arrange follow-up visit to the dental team	<ul style="list-style-type: none">• Provide the patient or carer with a contact telephone number• Arrange an appointment• To ensure follow up occurs when the patient is discharged, an oral care entry should be made in the summary notes / discharge letter
2. Reinforce preventive messages	<ul style="list-style-type: none">• Provide equipment for home care where appropriate• Ensure patient information leaflet has been provided to support the advice given

APPENDICES

APPENDIX 1: ORAL HEALTH CARE SCREENING CHART

N.B. Please forward to the Dental Team **prior** to the commencement of Cancer Therapy

Name: _____ Hospital: _____

D.O.B.: _____ Consultant: _____

Address: _____ **Inpatients:**

_____ Ward: _____

_____ Ward telephone no: _____

_____ Date admitted: _____

Telephone no: _____

Duration of stay: _____

Diagnosis:	1. _____	
	2. _____	
	3. _____	
Past Medical History:	1. _____	4. _____
	2. _____	5. _____
	3. _____	6. _____
Current Medication:	1. _____	4. _____
	2. _____	5. _____
	3. _____	6. _____
Treatment to date: (including radiotherapy and chemotherapy)	1. _____	
	2. _____	
	3. _____	
Treatment proposed with dates: (including radiotherapy and chemotherapy)	1. _____	
	2. _____	
	3. _____	

Tick as appropriate:

URGENT
(Contact Dental Team by phone)

ROUTINE

Signature: _____ Date: _____

Status: _____

APPENDIX 2: PRACTICAL ORAL CARE:

Care of the edentulous patient should start at step 5. References relate to the Clinical Guideline reference list.

Oral Care	Notes
1. Tooth brushing	<ul style="list-style-type: none"> • Use a medium brush if possible, soft one if too sore • Encourage or assist with gentle thorough brushing of teeth and gums at least twice daily • Use a high fluoride toothpaste • Spit out excess, do not rinse • If toothbrushing has to be discontinued it should be resumed at the earliest opportunity.⁴³ • Patients at risk of aspiration should have suction available and sit up
2. Aqueous alcohol free chlorhexidine gluconate mouthwash	<ul style="list-style-type: none"> • Recommended for short term use if tooth brushing is inadequate • If toothbrushing is discontinued, use three to four times daily.^{4,42-43} • Thirty minutes should be allowed between use of chlorhexidine and tooth brushing • Mouthwashes may need to be diluted for comfort, i.e. 10ml mouthwash to 10ml water, ensuring the whole diluted volume is used • N.B. Stagger use of chlorhexidine mouthwash and nystatin antifungal agent - separate administration by at least one hour.⁶⁰
3. Fluoride mouthwash	<ul style="list-style-type: none"> • Fluoride should be used both during and after cancer therapy • Use a high fluoride toothpaste when tooth brushing • Use an alcohol free fluoride mouthwash daily as directed by the dental team • Fluoride gel / varnish may be used, as directed by the dental team.⁴⁶⁻⁴⁹ Fluoride varnish should not be used during acute episodes of mucositis
4. Dietary advice	<ul style="list-style-type: none"> • Preventive advice to reduce the risk of dental decay, should be given in liaison with a Dietician. • Emphasis should be placed on adequate hydration (Refer to para 2.2.2) • Assist with healthy meal choices

Appendix 2 contd.

Oral Care	Notes
5. Gentle Swabbing of the Oral Tissues	<ul style="list-style-type: none"> • Where available, polygon/gauze swabs soaked in alcohol free chlorhexidine mouthwash may be used to gently clean the oral tissues.^{4.84} • If the above cannot be tolerated, the swabs may be soaked in 0.9% saline (N.B. no antibacterial effect)
6. Moisten mouth and lips frequently	<ul style="list-style-type: none"> • Advise regular sips of water.⁷⁷ • Oral Balance or similar gel may be applied to dry lips or mucosa, this can be particularly helpful at night • Use recommended artificial saliva substitutes.^{78.79} <p>Refer to main clinical guideline explanatory notes para 2.3.8</p>
7. Swabs for candidal superinfection	<ul style="list-style-type: none"> • Regular swabs should be taken for detection of candida • Topical / systemic antifungal agents should be prescribed following the diagnosis of candida.⁵¹⁻⁵⁹ <p>Refer to the main clinical guideline explanatory notes para 2.3.6</p>

Appendix 2 contd.

Oral Care	Notes
<p>8. Care of appliances</p>	<ul style="list-style-type: none"> • After each meal / at least twice daily, dentures and obturators should be removed and meticulously cleaned with a tooth or denture brush • It is advisable to do this over a basin of water to prevent damage if the appliance is dropped • Rinse well before replacing in cleaned mouth. • Antifungal agents, as prescribed may be applied to the fit surface of the denture prior to re-insertion. • Remove all dentures at night and clean; soak in in chlorhexidine mouthwash overnight. An alternative is dilute sodium hypochlorite solution (Milton's diluted 1 in 80) provided there are no metal components. ^{47(11B),83} • If stored away from the patient they should be appropriately labelled.
<p>9. Appliance wear</p>	<ul style="list-style-type: none"> • Removable prostheses should be left out of the mouth if there is any evidence of ulceration • Dentures should be removed at night • Denture should be moistened with water or an appropriate saliva substitute before reinsertion • Obturators should not be left out at night for the first 6 months. A specialist opinion should be sought if there is evidence of ulceration.

APPENDIX 3: ORAL ASSESSMENT GUIDE

Please insert appointment number in relevant box based on your clinical examination of the patient.

Contact the Dental Team for further advice on the management of patients with scores of 3.

PATIENT NAME : _____	PLEASE DATE AND SIGN									
ASSESSMENT	METHOD OF ASSESSMENT	DATE	1	2	3	4	5	6	7	8
VOICE 3 = difficult/ painful speech 2 = deeper/ raspy 1 = normal	Converse with the patient. Listen to crying									
SWALLOW 3 = unable to swallow 2 = painful 1 = normal	Ask patient to swallow									
LIPS AND ANGLE OF MOUTH 3 = ulcerated / with or without bleeding 2 = dry / cracked 1 = normal	Observe and palpate the tissues									

ASSESSMENT	METHOD OF ASSESSMENT	DATE	1	2	3	4	5	6	7	8
TONGUE 3 = blistered / cracked 2 = coated or loss of papillae 1 = smooth, pink, moist	Observe the appearance of the tissues									
VOICE 3 = absent 2 = thick / ropy 1 = watery	Insert tongue depressor and observe tongue and floor of mouth									
MUCOUS MEMBRANES/GINGIVA 3 = ulceration / bleeding - gentle pressure 2 = candidal infection suspected - reddened/coated or white patches 1 = pink and moist	Observe the appearance of the tissues									
ORAL CLEANSING COMPLIANCE 3 = unable to clean 2 = cleans but needs help 1 = no difficulties	Observe tooth brushing / denture cleaning									

(Adapted from Eilers, J., Berger, A., Peterson, M. Development, testing and application of the Oral Assessment Guide . Oncology Nursing Forum 15(3): pp 325-330a: 1988)
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APPENDIX 4: PATIENT INFORMATION LEAFLET

Useful Addresses:

Cancer BACUP
3 Bath Place
Rivington Street
London
EC2A 3JR

Changing Faces
1 & 2 Junction Mews
London
W2 1PN

BACS
British Association of Counselling
1 Regent Place
Rugby
Warwickshire
CV21 2PJ

Let's Face It
Christine Piff
14 Fallowfield
Yateley
Hampshire
GU46 6LW

Tel: 01252 879630
Fax: 01252 872633

Taking Care of Your Mouth During Radiotherapy or Chemotherapy

- **Radiotherapy to the head and neck and chemotherapy are treatments that are used to remove cancer.**
- **Radiotherapy and Chemotherapy can have harmful effects in the mouth. Your oral health needs to be as good as possible before the start of treatment to avoid problems later.**
- **Ensure that you have a thorough dental check-up, including advice, from a dentist before therapy starts. If you don't have your own dentist this may be arranged by your oncology team.**
- **Throughout your radiotherapy or chemotherapy your mouth needs careful monitoring by either a dental hygienist or an appropriately trained nurse.**

What can I expect during cancer treatment?

About two weeks after the start of treatment you may notice an increase in mouth ulcers and mouth soreness. Your mouth will become dry and there will be a loss of taste. These changes will make it difficult to swallow and eat. They are worst between two and five weeks after starting treatment after which they will gradually improve.

In this leaflet it is explained what can be done to help you cope with the unwanted effects of treatment.

Unwanted effects of treatment	What happens?	What can I do?	What to avoid
<i>Loss of taste</i>	The taste buds are damaged by radiotherapy and chemotherapy	<ul style="list-style-type: none"> • Unfortunately there is little you can do • Taste will return, as it does you will notice an unpleasant taste for a time but this will improve 	<ul style="list-style-type: none"> • Sweet food or drinks – a great temptation at this time but if taken between meals or before bedtime you will rapidly get tooth decay
<i>Difficulty swallowing</i>	Dryness and Soreness of the mouth makes swallowing difficult	<ul style="list-style-type: none"> • Rinse your mouth or gargle with Difflam, a pain relieving mouth wash, before eating • Eat moist food and sip water frequently 	<ul style="list-style-type: none"> • Alcohol will increase mouth dryness
<i>Jaw stiffness</i>	The muscles that move the jaw can become stiff as the result of the radiotherapy	<ul style="list-style-type: none"> • Gentle jaw exercises will be given to you • You may be given an appliance to help you 	

Unwanted effects of treatment	What happens?	What can I do?	What to avoid
<i>Dry mouth</i>	Saliva moistens the mouth and protects against tooth decay and tooth sensitivity. Radiotherapy damages the glands which produce saliva. The dryness is worse during treatment but slowly improves. Saliva may not return completely.	<ul style="list-style-type: none"> • Sip water frequently. • Chew sugar-free gum. • Discuss saliva substitutes with the dentist / doctor (make sure it contains fluoride and is not acidic). • Oral gel, e.g. Oral balance lubricates the lips and tongue and will help you to sleep at night. 	<ul style="list-style-type: none"> • Fizzy drinks, diet drinks and fruit juice are acidic and will make your teeth sensitive. • Try and avoid food or drinks containing sugar between meals. • Avoid acidic foods.
<i>Sore mouth</i>	<ul style="list-style-type: none"> • Radiotherapy and chemotherapy damages normal cells. • The inside of the mouth, tongue and throat may become red, sore and ulcerated. • You may find it uncomfortable to eat, speak, swallow and brush your teeth. • The soreness may be due to a thrush infection. 	<ul style="list-style-type: none"> • Clean your teeth with a fluoride toothpaste and soft toothbrush. • Consider use of a mouthwash – ask for advice from the dentist or doctors. • You may need medication if you have thrush. 	<ul style="list-style-type: none"> • Hard food, spicy food and hot drinks will be painful. • Avoid alcohol and tobacco; they will make your mouth feel worse. • Strongly flavoured tooth paste or mouthwash will be uncomfortable to use and should be avoided.

Unwanted effects of treatment	What happens?	What can I do?	What to avoid
<i>Loss of weight</i>	<p>Saliva normally helps to protect the teeth. The absence of saliva encourages tooth decay.</p> <p>Mouth soreness, dryness and difficulty swallowing will reduce your appetite and enthusiasm for food.</p>	<ul style="list-style-type: none"> • Eat high energy food such as pasta, bread, yams and potatoes • It will be arranged for you to see a dietician if you are losing weight 	<ul style="list-style-type: none"> • Food or drink containing even small amounts of sugar between meals or before bedtime are damaging to the teeth. • Limit sweet food and drinks to meal times only
<i>Difficulty with dentures</i>	<p>Lack of saliva and mouth soreness makes dentures difficult to wear.</p>	<ul style="list-style-type: none"> • See your dentist if your dentures are painful • Clean your dentures carefully after each meal, at least twice daily • Clean the dentures with alcohol-free chlorhexidine mouthwash or toothpaste and a brush • Take your dentures out at night • Soak in an appropriate cleanser overnight 	<ul style="list-style-type: none"> • Leaving your dentures out all day during your cancer treatment can make them difficult to accommodate to when you need to use them later