Manual on Oral Care for Pediatric Cancer Patients
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This edition of the Manual on Oral Care for Pediatric Cancer Patients was written by Regina Maria Holanda de Mendonça, a graduate of dentistry with a master’s degree in oncology and a doctorate in child and adolescent health, and a dentist at the Boldrini Children’s Center in Campinas, Brazil. The author was also in charge of systematizing the edits made to the document.

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INTRODUCTION

Different types of complications related to cancer treatment can occur in the oral cavity, producing risks for patients and decreasing their quality of life.

Oral care involves more than just proper oral hygiene. This manual is aimed at health professionals involved in treating pediatric cancer patients who directly or indirectly face these possible complications. The content of this publication can contribute to a more accurate diagnosis of alterations of the oral cavity and the development of prevention and treatment strategies.

In an alternating format, the manual presents both general information and specific aspects of dental practice focusing on pediatric cancer patients. This format was chosen based on two considerations. First, in many cancer treatment centers, multidisciplinary teams do not include dentists; and second, even in those establishments that do have dentists, other staff members require more detailed knowledge about the repercussions of oncological treatments on the oral cavity. This can facilitate more effective interaction between team members, thereby favoring integral patient care.

This publication does not contain direct guidelines for parents or caregivers, but it does include information that supports oral care guidelines based on the structure and composition of the teams at cancer treatment centers.

The preparation of this manual involved the review of documents on oral complications of cancer treatment, including guides, scientific articles, and books. As the scientific literature constantly reveals new developments that affect the guidelines provided here, this document should be reviewed and updated periodically.

This manual has been published within the framework of the World Health Organization (WHO) Global Initiative for Childhood Cancer, with the purpose of improving the situation of children and adolescents with cancer around the world, so that they can have the best chances of survival, enjoy a full life and, above all, achieve the best possible quality of life, and, if all else fails, die without suffering.
Chapter 1
General Considerations on the Importance of Oral Health in Pediatric Oncology

Oral complications are a common adverse effect of childhood cancer therapy, and children are more affected than adults. In the pediatric population, the observed development of infections of the oral cavity is related to foci caused by dental caries, pericoronitis, dental exfoliation and oral mucositis, pain, impact on nutrition, and dysfunctions in the salivary glands that can increase the risk of dental caries (Figures 1 and 2).

Infections can act as a significant source of systemic infection during periods of bone marrow suppression. Bacteremia originating in the oral cavity can trigger secondary infections related to central venous access, such as venous catheters, leading to sepsis, prolonged or additional hospitalization, delayed treatment, and increased costs. As infection during neutropenia is a common cause of death in cancer patients, every effort should be made to minimize this risk.

1.1. Oral infections

Some of the infections of the oral cavity are due to bone marrow suppression by chemotherapy and are classified as indirect stomatotoxicity. They do not usually present classic signs of infection, such as secretions and abscesses visible on X-rays. This makes diagnosis difficult since these signs depend on the presence of neutrophils, which have been diminished in neutropenic patients. In addition, in cases of ulcerative mucositis, in which the protective function of the oral mucosa is compromised, and in cases of hyposalivation, there is an increased risk of opportunistic infections of bacterial, fungal and viral origin (1-4).

1.1.1. Fungal infections

In cancer patients, fungi are usually linked to infections, and the genus Candida is one of the most common types of yeast in the development of nosocomial infections in neutropenic patients. It is important to consider that in immunocompromised patients (Figures 3 and 4) the lesions may manifest atypically. Early diagnosis is essential to determine an appropriate treatment. The most common symptoms are pain, altered taste, and a burning or stinging sensation. In some situations, the
1.1.2. Viral infections

Herpes Simplex Virus (HSV) is the viral agent most commonly found in oral mucosal lesions in patients treated with chemotherapy (Figures 5 to 8). HSV reactivation in cancer patients may manifest with an atypical clinical presentation, which may lead to misdiagnosis. Infection with this virus usually begins with edema and local erythema, which precede the formation of vesicles in the oral or perioral cavity that rupture to form painful ulcers (4, 9).

- Figure 5. Viral lesions in the vesicle stage

In the oral cavity, lesions may appear on the buccal mucosa, the retromolar region, the floor of the mouth, the lingual frenulum, the anterior two-thirds of the tongue, the gingival mucosa, and the hard and soft palate.
The clinical distinction between oral mucositis and HSV infection is more difficult in immunosuppressed patients. These conditions can manifest simultaneously, and their presence is associated with more severe degrees of mucositis (10, 11).

Although HSV is the most common viral agent, other viruses, such as cytomegalovirus, varicella zoster and Epstein-Barr, can be identified in the oral mucosa, highlighting the need for studies to detect the pathogenic role of these viruses in the mouth (12). In case of a suspected viral infection in the mouth, the pathology laboratory may be asked to perform a Tzanck test to confirm a herpes simplex infection (types I and II) or varicella-zoster virus.

1.1.3. Bacterial infections

Bacterial infections can cause high morbidity in patients undergoing cancer treatment. In some cases, the oral cavity is a source of dissemination of pathogenic bacteria, since the oral microbiota presents itself in various forms, including gram-positive, gram-negative and anaerobic bacteria (7, 9, 13, 14) (Figures 9 to 13).

The tooth eruption period requires special attention because bacterial colonization of the oral cavity can predispose patients to infections throughout childhood and part of adolescence. Molars that are in the eruption period and partially covered by the pericoronary operculum or cap can become a source of infection due to the accumulation of food debris and biofilm. In addition to strict on-site hygiene, when the patient’s hematological status allows, excision of the overlying gingival tissue can be scheduled.
1.2. Oral bleeding

During periods of thrombocytopenia, bleeding into the oral cavity may occur (15). One common presentation is spontaneous gingival bleeding, but this can also occur due to traumatic injuries, including surgical procedures (16). Extraction and anesthetic injections increase the risk of bleeding and bruising in thrombocytopenic patients (Figures 14 to 16).

During periods of exfoliation, in which there is an increase in tooth mobility because of root resorption, oral hygiene should be maintained as carefully as possible.
Oral bleeding may be frequent during the dental exfoliation phase. If possible, extraction of these teeth is recommended prior to therapy and approximately 10 days before neutropenia (15 - 21). If the patient uses an orthodontic appliance, it should be removed in order to prevent injuries in the oral mucosa and to maintain adequate hygiene, in order to reduce the possibility of gingival bleeding (22).

**Figure 16.** Gingival bleeding, at the time of diagnosis, in a leukemia patient: view immediately after removal of the orthodontic appliance

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### 1.3. Peripheral neuropathy

Peripheral neuropathy is a complication resulting from the affection of the oral nerves that presents as pain in the bones of the face and in the teeth, in the absence of an orthodontic cause, and that tends to manifest mainly in the molar lower. An X-ray examination may show thickening of the periodontal ligament in teeth with pulp vitality (23). Its occurrence is related to the use of vinca alkaloids, etoposide, or cisplatin, and it causes paresthesia, motor dysfunction, or acute pain in the upper jaw or mandible (24, 25). Neuropathic pain is usually transient, and most symptoms become reversible when the drug is stopped.

### 1.4. Hyposalivation and xerostomia

Hyposalivation is an objective decrease in salivary flow, while xerostomia is a subjective sensation of dry mouth. Both can be caused by chemotherapy and radiation therapy in the head and neck region (2, 3). Its most common symptoms are oral discomfort, altered taste and difficulties with feeding and speech. Radiation therapy may cause decreased salivary flow due to atrophy of the glandular acinus. This effect depends on the radiation dose, the irradiated area, and the type of gland. (3, 22).

Radiation at doses above 1000 cGy produces changes in salivary flow and, at doses above 5000 cGy in fields involving salivary glands, can lead to irreversible hyposalivation, permanent damage to secretory acini, and irreversible fibrosis of the glandular parenchyma (26). Glandular regeneration can occur gradually over a few months, and residual saliva becomes viscous and more acidic, while its lubricating and protective power decreases (3). These cases have an increased risk of caries and exacerbated mucositis. In addition to the problems caused by radiation therapy in the head and neck, some chemotherapy drugs, including methotrexate and etoposide, may be secreted through saliva, causing direct mucotoxicity. Nevertheless, xerostomia does not usually occur in patients treated with chemotherapy (2) (Figure 17).
The change in saliva characteristics associated with antineoplastic treatments may increase loss of taste and appetite, and increase the risk of symptoms such as nausea, vomiting and pain. As a result, many patients develop harmful eating habits, which can increase the risk of tooth decay, periodontal disease, candidiasis, and nutritional deficiencies. Artificial saliva and sialogogues can relieve discomfort. Regular water consumption should be encouraged, as it helps hydrate the mucosa, maintain favorable saliva levels in quality and quantity, and prevent secondary complications (27–29).

1.5. Trismus

Trismus can be described as an injury, damage, or even any restriction in the opening of the mouth caused by trauma, tumor, surgery, or radiation therapy. It can present in an acute or late form, as a consequence of either the disease or treatment. In patients treated with radiation therapy, it may result from radiation-induced cell destruction, edema, and muscle tissue fibrosis (30, 31). The severity of trismus depends on the radiation dose, and it hinders proper oral hygiene (32) (Figure 18).

Figure 18. Trismus associated with tumor compression

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1.6. Oral mucositis

Oral mucositis is an adverse effect of chemotherapy or radiation therapy in the head and neck (34, 35). Its clinical presentation varies from an atrophic surface, with or without erythema, to the presence of ulcerative lesions, accompanied by pain of varying intensity (34). In the case of chemotherapy-induced oral mucositis, the appearance of lesions occurs, on average, within three to 10 days after drug administration. Lesions can develop in different places in the oral cavity. Non-keratinized mucosa is the most vulnerable, probably due to its high degree of cell renewal (Figure 19). The action of chemotherapeutic agents can cause the loss of integrity of the mucosal barriers, leading to exposed connective tissue. This allows for the translocation of microorganisms and favors opportunistic infections. Antineoplastic drugs such as bleomycin, cisplatin, cytarabine, cyclophosphamide, busulfan, 5-fluouracil, doxorubicin, and methotrexate are frequently associated with oral mucositis (36–38).

Figure 19. Etiopathogenesis of oral mucositis

Regions such as the buccal mucosa, soft palate, ventral surface and lateral edge of the tongue, floor of the mouth, and lips are frequently affected by this condition (19, 33, 36, 39, 40). In more severe cases, oral mucositis can cause difficulty chewing and swallowing, nutritional impairment, and difficulty cleaning the oral cavity. Therefore, it is associated with an increased risk of local or systemic infection. All these aspects increase treatment periods and costs, and decrease the quality of life of patients and their caregivers (33, 39, 41–44).

The main risk factors associated with the incidence and severity of mucositis are the type
of chemotherapeutic agent (Box 1), radiation dose and therapeutic regimen, hematologic parameters, oral microbial environment, salivary function, and oral hygiene habits (1, 16, 36, 43–46).

**Box 1.** Main chemotherapy drugs associated with the risk of oral mucositis in pediatric oncology.

<table>
<thead>
<tr>
<th>Bleomycin</th>
<th>Fluorouracil</th>
<th>Paclitaxel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Busulfan</td>
<td>Gemcitabine</td>
<td>Sunitimib</td>
</tr>
<tr>
<td>Cytarabine</td>
<td>Idarubicin</td>
<td>Thioguanine</td>
</tr>
<tr>
<td>Actinomycin D</td>
<td>Nitrogen mustard</td>
<td>Topotecan</td>
</tr>
<tr>
<td>Daunomycin</td>
<td>Melphalan</td>
<td>Vinblastine</td>
</tr>
<tr>
<td>Docetaxel</td>
<td>6-mercaptopurine</td>
<td>Paclitaxel</td>
</tr>
<tr>
<td>Doxorubicin</td>
<td>Methotrexate</td>
<td>Ifosfamide</td>
</tr>
<tr>
<td>Etoposide</td>
<td>Mitoxantrone</td>
<td>Cisplatin and carboplatin</td>
</tr>
</tbody>
</table>

*Note: The association of these drugs, common in most chemotherapy protocols, accentuates the severity of mucosal lesions.*

Orofacial tissues that may be compromised by head and neck irradiation include salivary glands, taste buds, mucous membranes, bones, teeth, the temporomandibular joint, and craniomandibular musculature. Unlike chemotherapy, radiation damage is site-specific and toxicity is explained in volumes of irradiated tissue (41, 47). Clinically, it may manifest as diffuse oral ulcers that may persist for the duration of radiation therapy and up to two to four weeks after completion of treatment (36) (Figures 20 to 25).

**Figure 20.** Oral mucositis from radiation therapy in the head and neck

**Figure 21.** Different clinical aspects of WHO grade I oral mucositis

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Correctly identifying the severity of oral mucositis can help when developing and applying appropriate management strategies (Table 1).

- **Figure 22.** Different clinical characteristics of WHO grade II oral mucositis

- **Figure 23.** Different clinical aspects of WHO grade III oral mucositis

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Figure 24. Different clinical aspects of WHO grade III oral mucositis

Figure 25. Grade IV oral mucositis associated with herpes infection

Table 1. World Health Organization criteria for assessing the grade of oral mucositis

<table>
<thead>
<tr>
<th>Grade of Mucositis</th>
<th>Clinical Presentation or Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Mucosa without lesion</td>
</tr>
<tr>
<td>II</td>
<td>Pain or erythema</td>
</tr>
<tr>
<td>III</td>
<td>Erythema and ulcers</td>
</tr>
<tr>
<td>IV</td>
<td>Ulcers (the patient does not tolerate a solid diet)</td>
</tr>
<tr>
<td>V</td>
<td>Ulcers (the patient does not tolerate an oral diet)</td>
</tr>
</tbody>
</table>


According to the classification of the National Cancer Institute (NCI) of the United States of America (49), the degree of oral toxicity is based on the assessment of objective signs, such as erythema and ulceration, and functional and subjective outcomes, such as the presence of pain and changes in swallowing ability (Table 2).
Table 2. Criteria for assessing the grade of oral mucositis

<table>
<thead>
<tr>
<th>Grade of Mucositis</th>
<th>Presentation upon clinical examination</th>
<th>Functional aspects and symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Hypertrophic or erythematous mucosa</td>
<td>Upper aerodigestive tract: minimal symptoms, normal diet, few respiratory symptoms, no interference in function.</td>
</tr>
<tr>
<td>II</td>
<td>Some ulcerations or pseudomembranous zone</td>
<td>Upper aerodigestive tract: symptomatic, but the patient can ingest a modified (doughy) diet, respiratory symptoms interfere with function.</td>
</tr>
<tr>
<td>III</td>
<td>Confluent or pseudomembranous ulcerations, bleeding in minor trauma</td>
<td>Upper aerodigestive tract: symptomatic and unable to eat adequately or hydrate orally, severe respiratory symptoms.</td>
</tr>
<tr>
<td>IV</td>
<td>Tissue necrosis, significant spontaneous bleeding; risk of death</td>
<td>Symptoms associated with the risk of death.</td>
</tr>
<tr>
<td>V</td>
<td>Death</td>
<td>Death</td>
</tr>
</tbody>
</table>


The Children’s International Mucositis Evaluation Scale (ChIMES) (50) consists of a scale for self-assessment of mucositis. There is a version for children and adolescents aged 8 to 18, plus a version to be completed by parents or caregivers of children under 8 years of age.

The rating scale to be used must always have been validated in the language of the population to be applied.

1.7. Graft-versus-host disease

Graft-versus-host disease (GVHD) is one of the main complications of hematopoietic stem cell transplantation. In these cases, the cells of the alloreactive donor exhibit cytotoxic activity against the tissue of the recipient organism, which is the main cause of morbidity and mortality (51-53). GVHD can be acute or chronic (cEICH).

This complication frequently affects the oral cavity (54). Symptoms of cEICH seen in the oral mucosa include sensitivity to spicy, acidic, and salty foods, as well as to alcoholic beverages and mouthwashes containing alcohol and flavoring agents. Xerostomia, difficulty speaking, swallowing, and chewing, and variations in taste, with the possibility of multiple simultaneous symptoms, are also reported.

These changes result in adverse effects on physical and psychosocial function and result in decreased quality of life (52, 55).

There is a diverse spectrum of the clinical presentation of oral cEICH. It includes, among others, erythema, lichenoid hyperkeratosis, xerostomia, mucocele, atrophy, edema, fibrosis, pseudomembrane, and ulcerations, and may affect any oral cavity site. The NIH Oral Mucosal Score (NIH WHO) was developed as an appropriate instrument for this purpose, and it should be used to assess the severity of oral cEICH and its manifestations (54).

The multi-professional approach and the careful assessment of the oral cavity permit the early detection of alterations and help define strategies for managing them.
Patients with adequate oral health tend to develop fewer oral manifestations, and their clinical evolution is faster. Several studies show the importance of oral health in preventing and reducing oral complications in cancer treatment (16, 56). To prevent and manage possible complications that may arise in antineoplastic therapy, the presence of a dental surgeon in the multidisciplinary team is indispensable. However, team members' involvement in oral care goes beyond dental practice. Coordination between the dental team and other members, such as nurses, doctors, nutritionists and psychologists, for example, can enable a comprehensive approach for patients and their families that effectively leads to achieving balanced oral health.

Caregivers, as well as patients old enough to understand, should be guided on the need for a thorough dental evaluation before initiating cancer therapy, maintaining good oral hygiene, a balanced diet, and the benefits of preventive oral monitoring to avoid problems during and after treatment. The importance of oral hygiene during early teething may not be apparent to caregivers, as they may consider it transient (57); therefore, parents should be informed about the negative consequences of the destruction and loss of primary teeth.

Caregivers should receive clear guidance on possible dental and salivary changes related to anticancer agents (Box 2). Occasionally, children and adolescents experience variations in taste and other situations that interfere with feeding. In periods of nutritional difficulties, it is common for families to try to increase the patients' caloric intake by providing a diet rich in carbohydrates, which increases the risk of caries (58-60). When training caregivers, it is necessary to recognize that oral hygiene may not be a priority with a childhood cancer diagnosis, and dental care is often sought only after the onset of symptoms.

Therefore, establishing a relationship of trust with the patients and their families requires constant effort in dental care. A cancer diagnosis can cause emotional distress related to the diagnosis itself and to the treatment. The initial consultation with the dental surgeon should be minimally invasive (61, 62), and therefore should apply basic behavioral orientation techniques and language that respects each individual's ability to understand. Notably, even in the case of young children, the patient and caregivers should be instructed in oral hygiene techniques (63-66). In terms of oral hygiene, it is essential to brush the teeth and tongue with a soft or extra-soft bristle brush, using an age-appropriate concentration of fluoride toothpaste (1100 ppm-1500 ppm) (67). The use of dental floss is recommended for children who have developed fine motor skills for this type of movement. If this is not possible, family members should help, unless there are restrictions due to periods of severe neutropenia or thrombocytopenia (68, 69).

The recommended amount of toothpaste for boys and girls up to 4 years of age corresponds to the size of a grain of rice (approximately 0.1 g), which is equivalent to a “lick” or “spread” on the brush (Figure 26, panel A). For those over 4 years of age, the amount should be similar to a small pea (0.25 g to 0.3 g), so it is necessary to use the transverse technique to place the toothpaste on the brush (Figure 26, panels B and C) (70).
**Figure 26.** Recommended amount of toothpaste for boys and girls

A. Grain of rice  
B. Pea  
C. Transversal technique

*Source: Eraldo Pesaressi, Universidad San Martín de Porres, Lima, Perú.*
The complete dental evaluation involves the clinical examination, which includes a dental assessment of the intraoral soft tissue and bone structures and noting whether there is a dietary routine and any harmful habits.

X-ray testing should be prescribed with precaution in order to expose pediatric patients to the lowest amount of radiation possible. If possible, use digital X-rays that reduce patient exposure. If necessary, panoramic, bitewing, and periapical X-rays (62, 71–73) may be ordered.

Use retractors or gauze for soft tissue retraction. The oral cavity inspection should assess changes from normality (color, texture and volume), bleeding, traumatic lesions in the mucosa, and labial or perioral edema.

The dental surgeon must be familiar with the antineoplastic treatment protocol that the patient will receive, including the side effects of the drugs used, the correct interpretation of the patient’s hematological conditions, the parameters of radiation therapy (irradiation field, total dose, fractional dose, and number of sessions) in the head and neck, and other medications (anticoagulants, anticonvulsants, cardiovascular and others) (73).

Whenever possible, the treatment center should have a dental surgeon who specializes in the care of cancer patients as part of the multidisciplinary team and who is in direct contact with the oncologist. Consultation with the dental surgeon should take place soon after the cancer diagnosis. This allows for planning the dental treatment schedule, considering the type of procedure and the clinical conditions that the patient presents during each treatment phase, as well as establishing the follow-up schedule to prevent or diagnose future side effects early. If the dental surgeon is not part of the multi-professional team, the oncologist should guide caregivers on basic daily care, suggest an external dental evaluation, and be available for queries from the dental surgeon who will receive the patient.
Dental care can be established in a didactic way, based on the objectives for each stage of treatment.

**Before starting cancer treatment**

In the pediatric population, the development of infections originating in the oral cavity and associated with caries foci, pericoronitis, dental exfoliation, oral mucositis, and pain is frequently observed. The infections can affect nutrition and lead to salivary gland dysfunctions which, if persistent, increase the risk of caries. These conditions, whose literature references are varied, may result in fever, sepsis, increased hospitalization, treatment delays, and increased costs (68, 74, 75). Patients with better health status and satisfactory oral hygiene tend to develop fewer oral lesions, and those that do occur tend to have a more rapid clinical course. Studies have reinforced the importance of oral health to prevent and reduce the oral complications of cancer treatment (76).

Whenever possible, the oral environment should be adapted by eliminating sources of trauma, such as orthodontic appliances, biofilm, calculus, fractured teeth or restorations and temporary teeth in the exfoliation phase. This is a key measure to avoid infectious processes and bleeding (76).

**During cancer treatment**

It is not always possible to perform all the necessary dental treatment before starting therapy. When it is necessary to maintain dental care during cancer treatment, it should be carefully planned and discussed with the doctor responsible for the patient, so that interventions by the dental surgeon take place at the appropriate times during treatment and are safely distant from the immunosuppression or thrombocytopenia phases. Patient follow-up during treatment is essential for the prevention and early identification of variations in the oral cavity.

**After completing cancer treatment**

Cancer treatment can cause changes in bone, salivary, and dental structures that do not go away after it is completed. In addition, depending on the type of therapeutic modality used, the risk of developing second neoplasms increases. Therefore, it is recommended to carry out a dental follow-up that prevents complications derived from cancer treatment, provides guidance, monitors habits designed to reduce the manifestation of complications, and aids the early detection of second neoplasms in orofacial structures.

Dental care protocols should be designed to provide the shortest possible resolution of pre-existing oral problems and to prevent and mitigate alterations in the oral cavity.

To establish a needs-based protocol and to be able to offer services in the cancer treatment facility, it is necessary to consider the hospital infrastructure, care resources, and available multidisciplinary team.

4.1. **Before starting cancer treatment**

As already noted, all dental interventions for pre-existing conditions should be completed before starting cancer treatment. If this is not possible due to the urgency of initiating cancer therapy, the dental surgeon must prioritize the adequacy of the oral environment by encouraging the
4.2. During cancer treatment

Dental treatment should be based on the oral diagnosis and the patient's general status, according to the resources available in the facility where the anticancer treatment will be carried out. Oral procedures (removal of deteriorated tissue and temporary restorations, endodontic treatment, and extractions) should be scheduled around medical treatment. Depending on the patient's clinical status, in the absence of safe systemic conditions (anemia, thrombocytopenia, leukopenia, etc.), the preparation of the oral environment may be delayed. For invasive procedures, the patient's use of anticoagulants should also be verified.

When there is a need to continue dental care, it should be carefully planned so that dental surgery takes place at the appropriate times during treatment, safely distant from the phases of immunosuppression or thrombocytopenia. When indicated, extractions and surgical procedures should be performed at least seven to 14 days prior to the start of chemotherapy and 14 days prior to head and neck radiation therapy, with antibiotic prophylaxis.

4.2.1. Hematological criteria for the dental treatment of pediatric cancer patients based on hematological status

Annex 1 lists oral care recommendations based on certain hematological parameters of the dental patient with cancer. These recommendations may be adjusted depending on the type of...
procedure and the structure of care available to the patient in an outpatient or hospital setting.

In addition to tailoring the procedures based on the platelet count, the use of local hemostatic agents, such as microfibrillar collagen, topical thrombin, topical adrenaline, hemostatic sponges, or aminocaproic acid/tranexamic acid may aid hemostasis and clot stabilization (79).

In the oncological context, it is possible to observe a platelet count within normal limits, with a concomitant increase in coagulogram, and a clotting time that is longer than expected. Because the normal platelet count is not sufficient to ensure hemostasis, it is recommended to request a coagulogram to schedule invasive procedures. This test provides the dentist with additional important information, such as thrombin, prothrombin and thromboplastin time, international normalized ratio, and partial activation (79).

Low hemoglobin levels are not an absolute contraindication to dental procedures, provided that the platelet count and coagulogram reassure the professional as to the risk of bleeding. When hemoglobin is less than 7 g/dL, it is recommended to postpone treatment or request a medical evaluation for red blood cell transfusion (79).

4.2.2. Dental treatment protocols

Dental care protocols should be designed and based on the shortest possible resolution of pre-existing oral problems and to prevent and mitigate alterations that may exist in the oral cavity.

To establish a needs-based protocol and offer services in the cancer treatment facility, the hospital infrastructure, the care resources, and the multidisciplinary team available must all be taken into consideration.

4.2.3. Dental Procedures

Restorative procedures can be performed with preferred materials, such as composite resin and high-viscosity glass ionomer cement modified with composite resin (80), whose release of fluoride increases saliva content and decreases bacterial colonization in the oral cavity, translating into greater tooth protection.

When there is not enough time to complete conventional restorative treatment before starting cancer treatment, atraumatic restorative treatment (ART) may allow for a more conservative approach to caries lesions (81, 82). This technique causes less stress and may benefit patients with prolonged inpatient dental treatment, which can lead to increased anxiety about dental treatment (83).

Several factors influence the choice of restorative material for young permanent teeth, such as larger pulp chambers and lower restoration survival in those types of teeth (84). The decision about which material to use for restoration will depend on the intensity of the cancer treatment and later effects that may affect the risk of long-term caries. Composite resin, for example, is a material widely used in restorations of young permanent teeth (85), since it features good resistance to wear and adhesion to the dental structure (86). Its drawback, however, is lower durability in patients at high risk of caries.

Endodontic treatment on permanent teeth should be considered with caution. Ideally, root canal treatment for permanent teeth should be completed at least one week prior to the start of cancer treatment to ensure recovery of periapical periodontal tissue (22, 73). If this is not possible, permanent teeth can be opened, with constant exchange of intracanal medication. In any case, these treatment options should be based on expert opinion and should be discussed with the medical team in order to propose the best option for the patient. If the tooth is not restorable,
According to the American Academy of Pediatric Dentistry (AAPD), pulp therapy is a relative contraindication in children with neoplastic diseases (22, 80). Pulp therapy on primary teeth is not recommended prior to starting chemotherapy or radiation therapy, and extraction should be used to minimize the risk of oral injury and systemic complications. In the absence of evidence-based recommendations for pulpotomy, there is a tendency to perform extractions to avoid complications in the next stage of immunosuppression, unless temporary teeth previously treated with pulpotomy are clinically and radiographically healthy (87). In young children with extensive caries and limited cooperative capacity, tooth extraction may be the most appropriate and definitive option, as this approach reduces the risk of future infections. Natural exfoliation of temporary teeth should be allowed, and the patient should be warned not to "play" with them to avoid bacteremia and gingival bleeding. There are exceptions during a period of intense neutropenia or thrombocytopenia and if there are existing teeth with exfoliative mobility, in which case preemptive tooth extraction can prevent infectious or hemorrhagic complications. Another situation in which preemptive exfoliation may be considered is when dental treatment is performed under general anesthesia, and it is possible to reconcile exodontia with other dental procedures, optimising the timing. (22, 73).

Infected non-restorable teeth, retained roots, and compromised periodontal teeth should be removed one to two weeks before starting cancer therapy to allow adequate time for healing. In situations where this is not possible, extractions should be scheduled between periods of immunosuppression to allow for proper healing before starting the next cycle of therapy (22).

All surgical procedures should be performed in the least traumatic manner possible, avoiding sharp bony edges and ensuring the satisfactory closure of surgical wounds (88, 89). The implementation of local hemostatic measures, such as sutures, fibrin sponges, vasoconstrictors, and pastes with antifibrinolytic agents should also be considered to reduce the risk of bleeding and promote rapid healing.

Partially erupted dental elements can also become a source of pericoronitis infection; therefore, whenever possible, the overlying gingival tissue should be removed (61, 80, 88).

In terms of preventive procedures, for populations at high risk of caries due to previous problems or if the fissures are particularly retentive, it is advisable to use silver diamine fluoride or, ideally, glass ionomer sealants for pits and fissures. In this context, salivary alterations caused by cancer treatment, difficulty in cleaning, and taste alterations that are often associated with more frequent consumption of cariogenic foods, justify the application of occlusal sealants to all teeth in this population.

In terms of the topical fluoride application, the use of neutral fluoride gel (2%) is a good option. Although it provides a lower amount of calcium fluoride (CaF₂) than products with acidulated fluorine phosphate (1.23%), it does not interfere with restorations. Fluoride can be applied using disposable cups or by rubbing it on the teeth with a toothbrush, provided the child can spit (88).

Another fluoride and topical material widely used in pediatric dentistry is sodium fluoride varnish, mostly with a concentration of 22 600 ppm. The application should be initiated on the proximal faces of the selected teeth, which should be brushed with the varnish in a thin layer (90). For the contact points, dental floss should be used to help the varnish penetrate, and there is no need to air dry the product. The modality and frequency of professional fluoride application should be customized and based on the patient’s caries risk assessment (91). Daily mouthwash with 0.05% sodium fluoride solution is recommended for patients at high risk of caries lesions.

Preparation protocols for patients receiving radiation therapy in the head and neck should include pre-irradiation restorations (92, 93). There is a negative interaction between ionizing radiation doses and metallic dental materials, which increase the original radiation dose.
due to their high density, atomic number and conductivity. The mechanical properties and durability of restorations with materials such as conventional glass ionomer cement and resin-modified glass ionomer cement may be indirectly affected by changes in saliva produced by radiogenic damage to the salivary glands. Alternatively, composite resins can be used. They are insoluble and have excellent optical properties and an elastic modulus similar to enamel and dentin, allowing for a more homogeneous distribution of the masticatory load (94). Physiotherapy and speech therapy, in the form of masticatory muscle stretching exercises, should be started before radiation therapy and continued after its completion to avoid or minimize the development of trismus (22).

If the patient does not allow dental care or if there is an urgent need to complete it, treatment can be performed under sedation (80, 88). In these cases, treatment is usually radical; to prevent sepsis, extractions are performed for all teeth with pulp exposure or that have a poor prognosis (80). Alternatives, including sedation with diazepam or nitrous oxide, may be used to treat children with anxiety.

When it is not possible to complete dental treatment before starting chemotherapy, it should be completed as soon as possible by taking advantage of the “windows of opportunity” for dental care. However, it is mandatory to stop oral preparation prior to radiation therapy in the head and neck region, and also in cases involving hematopoietic stem cell transplantation.

4.2.4. Prevention and treatment of oral mucositis

To establish and implement a care routine for the prevention and treatment of oral mucositis, the dental surgeon and other team members involved in these procedures should be familiar with:

- The antineoplastic treatment protocols to which the patient will be subjected and the side effects of the drugs that will be used
- Radiation therapy parameters (irradiation field, total dose, fractional dose and number of sessions) in the head and neck region (Box 3)

**Box 3. Guidance on the prevention and management of oral mucositis**

<table>
<thead>
<tr>
<th>Assessment of the oral cavity: should be performed regularly, based on a schedule that includes the dental team and the medical visit, or before the scheduled dates, if deemed necessary. In the case of any oral alteration prior to the scheduled date, the patient should be instructed to return earlier.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospitalized patients: A daily inspection should be performed for signs and symptoms of mucositis. If the medical or nursing team notices changes in the oral mucosa between daily appointments, the dental surgeon should be notified.</td>
</tr>
<tr>
<td>If the mucositis is already present, it must be classified, and institutional protocol measures should be taken based on the human and physical resource structure available.</td>
</tr>
<tr>
<td>Brush two to three times a day (minimum) and before bedtime; Use a soft or extra soft bristle brush, soft toothpaste and fluoride (1000–1500ppm), with the appropriate amount for each age group.</td>
</tr>
<tr>
<td>• Oral hygiene activities should always be reinforced. In cases where patients cannot perform any type of oral hygiene, a non-alcoholic solution of 0.12% chlorhexidine, with mouthwash or soaked gauze, can be used every 12 hours.</td>
</tr>
<tr>
<td>• Chlorhexidine will not act to prevent or treat mucositis, but it will help control the oral microbiota, reducing the inflammatory process and the risk of infections. This procedure may be performed by the dental surgeon or nursing staff.</td>
</tr>
</tbody>
</table>
Daily mouthwashes with saline (0.9%) are recommended during chemotherapy at least three to six times per day, depending on the anticancer regimen and the oral mucosa status. For patients receiving facial radiation therapy, a baking soda solution may be used.

It is recommended to perform mouth rinses with a salivary enzymatic system, which is indicated in the case of stomatotoxic chemotherapy regimens or head and neck radiotherapy.

Moisturize lips often with water-based lubricants, essential fatty acids or lanolin. Do not apply petroleum jelly.

Guidance for proper nutrition should be provided by the nutrition team. In general, mild foods of paste or semi-liquid consistency, free of hot and sour spices, served cold or at room temperature, are better tolerated.

Topical anesthetics (2% viscous lidocaine solution [5 ml] diluted in 0.9% saline [10 ml]) or analgesic spray may be used when the patient is conscious and can perceive the sensation of anesthesia in the oral mucosa. In other circumstances, its use should not be indicated, due to the risks of bite trauma and broncho-aspiration. The prescription of systemic analgesics should be discussed with the medical team.

Photobiomodulation is recommended as a prophylactic method and mucositis treatment, with the application of low-intensity laser as a preventive approach, in cases where stomatotoxic or myelotoxic chemotherapy is given.

The patient or caregiver should be advised to book a new medical consultation if changes (paleness, hypertrophy, hyperemia; desquamation, pain, or ulcers) are perceived in the oral cavity, for a therapeutic laser application. In this case, daily application is recommended until the problem is resolved.

Daily application of low-intensity lasers is recommended in patients treated with a conditioning regimen for hematopoietic stem cell transplantation up until grafting. Follow-up should be maintained, and the routine continuity of sessions established.

The application of low-intensity lasers is recommended when radiation therapy involves orofacial structures, with daily sessions, from the first day of radiation therapy until one week after its completion or (if lesions have appeared) until the lesions are resolved.

If radiation therapy is applied to the central nervous system or cervical region, periodic evaluation of the patient is recommended. If there are changes in the mucosa or pain during swallowing, start daily sessions, applying lasers until the problem is resolved.

In the case of myeloid leukemias, start using lasers only after checking the absence of circulating blasts in the peripheral blood, because leukemia cells may infiltrate the oral tissues.

For babies, if they cannot remain immobile, extraoral applications should be performed, even though the effect of administering light to the tissues is reduced.

The use of cryotherapy is recommended for cooperative patients, especially those receiving melphalan or 5-fluorouracil (42). The use of glutamine is also suggested for patients treated with head and neck radiation therapy with concomitant chemotherapy (95). According to some sources, it is advisable to use vitamin E, chamomile, aloe vera or zinc; however, its effectiveness has not been established (or is debatable) (95–97).

Photobiomodulation is a method used to prevent and treat oral mucositis that is recognized by the Multinational Association for Supportive Care in Cancer/International Society of Oral Oncology (MASCC/ISOO) (98); however, there is still no consensus on the best protocol to use (40, 41, 99–101) (Annexes 2 and 3).
4.2.5. Palliative Care

In dentistry, palliative care for cancer patients can be described as the treatment of complications that manifest in the oral cavity due to toxicities generated by the treatment or by the progression of the underlying disease (102).

Symptoms may be specific to the disease process or the effects of medication, or they may be part of the individual's overall deterioration. The most common oral signs and symptoms are pain, bleeding, trismus, ulcers, opportunistic infections, dysphagia, xerostomia, hypersalivation, halitosis, and saburra.

Secretions in patients with tracheostomy also compromise verbal communication, cause oral dysfunction, and accentuate suffering. In addition, maintaining oral hygiene can cause severe pain and great discomfort, and should be done carefully to minimize oral complications, in order to maintain oral health, reduce irritation and tissue damage, minimize the risk of oral and systemic infections, and promote greater comfort. In these situations, it is essential for the dental surgeon to collaborate with the nursing team and perform procedures aimed at reducing local complications, to optimize patient comfort (102–104).

4.3. Special considerations for oral care after therapy and for the surviving patient, depending on the type of cancer treatment

Caring for the oral cavity after completing antineoplastic therapy includes incorporating regular oral hygiene habits and the involvement of the dental surgeon in planning therapeutic strategies (Annexes 4 to 7)

4.3.1. Hypofunction of the salivary glands

Hypofunction of the salivary glands is accompanied by a persistent sensation of dry mouth (xerostomia), and the consequent oral and systemic complications that this implies. Patients presenting with this type of gland dysfunction may have a wide range of oral and systemic clinical disorders, which change over time and differ in different individuals receiving similar treatments. Xerostomia can vary in frequency and severity and cause different levels of limitation in patients with similar clinical conditions and treatments.

After irradiation, it is possible to recover the salivary glands after 12 to 18 months, depending on the area treated and the dose of radiation received. However, hypofunction may remain a chronic side effect of cancer treatment. In this case, the procedure is basically symptomatic; its objective is to stimulate the residual secretory capacity of the salivary glands and is based on using lubricating agents. According to recently published studies, the use of drugs that cause saliva production has yielded positive results, but this strategy is still associated with a large number of side effects. The main chronic complication of severe hyposalivation is the significantly increased risk of developing caries (26, 105).

4.3.2. Radiation-related caries

Radiation-related caries (CRR) lesions, also known as “radiation caries,” are characterized by a clinical profile of “rampant caries” with rapid onset and progression. They are difficult to treat, which can lead to widespread tooth destruction within a few months after completing radiation therapy (106).
Although the exact nature of RRCs is not yet fully understood, it is considered a complex, multifactorial disease related to the direct and indirect effects of radiation on the salivary glands and teeth (107–110). This reinforces the need for preparing and examining the oral cavity, and for patients and caregivers to understand the importance of maintaining satisfactory eating habits and oral hygiene prior to treatment.

According to Santos Silva et al. (106), RRC begins clinically 6 to 12 months after completion of head and neck radiation therapy. It starts with changes in the enamel translucency and staining pattern, which manifest as a brown or blackish-brown pigmentation of the smooth surfaces of the non-cavitated enamel and cervical dentin. In the early stages, it is possible to observe cracks and fissures in the enamel that have the potential to advance and produce enamel fracture with early exposure.

Enamel delamination can be observed in later stages, possibly due to changes in the mechanical properties of the amelodentinary junction, which impairs adhesion between enamel and dentin, contributing to rapid tooth decay and the progression of RRC.

The final stage of the process involves coronal amputation, which consists of the total detachment of the dental crown so that only root remnants remain in the patient’s oral cavity.

There are currently no well-established and validated protocols for treating RRC that can be taken as a guide for using more appropriate restorative materials based on each dental stage after radiation therapy. In the absence of scientific evidence on the topic and an ideal technique, it is recommended to restore teeth with adhesive materials or composite resin (which are used for conventional caries), use retractor wire and interproximal matrix for cases involving cervical lesions, and use a bevel for incisal restorations (106).

4.3.3. Facial, cranial and dental changes

Changes in craniofacial, skeletal, and dental development are some of the complications faced by cancer survivors in childhood or adolescence. Long-term effects associated with antineoplastic therapy may include dental agenesis, delayed eruption, microdontia, variations in size and shape, enamel hypoplasia, pulp chamber abnormalities, root disorders, reduced height of the alveolar process, facial asymmetry, and salivary gland hypofunction (hyposalivation) (Figures 28 to 30).
The intensity of the changes will depend on the age and stage of development at which exposure to cytotoxic agents (especially alkylating agents) or ionizing radiation occurs. The changes occur most often in boys and girls who are younger than 6 years old at the time of cancer therapy (3, 22, 111, 112).

When the masticatory muscles and temporomandibular joint are included in the irradiated field, musculoskeletal fibrosis can cause trismus and jaw dysfunction. Because limitations around opening the mouth interfere with the possibilities of proper oral hygiene, hygiene control should be rigorous and daily use of fluoride mouthwash is indicated (113).

4.3.4. Orthodontic treatment

In pediatric cancer patients, radiation therapy in the head and neck causes bone alterations resulting from injury to the bone remodeling system (osteocytes, osteoblasts and osteoclasts).

These changes pose a risk that can lead to the development of osteoradionecrosis. In addition to bone histological variations, patients treated with radiation therapy may present with changes in the growth and maturation of craniofacial skeletal structures, requiring orthodontic
intervention (113). The AAPD recommends that orthodontic treatment be initiated two years after the end of antineoplastic therapy, when the risk of relapse is reduced and the patient is no longer using immunosuppressive drugs (22), and after a complete evaluation of possible dental developmental disorders. In the case of patients who received low doses of radiation in orofacial structures, its use may be indicated for a shorter period, but never less than six months, and always under completely stable hematological conditions. Family members, as well as patients capable of understanding, should be advised that previous radiation therapy may limit the effectiveness of orthodontic techniques and the treatment results may not meet expectations.

Using lighter orthodontic forces and simpler techniques can minimize the risks of root resorption. A periapical X-ray is recommended six months after the start of active treatment. If the X-ray examination reveals areas of resorption, orthodontic treatment should be discontinued (22, 61). It is essential to take specific guidelines into consideration for orthodontic management, including ideal force and rhythm (22).

4.3.5. Osteoradionecrosis

Osteoradionecrosis is characterized by devitalization and exposure of irradiated bone for a minimum period of three months in patients who have received more than 4000 cGy in facial bones. It affects the mandible more frequently than the maxilla (44, 113, 114).

In its early stage, osteoradionecrosis may present asymptptomatically, although the main signs (erythema, gingival bleeding, exposed bone devitalized through the ulcerated mucosa or skin) may be evident on visual inspection. In some cases, exposure of devitalized bone tissue can progress to the development of bone sequestration (a portion of bone detaches from healthy bone during the necrosis process) and orocutaneous fistulas due to secondary infections and pathological fractures. Functional alterations, such as trismus, and difficulty chewing and swallowing may also occur (115).

In cases where there is low bone exposure, a conservative approach is usually effective. Localized care of exposed bone tissue and surrounding soft tissue includes maintaining strict oral hygiene. This involves cleaning the wound with antimicrobial solutions, regular use of 0.12% chlorhexidine and, if necessary, taking antibiotics. The wound must be irrigated and sanitized periodically, and bone sequestration must be eliminated without trauma because its presence delays the healing process and its removal facilitates epithelialization at the site. In cases where bone exposure is associated with a local infection, antibiotic therapy should be administered (115).

Surgical treatment consists of debriding all devitalized bone tissue and facilitating extensive local cleansing. This is associated with the stimulation of bleeding from adjacent bone tissue, which is critical to the repair process. Removal of sharp edges that can cause soft tissue trauma and primary closure of the surgical wound are also essential to successful treatment. However, even with proper surgical technique, a significant number of cases with bone exposure persist (115).

4.3.6. Neoplasms secondary to cancer treatment

Cancer patients who survive into childhood or adolescence are at risk of developing second malignancies, which vary according to factors such as cancer type, type of treatment, environmental exposures, genetics, etc. (102, 116, 117) (Figure 33).

Signs and symptoms of neoplastic diseases affecting the oral cavity during childhood and adolescence involve manifestations common to other non-malignant diseases. As there is a direct relationship between early diagnosis and improved prognosis, careful intraoral examination and careful interpretation of signs and symptoms are essential for early detection of neoplasia (102).
Figure 33. Squamous cell carcinoma in a patient treated for childhood acute lymphoid leukemia

© Centro Infantil Boldrini, Campinas, Brasil.
Providing oral care for the pediatric cancer population should be understood as a set of preventive and curative actions, including good oral hygiene, raising awareness among caregivers, applying specific dental procedures (when necessary), systematic and routine monitoring, support for detecting and treating alterations that occur in the oral cavity during antineoplastic therapy, and guidelines for adequate monitoring of oral health after completing cancer treatment.

It is suggested that patients be accompanied by dentists who are directly involved in the team responsible for cancer care for at least six months, or until the patient is no longer immunocompromised. When this is not possible, the dental surgeon (or the oncologist) should inform the dental surgeon who will be caring for the patient about the previous treatment and its impact on the orofacial structures. Based on this information and the patient’s oral care habits, the dental surgeon will determine the ideal period for visits, oral care, and hygiene practices in each situation.
REFERENCES


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Annex 1
Hematological criteria for dental treatment of pediatric patients with cancer based on hematological status

<table>
<thead>
<tr>
<th>Hematological status</th>
<th>Recommendations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient with catheter for venous access (for example, Hickman catheter).</td>
<td>American Heart Association antibiotic prophylaxis (low risk). There is no clear scientific evidence detailing the risk in this population. This recommendation is empirical.</td>
</tr>
<tr>
<td><strong>Absolute neutrophil count (ANC)</strong></td>
<td></td>
</tr>
<tr>
<td>&gt;2000/mm³</td>
<td>Antibiotic prophylaxis is not needed.</td>
</tr>
<tr>
<td>1000/mm³ to 2000/mm³</td>
<td>Clinical judgment based on patient status and planned procedures. Some authors suggest that antibiotic coverage with ANC between 1000/mm³ and 2000/mm³ should be instituted. If there is an infection or suspected infection, more aggressive antibiotic therapy may be indicated, as discussed with the medical team.</td>
</tr>
<tr>
<td>&lt;1000/mm³</td>
<td>Postpone elective dental care. In case of emergency, antibiotic coverage should be discussed with the medical team before proceeding with the procedure. Antibiotic coverage should be carried out based on the sensitivity of known or expected microorganisms. The patient will need to be admitted to the hospital for dental treatment.</td>
</tr>
<tr>
<td><strong>Platelet count</strong></td>
<td></td>
</tr>
<tr>
<td>&gt;75 000/mm³</td>
<td>No additional support is required.</td>
</tr>
<tr>
<td>40 000/mm³ to 75 000/mm³</td>
<td>A platelet transfusion should be considered prior to and 24 hours after the procedure, depending on the degree of difficulty of the procedure and the risk of bleeding. Local procedures to contain prolonged bleeding include sutures, hemostatic agents, local pressure, and gel or sponges.</td>
</tr>
<tr>
<td>&lt;40 000/mm³</td>
<td>Postpone elective dental care. In case of emergency, supportive measures (platelet transfusion, bleeding control, hospitalization, and specialized management) should be discussed with the patient’s physician prior to the procedure. In addition, localized procedures (e.g., microfibrillary collagen, topical thrombin) and medications recommended by the hematologist-oncologist (aminocaproic acid, tranexamic acid) may help control bleeding.</td>
</tr>
</tbody>
</table>

**Note:** Other coagulation tests may be requested, based on the individual characteristics of each patient.  
Evidence suggests that photobiomodulation acts on mitochondria to activate the transmembrane protein cytochrome c oxidase responsible for transferring electrons to oxygen molecules that become water.

**Annex 2**

**Cellular effects of photobiomodulation**

Potential to promote the reduction of mitochondrial oxidative cytochrome c blockade, inhibiting apoptosis in various physiological and pathological conditions.

Potential to increase the expression of cell culture factors, including fibroblasts, keratinocytes, endothelial cells, and lymphocytes.

Potential to stimulate the migration and metabolism of cells associated with soft tissue healing, to promote the healing process and wound closure.

Photobiomodulation can modulate integrin expression patterns and focal action kinase activity, consequently modulating cell-cell and cell-extracellular matrix adhesion patterns.

Annex 3
Effects of photobiomodulation on soft tissues

**Epithelium**
The effects of photobiomodulation on the release of factors such as TGF-β and VEGF, mentioned above, act mainly in stimulating the proliferation and metabolism of fibroblasts and epithelial cells, to accelerate the processes of healing and tissue repair.

**Connective tissue**
Acts on the components of the connective extracellular matrix to promote the synthesis of collagen and procollagen, and also in the process of angiogenesis and increased blood flow, in order to support the tissue remodeling and repair process. Also acts on specialized connective tissue.

**Muscle tissue**
Has the potential to modulate matrix metalloproteinases, stimulate the reactivation and proliferation of myofibrils, and act on stem cell activation, promoting the regeneration and neoformation of smooth muscle and skeletal muscle components.

*Note: PBM: photobiomodulation; TGF-β: transforming growth factor beta; VEGF: vascular endothelial growth factor.
Annex 4
Flowchart showing interactions between groups of symptoms in the head and neck and gastrointestinal symptoms

Oral mucositis
Radiodermatitis
Pain
Dysphagia
Hyposalivation
Dysgeusia

Dietary adaptations
Poor oral hygiene

Increase in cariogenic microorganisms
Decreased salivary pH
Accelerated demineralization and reduced remineralization
Radiation-related caries

Dehydration
Nausea and vomiting

Annex 5
General procedures related to oral care, depending on the availability of a dental surgeon on the cancer treatment team and the structure of the treatment facility

Pediatric oncology team

- Team has a dental surgeon who works exclusively with pediatric cancer patients
- Referral for dental assessment soon after diagnosis
- Preparation of the oral cavity, respecting clinical and hematological criteria
- Oral care guidance for parents and patients
- Preventive and therapeutic measures related to mucositis in collaboration with the nursing team
- Follow-up dental appointments scheduled
- Outpatient and hospitalization follow-up, together with medical and nursing teams
- Dental follow-up throughout the patient’s entire cancer treatment
- Dental follow-up after completing cancer therapy, to detect late effects and second neoplasms in the oral cavity
- Dental surgeon available at the cancer treatment facility, with on-demand care
- Referral for on-demand dental assessment after identification of alterations in the oral cavity by the medical or nursing team
- Resolution of the complication and preparation of the oral cavity, respecting clinical and hematological criteria
- Oral care guidance for parents and patients, under the responsibility of medical and nursing staff
- Preventive and therapeutic measures related to mucositis in close collaboration with the nursing team
- Conducting outpatient or inpatient dental consultations, as required by the medical or nursing team
- Dental support during the patient’s cancer treatment of the patient, respecting the care structure of the facility
- Dental follow-up completing cancer therapy, to detect late effects and second neoplasms in the oral cavity, respecting the care structure of the facility
- No dental surgeon at the cancer treatment facility
- Management of changes in the oral cavity with local care and pharmacological measures, to resolve acute conditions
- Evaluation of the possibility of referral for dental treatment in partner facilities
- Oral care guidance for parents and patients, in close collaboration with the nursing team
- Preventive and therapeutic measures related to mucositis, under the responsibility of medical and nursing staff
Annex 6
Specific oral care procedures, based on each stage of cancer treatment

01 Before starting treatment

- Referral of all patients admitted for antineoplastic treatment to an initial dental consultation for a clinical examination, initial guidelines, and detailed planning. If the patient is admitted and subsequently hospitalized, the first contact with the dental team will be in an inpatient setting.
- “Zero Time” assessment: Estimate the priority of preparing the oral cavity depending on the cancer treatment protocol.
- Preparation of the oral environment with the elimination of possible sources of infection, including biofilm, calculus, fractured teeth or restorations, and temporary teeth in the exfoliation phase. Perform adhesive restoration procedures and apply sealants and topical fluoride.
- Removal of orthodontic appliances: If clinical instability does not allow them to be removed shortly after admission, they will be monitored daily and the issue will be discussed with the medical team to determine when the patient is least at risk. In case of severe thrombocytopenia, extraction should be performed shortly after a platelet transfusion to optimize the timing of the procedure. If necessary, the orthodontic appliance can be removed in the floor units or in the intensive care unit.
- Cases with prescribed extractions should be addressed before placing a central venous catheter in order to reduce the possibility of contamination.
- Possible infectious foci should be removed before stent placement, in cases involving tumors of the musculoskeletal system.
- All oral preparation should be done before radiation therapy to the head and neck region; The patient and caregiver should be counseled about oral care during radiation therapy and possible chronic toxicities.
- All oral preparation should be carried out before performing hematopoietic stem cell transplantation, as well as eradicating any oral infection present or possible infectious foci; it is necessary to provide guidance to the patient and caregiver about oral side effects and oral care during transplantation.

02 During treatment

- The patient should brush their teeth with a small-head toothbrush with soft or very soft bristles, if they cannot do so, a dry gauze should be used.
- Use fluoride toothpaste (1000 ppm-1500 ppm), respecting the amounts indicated based on the age of the patient, preferably with non-acidified creams to reduce the risk of irritating the oral mucosa.
- Keep lips moisturized with moisturizing products, preferably lanolin-based or essential fatty acids.
- When necessary, use artificial saliva to hydrate the mucous membranes.
- Apply mouthwash as prescribed based on the therapeutic regimen: 0.9% saline, solutions with salivary enzyme complex, topical anesthetic agents or antimicrobial solutions. For patients receiving facial radiation therapy, a baking soda solution may be used.
- Schedule low-power laser applications to prevent or treat oral mucositis.

03 Post-treatment

- Periodic oral evaluation to reinforce oral hygiene guidelines, biofilm removal, and topical application of fluoride gel.
- Prescribe the use of daily mouthwash use with 0.05% fluoride sodium solution, for patients at high risk of caries. Applications of 2% sodium fluoride gel and fluoride varnish may also be considered.
- Careful inspection of all orofacial structures to identify late effects associated with cancer treatment, potentially malignant or neoplastic lesions.
- Guidance on exposure to environmental carcinogens and harmful habits.
- Prescribed X-ray examinations, if necessary, to detect changes in dental elements, such as agenesis or root malformation.
- Provide referrals and encourage interfacing with the external professional who will carry out the dental treatment after the completion of cancer therapy.

Suggested guidance for caregivers (may be adapted and provided by the team, based on the structure of each cancer treatment facility)

Oral cavity care is not limited to technical dental procedures. Instead, it should be considered as a sum of the efforts of the members of the multidisciplinary team.

Although the oral cavity is a priority field of action for dental surgeons, the nursing team plays a critical role in helping to maintain oral health in pediatric cancer patients.

The table below provides guidelines that can be offered to patients and caregivers, based on the structure of each cancer treatment facility.

<table>
<thead>
<tr>
<th>Change</th>
<th>Suggested care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>Advise that pain in the oral cavity in cancer patients can have many causes, such as mucositis, peripheral neuropathies, erupting teeth, or teeth with extensive carious lesions as a consequence of the disease itself or its treatment. Therefore, any complaints of pain should be reported to the team so that the situation can be assessed, and the appropriate treatment applied.</td>
</tr>
</tbody>
</table>
| Mucositis| • Inspect the mouth daily.  
• Always keep the mouth clean, especially after meals, using a soft-bristled toothbrush.  
• Brush the teeth two to three times a day (minimum) and before bedtime, with a soft or extra-soft bristle brush (preferred) and non-irritating toothpaste containing fluoride (1000 ppm-1500 ppm), respecting the appropriate amount for each age group. At this time, children require stricter supervision of oral hygiene.  
• Floss gently. If the patient is younger and cannot use it alone, an adult should help.  
• Do not use mouthwash with products containing alcohol.  
• Daily mouthwash with saline (0.9%) is recommended at least three to six times per day during chemotherapy, depending on the cancer treatment and the condition of the oral mucosa.  
• For patients receiving facial radiation therapy, a baking soda solution may be used.  
• It is recommended to perform mouthwashes with a salivary enzyme system. This is indicated in cases involving stomatotoxic chemotherapy regimens or radiation therapy in the head and neck.  
• Cleaning the oral cavity with gauze soaked in saline solution helps disinfect if children cannot rinse.  
• Keep lips moisturized with moisturizing products, preferably lanolin-based or essential fatty acids. Do not apply petroleum jelly.  
• Modify the consistency of foods to make them softer, more liquid, and pastier (e.g., soup, cream and puree). Mix the ingredients in a blender if necessary. |
- Avoid acidic, spicy, hard and hot foods.
- Avoid deep-fried foods. Fruits can be crushed or made into a puree.
- Avoid fruit and foods that are acidic or bitter, or that have too much salt or seasoning.
- Prioritize food prepared at room temperature and cooler, as they act as analgesics. Cold foods, such as ice cream and smoothies, are good choices.
- Provide advice about laser therapy if it is available at the facility.

**Important:** The nutrition service can help a lot in choosing food in this situation.

### Dry mouth

- Go to the dental surgeon before starting treatment, radiation therapy, or chemotherapy, to monitor dental and oral health.
- Brush teeth two to three times a day (minimum) and before bedtime, with a soft or extra-soft bristle brush (preferred) and non-irritating toothpaste containing fluoride (1000 ppm-1500 ppm), respecting the appropriate amount for each age group. At this time, children require stricter supervision of oral hygiene.
- Floss gently. If the patient is younger and cannot use it alone, an adult should help.
- Do not use mouthwash with products containing alcohol.
- Daily mouthwash with saline (0.9%) is recommended during chemotherapy at least three to six times per day, depending on the anticancer regimen and the condition of the oral mucosa.
- For patients receiving facial radiation therapy, a baking soda solution may be used.
- It is recommended to perform mouthwashes with a salivary enzyme system, which is indicated in cases involving stomatotoxic chemotherapy regimens or radiation therapy in the head and neck.
- Cleaning the oral cavity with gauze soaked in saline solution helps disinfect if the child cannot rinse.
- Keep lips moisturized with moisturizing products, preferably lanolin-based or essential fatty acids. Do not apply petroleum jelly.
- Drink small sips of water throughout the day and use artificial saliva to moisten the mouth when indicated.
- Chew sugar-free gum or suck on sugar-free candy to increase saliva flow.
- Consume sauces, broths and soups with meals, as they facilitate chewing and swallowing.
- Avoid eating too many sweet foods.

**Important:** The nutrition service can be of great help in choosing food in this situation.

### Candidiasis

- Maintain local hygiene.
- Medical assessment for the use of specific medication, according to the patient’s situation.

### Oral herpes

- If there is a complaint of itching, burning, or the presence of "bubbles" on the lips or sores inside the mouth, caregivers should notify the health care team so that appropriate medication can be prescribed.
- If available at the facility, laser therapy may be prescribed to speed healing and help with analgesia.
This manual has been developed within the framework of the World Health Organization (WHO) Global Initiative for Childhood Cancer—Cure All Americas, to help improve the situation of children and adolescents with cancer around the world, so that they can have the best chances of survival, enjoy a full life and, above all, achieve the best possible quality of life, and if all else fails, die without suffering.

The target audience are health professionals who treat pediatric cancer patients and who directly or indirectly face the complications that treatment can cause at all levels. The content of these pages should contribute to more accurate diagnosis of alterations of the oral cavity and to the development of strategies for the prevention and treatment of these complications. There is no direct guidance for parental guardians or caregivers, but information is presented that serves as a guide for oral care, based on the structure and composition of the teams at different cancer treatment centers.