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**ORAL HEALTH AWARENESS AMONG THE PARENTS OF
CHILDREN UNDERGOING CANCER THERAPY**

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II. Abbreviations and Symbols

AAPD: The American Academy of Pediatric Dentistry

ALL: Acute Lymphoblastic Leukemia

BMT: Bone marrow transplant

DMFT: Decayed, Missing or Filled Teeth

GvHD: Graft Versus Host Disease

G-CSF: granulocyte colony stimulating factor

GY: The gray, derived unit of ionizing radiation dose

HSCT: Hematopoietic stem cell transplantation

HSV: Herpes simplex virus

NS: non-significant

OHI-S Simplified Oral Hygiene Index

OM: Oral mucositis

Sd: standard deviation

Sig: significance

SPSS: Statistical Package for the Social Sciences

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1. ÖZET

KANSER HASTASI ÇOCUKLARIN AİLELERİNİN, ÇOCUKLARININ AĞIZ SAĞLIĞI İLE İLGİLİ FARKINDALIĞI

Levent Akkaş, **Danışmanı:** Prof. Dr. İlknur Tanboğa, Pedodonti Anabilim Dalı

Amaç: İstanbul Üniversitesi Onkoloji Enstitüsü Çocuk Hematoloji-Onkoloji Bilim Dalı'nda tedavi gören çocuk hastaların ailelerinin çocuklarının ağız sağlığı durumları konusundaki farkındalığını değerlendirmektir

Gereç ve Yöntem: 6 ile 17 yaş arasında 50 çocuk hasta muayene edildi. DMFT/dmft, OHI-S indeksleri ve günlük ağız bakımı not edildi. Aynı yaş ve cinsiyetten 50 sağlıklı okul çocuğu kontrol grubu olarak belirlendi. Kanser hastası çocukların aileleri Türkçe hazırlanan anketi dolduruldu.

Ankette sorulan konular: Kanser türleri ve görülen tedavinin genel bilgileri, tedaviden kaynaklanan ağızdaki komplikasyonlar ve tedavi sürecinde ağız hijyeni sağlama yöntemlerinin bilgileri

Bulgular: Hastaların 42%i kemoterapi tedavisine başlamadan önce diş hekimine danışmıştır, 70%i tedaviden kaynaklanan komplikasyonlar ile ilgili bilgilendirildiğini belirtmiştir, 39(%78) hasta tedavi sırasında tedavinin ağız komplikasyonlarını yaşamışlar ve o komplikasyonlar nedeniyle %12 ini tedavisi ertelenip ya da dozu düşürülmek zorunda kalmıştır. En çok karşılaşılan komplikasyon oral mukozit ve enfeksiyon(%46), tat alma değişikliği (%38), yutkunma güçlüğü (%34), ağız kuruluğu (%28) idi. 12 yaş üzerindeki çocuk hastaların OHI-S değerleri daha yüksek bulunmuştur.

Sonuçlar: Kemoterapi gören çocukların ağız sağlığı tedavi komplikasyonlarına bağlı olarak olumsuz etkilenmiştir. Ancak aileler ağız sağlığı ve hijyeni öncelikli sorun olarak görülmemektedir. Çocuk onkoloji hastalarında çocuk onkolog, pedodontist, yardımcı personel ekip çalışması ve protokolların gerekliliğini göstermektedir ve bu konuda aileler bilgilendirilmeli ve gerekli aile eğitimi verilmelidir.

Anahtar kelimeler: Kanser, Kemoterapi, Radioterapi, Ağız sağlığı

2. SUMMARY

ORAL HEALTH AWARENESS AMONG THE PARENTS OF CHILDREN UNDERGOING CANCER THERAPY

Levent Akkaş, **Supervisor:** Prof. Dr. İlknur Tanboğa, Pediatric Dentistry Department

Aim: To assess the oral health awareness in parents of pediatric patients receiving chemotherapy/radiotherapy at Istanbul University, Oncology Institute, Division of Pediatric Hematology-Oncology.

Materials-Methods: 50 patients aged between 6 and 17 years were examined. DMFT/dmft index and (OHI-S) scores were noted. A control group of 50 healthy school children was obtained to match the cancer children with respect to age and sex. Parents of the cancer group were surveyed by a questionnaire written in Turkish to assess the following points: general information about the malignancy and the treatment type, oral complications that occurred during the treatment, their knowledge of the ways to maintain oral hygiene of their child.

Results: 42% of the patients have visited the dentist before starting chemotherapy, 70% said that they've been informed about the oral complications. 39 (78%) patients have experienced oral complications during treatment. The most encountered oral complications were: mucositis and infections (46%), change in taste (38%), discomfort in swallowing (34%), dry mouth (28%), OHI-S scores were higher in the cancerous group than the control group in the children aged between 12 and 17.

Conclusion:

Oral complications can cause significant impairments to oral health. However, the findings revealed that oral hygiene was not a priority for most of the families. Oral health can be maintained by the combined efforts of pediatric hematologist-oncologists, nursing staff, and pediatric dentists.

Keywords: Oral Health, Chemotherapy, Radiotherapy, Cancer.

3. INTRODUCTION

Cancer is one of the main causes of death for children, as 300,000 new cases are diagnosed each year in the pediatric population in the ages 0-19 years. Overall, low- and middle-income countries are responsible for four times the number of deaths of the disease in children than the number of deaths in high-income countries. This is mainly because patients in these countries rarely secure means of diagnosing the disease, do not find health professionals who have specialized training, and are most often forced to abandon the treatment because of the high costs (WHO, 2019)

Various modalities are used in the management of cancer, including surgery, hormone therapy, chemotherapy, radiotherapy (radiation therapy), and biological therapy.

Better cancer treatment has successfully managed to increase the number of survivors from the disease. New treatment methods and increased number of survivals are often associated with more cycles of chemotherapy and longer treatment time overall. In many cases, this can increase the risk of both short and long-term adverse effects (Wilberg, 2016).

All of the modalities used can result in oral complications, although some of them, like chemotherapy and head-and-neck radiotherapy, are more relevant than others. In more detail, the National Cancer Institute reports that oral complications can be developed by approximately 10% of the patients undergoing adjuvant chemotherapy, 40% of patients undergoing primary chemotherapy, 80% of patients undergoing myeloablative chemotherapy (i.e. during hematopoietic stem cell transplantation). All patients undergoing head and neck radiotherapy are likely to develop oral complications.

The most common oral complications of chemotherapy are oral mucositis, oral infections (viral- fungal- bacterial), taste disturbance, salivary gland dysfunction, neuropathy, hemorrhage, induction of second malignancy and dental/skeletal developmental problems (Alberth et al., 2006; Dickerman, 2007). Some common oral complications are also developed in head-and-neck radiation therapy. Examples include oral infections (fungal and bacterial), oral mucositis, salivary gland dysfunction, osteonecrosis, taste

disturbance, soft tissue fibrosis, soft tissue necrosis, induction of second malignancy and dental/skeletal developmental problems (Hancock et al., 2003).

Oral problems are responsible for morbidity per se, although the effects of oral problems vary from an individual to another. Thus, some oral problems are mild in intensity, short-lived and are not typically associated with significant distress. Other oral problems, however, are severe in intensity, long-lasting, and are typically associated with significant distress (e.g. radiotherapy- related salivary gland dysfunction). It is worth noting that some ordinary oral problems, such as taste disturbance, can have as much (or greater) impact than other dramatic oral problems, such as oral mucositis.

Cancer therapy can also be responsible for caries prevalence as several studies indicate a relationship between the two. All members of the multidisciplinary team (MDT) should be concerned about oral care, although some of them, such as dentists and dental hygienists, will naturally have specific roles in the management/prevention of oral problems. It is of great importance to involve experienced oral care specialists in the training of non-specialists, and in the development of understandable local care pathways and treatment guidelines. (Qutob et al, 2012)

Role of oral hygiene

An appropriate level of oral hygiene must be maintained during cancer treatment. It is the parents' role to have a good understanding of the oral hygiene protocol, and of the effectiveness of the techniques recommended. The role of dental hygienists and pediatric dentists, however, is to support the oncology team by providing basic oral/dental care, applying oral hygiene measures, delivering emergency dental treatment, and taking part in managing oral complications following cancer therapy (Brennan et al., 2008).

Aim of the study

The aim of this study was to assess the patients' oral health status and the parents' awareness of oral complications for their undergoing cancer treatment children.

4.GENERAL INFORMATION

4.1. Childhood cancers

4.1.1. Background

Children take a percentage of approximately 2% of all registered cases of those who have cancer around the world. Cooperative pediatric clinical groups offer data that suggests a 4.1% increase in the total incidence of childhood cancer in the period 1973–88, and a 1% increase each year thereafter. However, interpreting these data must be done with caution, as these data are somewhat dependent on factors; as a better reporting of cancer, and some random variation in the occurrence of the disease. In the USA, children born in 1999 can develop cancer by the age of 20 with a probability of 1 in 300 – 333 (males – females, respectively) Surveillance, Epidemiology and End Results (National Cancer Institute,2019)

4.1.2. Types

The adult population and the pediatric population vary greatly in respect to the types of cancer that occur in each. The most common neoplasms are acute myeloid leukemia, acute lymphocytic leukemia, neuroblastoma, central nervous system (CNS) tumors (e.g. brainstem glioma, medulloblastoma), Hodgkin's disease, Non-Hodgkin's lymphoma, Wilms' tumor, retinoblastoma, rhabdomyosarcoma, osteosarcoma, and Ewing's sarcoma (Gurney et al., 1995).

4.1.3. Treatment

Remarkable advances have been accomplished in the treatment of most pediatric cancers in overall survival terms. Indeed, a child has an approximately 70% overall chance of being cured of cancer. Children affected by lymphomas, sarcomas, and acute lymphocytic leukaemia have shown the best results achieved. The improvements in survival do not only include improvements in anti-cancer therapies, but also improvements in supportive care (i.e. management of the life-threatening complications of cancer/anti-

cancer therapies). However, cancer remains the most common disease to cause death in childhood.

There is a difference in biology between childhood tumors and adult tumors result in a difference between treatment schedules for children and those of adults. For instance, the schedule for the treatment of acute lymphocytic leukemia involves a sequential combination of drugs at low to intermediate dosages, and consists of three phases; induction, consolidation, and maintenance (of about 18 months). Hematopoietic stem cell transplantation (HSCT) may be indicated in patients with stage IV rhabdomyosarcoma, relapsed acute lymphocytic leukemia, high-risk acute myeloid leukemia, and stage IV neuroblastoma.

4.1.4. Pediatric oncology in Turkey

Each year in Turkey, 2500 – 3000 new cases for childhood cancer are expected. According to the Turkish Pediatric Hematology Societies Registry and Turkish Pediatric Oncology Group, around 2000 new childhood cancer cases are reported each year.

Turkey has a relatively young population, approximately 25% of which is younger than 15 years of age. According to childhood mortality, the fourth cause of death is cancer (7.2%), after infections in the first place, cardiac deaths in the second and accidents in the third.

The major pediatric cancers in Turkey are lymphoma (19%), leukemia (31%), neoplasms (13%), central nervous system (CNS), neuroblastomas (7%), bone tumors (6.1%), soft tissue sarcomas (6%), followed by germ cell tumors, renal tumors, carcinomas- epithelial neoplasms, retinoblastoma, hepatic tumors and others. (Kebudi, 2012)

4.2. Oral complications

Children undergoing head and neck radiotherapy, systemic chemotherapy, and HSCT regularly show symptoms of oral complications. Indeed, acute/long-term oral side effects are developed by children and adolescents more than they are by adults.

Oral complications are a potential cause of mortality, and they are a significant cause of morbidity.

4.2.1. Early complications

4.2.1.1 Oral mucositis

Mucositis induced by cancer therapy occurs in 40-80% of children. Patients undergoing whole-body radiotherapy and/or myeloablative chemotherapy prior to HSCT have the highest percentage of the occurrence of mucositis.

Due to the facts that children and adolescents use more intensive treatment protocols than adults do and are subject to higher mitotic index of the epithelial basal cells than adults are, as well as the fact that they are subjected to a high incidence of hematological malignancies, children and adolescents have a greater overall risk of mucositis than adults. Oral mucositis is one of the most exhausting complications of pediatric cancer therapy. Children and adults share similar clinical features in that.

Generally, mucositis develops gradually in a predictable sequence of stages that presents as erythema, atrophy, ulceration, and finally healing. Induction by chemotherapy or radiation results in the same mentioned results (Scully et al., 2003).

For patients receiving radiation therapy to treat tumors of the head and neck, the initial clinical signs of mucositis occur with cumulative radiation doses as low as 10 Gy, and consist of mucosal erythema, superficial sloughing, and discomfort. Although the mucosa is intact at this stage, it is not uncommon for patients to complain of mucosal burning analogous to pain associated with a food or chemical burn. By cumulative radiation doses of 20 Gy–30 Gy (usually occurring between the second and 3rd week of treatment in a typical radiation schedule), the intact mucosa starts to break down and ulceration occurs (Bentzen et al., 2001).

No site in the mouth is immune to the effects of radiation-induced injury, but the most reported areas for lesions are floor of the mouth, the buccal and lingual mucosae, and soft palate. At this stage, mucositis appears as a penetrating ulcerative lesion with uneven borders. A pseudo membrane consisting of necrotic tissue laden with bacteria often covers the ulceration. This phase is characterized by severe pain often requiring opioid analgesia and resulting in patient's inability to eat normally. This severe phase of mucositis typically persists for up to 3 weeks following the completion of the radiation course.

Ulcerative mucositis induced by chemotherapy tends to have a more acute course and begins within days of drug infusion (Woo et al., 1993).

Primary changes in the oral mucosa are seen within 5 days of chemotherapy administration. Painful ulceration usually appears by day 7. Lesions can involve any area of the movable oral mucosa; the more heavily keratinized areas such as the hard palate, dorsal tongue, and gingiva are spared. This site distribution is important and, often, helpful in differentiating mucositis from lesions of infectious origin such as candidiasis or viral infections. As with radiation-induced mucositis, mucosal injury caused by chemotherapy is extremely painful and requires opioids for reasonable control. The ulcerative phase lasts for about a week to 10 days and, in most cases, goes on to heal spontaneously by 3 weeks of its origin.

Children initially describe (when possible) a burning or tingling sensation, followed by intolerance to food. Drooling may occur in children that cannot swallow normally. The severity of mucositis in childhood is clearly related to the use of narcotic analgesics, use of total parenteral nutrition, use of antibiotics, development of life-threatening infections, 100-day mortality statistic, and higher cost of care. Oral mucositis tends to resolve more quickly in children than in adults.



Figure 4.1 Chemotherapy-Induced Oral Mucositis

Prevention of Oral Mucositis

Modifying the treatment plan such that the doses are lower and recovery periods between them are longer is still the best way to limit the severity and prevalence of mucositis. That being said, mucositis remains a primary factor to limit doses. However, reducing doses (Cheng et al., 2002), interrupting the treatment and stopping it completely (Logan et al., 2007), might have a negative impact on treatment prognosis. This can have a direct effect on length of remission, cure rates and, subsequently, patient survival (Cheng et al., 2002).

A Cochrane review 2010 shows some evidence that preventing oral mucositis is practically possible by using keratinocyte growth factor (palifermin) and cryotherapy (ice chips). The review also shows that reducing the severity of oral mucositis is also possible using Sucralfate. Weak evidence suggests that reducing oral mucositis might also be achieved using amifostine, aloe vera, intravenous glutamine, laser, honey, antibiotic lozenges and granulocyte colony stimulating factor (G-CSF). However, applying this knowledge is not as easy as stating it in theory, and there are two reasons for that. First, cancer therapies were applied to only a few types of cancer, and second, these therapies might not be quite similar or be combined when applied in the process (Worthington et al., 2013). In her systematic review, Qutob et al., 2013 mentioned that we have a tangible reason to believe we can mitigate the severity and reduce the frequency of oral mucositis by applying an effective oral care protocol. A successful attempt was actually witnessed in South Australia at the “Women’s and Children’s” Hospital by applying an oral care protocol.

Treatment of Oral Mucositis

An effective treatment for oral mucositis is still not routinely available today. According to a Cochrane review, there is two-trials limited evidence that the severity of oral mucositis may be reduced by low-level laser treatments. More research is needed to confirm (Worthington et al., 2011).

Currently, treatment mainly focuses on preventing secondary infection and palliating symptoms. This currently involves good oral hygiene; the use of systemic, topical and IV analgesics; and a specific amount of parenteral nutrition. (Peterson et al., 2012; Keefe et al., 2007; AAPD, 2013).

Upon finding that alcohol with chlorhexidine rinses causes irritation, non-medicated mouth rinses have been recommended once oral mucositis has developed. Saline and sodium bicarbonate are good examples. Due to its antimicrobial benefit that may prevent secondary infection, 0.2% chlorhexidine mouth rinse (non- alcoholic) has been recommended, during periods of oral mucositis, by the Women's and Children's Hospital in Adelaide. Further research in this area is clearly needed in the pediatric population.

4.2.1.2. Oral infections

Every type of oral infection is a potential risk in children, due to compromise of the immune system and the mucosal barrier.

Fungal infections

Children receiving systemic chemotherapy (especially throughout periods of severe immunosuppression) and those receiving head-and-neck radiotherapy often develop oral fungal infections. It is, therefore, of critical importance to control local infection and prevent fungal colonization in order to avoid systemic fungal infections (Gozdasoglu et al., 1999).

Bacterial infections

Mucosal surfaces in general are at potential risk of bacterial infections, but the gingival tissues are the areas most commonly involved. Potential complications of oral mucosal infections are manifested in fevers and systemic bacteremia. Infection can also result in the primary teeth being exfoliated and permanent teeth being erupted.

Viral infections

Herpes simplex virus (HSV) is responsible for the bigger part of the oral infections in those with cancer in the pediatric population. The HSV infection manifests in oral/extra-oral ulcers associated with erythema and crusting. It is not unusual for children with cancer to have widespread herpetic stomatitis suddenly emerging. (Brethauer et al., 2005).



Figure 4.2 Herpes Simplex Virus

Prevention of Oral Infections

Reducing the chance of oral infections can be achieved using an antimicrobial mouth rinse and maintaining excellent oral hygiene in general. It is also recommended to eliminate areas of irritation which might, in any case, lead to a breach in the epithelium part of the mouth (AAPD, 2013). The prescription of antifungal and antiviral on an individualized basis is also a good option to be taken by the oncologist.

Treatment of Oral Infections

One of the most important oral infections is Candidiasis, and microscopic examination is the best approach to guarantee a definitive diagnosis for this type of infection. Using topical oral antifungal agents is the best way to manage Oral Candidiasis (Little et al., 2008). A good approach for treating the infections would also be the use of amphotericin lozenges, miconazole 2% gel or nystatin oral drops four times after food on a daily basis, as recommended by the Australian therapeutic guidelines (TG, 2012).

When suspecting a bacterial oral infection, it is recommended to perform sensitivity testing for culture and bacteria using a swab, to then treat accordingly with antimicrobials (Little et al., 2008).

A swab together with laboratory tests are also recommended for patients with immunocompromised HSV to achieve a definitive diagnosis for aphthous ulcers on the non-keratinised epithelium. This approach is also useful to distinguish between other infections like the one from cytomegalovirus and varicella zoster. Keeping the HSV suppressed during chemotherapy in HSV positive patients can be fulfilled by a sufficient

dose of acyclovir or some equivalent antiviral on a daily basis (Little et al., 2008). For those positive to cytomegalovirus and undergoing BMT in periods of immunosuppression, prophylaxis is a recommended medication (da Fonseca, 1998). Antiviral sensitivity is also suggested in cases where the lesions are extensive or unresolved (Little et al., 2008).

4.2.1.3. Salivary gland dysfunction

There might be a relation between salivary gland dysfunction and toxicity from systemic chemotherapy, head-and-neck radiotherapy, and HSCT (Belfield et al., 2004). Salivary gland dysfunction that is induced by chemotherapy is generally temporary, typically resolves in 48 h following treatment. Dysfunction induced by radiotherapy is generally permanent. However, despite the damage caused by radiation to the acini of the salivary glands, some children do achieve an improvement in salivary gland function in 2–12 months after radiotherapy

Prevention of Xerostomia and Salivary Gland Hypofunction

The fact that salivary glands are critical areas in the process and that minimizing any damage to them is quite important made it necessary to reduce their exposure to the radiation, which can be achieved by utilizing shields during radiotherapy.

Though it was shown that the use of shields does fulfil this purpose, it is important to note that reducing or preventing salivary gland damage is not always possible and, therefore, continual assessment and monitoring is recommended before, during and once the treatment has been completed. The effects that chemotherapy has on salivary glands are thought to be temporary (Jensen et al., 2010).

However, the reduced function of the salivary glands results in a clinical manifestation of xerostomia, which has to be reduced too by keeping patients well hydrated and making sure they consume a slightly acidic diet. (Hong and da Fonseca, 2008).

Treatment of Xerostomia and Salivary Gland Hypofunction

The pediatric population is not recommended to use the same saliva stimulating medications, such as parasympathomimetic (pilocarpine) or anticholinergic, that the adult population is recommended to use to help with salivary flow during and after radiotherapy. Topical agents such as oral mucosal coating agents, neutral mouth rinses and salivary substitutes can be beneficial for treatment (Hong and da Fonseca, 2008). It would also be

useful to maintain practices like sipping of water, chewing sugar-free gum, and placing a humidifier beside the bed (Hong and da Fonseca, 2008).

4.2.1.4. Taste Disturbance

Cancer therapy is one of the main reasons responsible for an altered sense of taste and/or loss of taste discrimination (Skolin et al., 2006). However, children usually recover their sense of taste 1–3 months after the cancer therapy has ended. These sequelae may cause significant distress to the patient, reduce their nutritional intake, and interfere with their physiological growth.

It should be noted that nutritional intake may also be affected by other common therapy-related problems such as anorexia, nausea and vomiting, and oral mucositis/stomatitis.

Management protocols that are currently applied focus mainly on improving the appearance, as well as the texture and the smell of the food. It would help enhancing the nutrition to make foods that children and adolescents usually prefer a prime option (i.e. specific drinks or snacks).

Supplements containing zinc were proved, in some instances, to have a positive impact to help recovering the sense of taste.

4.2.1.5 Oral Bleeding

Oral bleeding occurs on a rate ranging from 6% to 42% as to those receiving cancer therapy in the pediatric population. Risk factor most commonly involve orthodontic appliances, mucosal trauma, mucosal infections, thrombocytopenia, coagulopathies, mobile primary teeth, and poor oral hygiene.

Spontaneous bleeding is rare with a platelet count of $\leq 50\ 000/\text{mm}^3$, and the occurrence and severity of the bleeding are decreased as long as the platelet counts is above $20\ 000/\text{mm}^3$.

Oral hemorrhage can manifest in a spectrum of situations, ranging from simple gingival oozing to serious mucosal bleeding; It can be clinically problematic, however, in situations where mucosal breakdown or infection occurs in a patient with severe thrombocytopenia.

Prevention of oral bleeding

Poor oral hygiene contributes to more dangerous situations of gingival hemorrhage. It is recommended, therefore, to maintain good oral hygiene all the time, and periods of

thrombocytopenia are not an exception, though it is better to use soft devices in this case. It would reinforce the importance of oral hygiene to say that teeth and gingival areas still need to be taken care of when brushing is not possible. In this case, a good approach would be to soak a sponge in chlorhexidine and wipe the tissues with it (Little et al., 2008; AAPD, 2013).

Treatment of oral bleeding

It is possible to stop or mitigate oral bleeding with simple methods like ice packs and gauze pressure packs. Tranexamic acid, among other topical agents, is also useful. It is necessary to contact the Oncology Team, however, if the attempt is unsuccessful and there is insufficiency in the platelets, for which a platelet transfusion should be considered (Little et al., 2008).

4.2.2 Long-term complications

4.2.2.1. Dental developmental abnormalities

Chemotherapy/radiotherapy administered during odontogenesis may cause various dental abnormalities (Alberth M et al., 2004). These sequelae are direct effects of the three following factors; children's age when cancer therapy is initiated (greater risk is expected when the cancer therapy starts prior to age 5, the stage to which the teeth are developed, and the type of protocol decided for treatment. Dental abnormalities occur in higher rates in children with mixed dentition that undergo cancer therapy, which is possibly caused by the rapid/major odontogenic changes that occur through the therapy. When radiation is responsible for the abnormalities, they only occur in the irradiated area. Radiotherapy of a high dose during the earliest phases of tooth development can have a negative impact on the tooth so much as to leave the cells of tooth germ destroyed, which results in complete dental agenesis. Radiotherapy of a lower dose also has its own complications, though not as drastic. These include defective calcification and enamel hypoplasia, stunted or tapering roots, and microdontia (i.e. small teeth). When radiotherapy is initiated at late stages of dental development, the mentioned complications can also take place. Radiotherapy-related changes/damage occur simultaneously in the pulp, periodontal ligament, and adjacent bone.

Chemotherapy may damage the developing odontogenic cells which would disturb the dental development by causing enlarged pulp chamber, microdontia, crown hypoplasia, and root abnormalities (i.e. short V-shaped roots, conical roots, etc).

Chemotherapeutic agents usually cause localized dental defects, with the changes occurring mostly in the lower incisors and premolars. It is generally rare to reach complete dental agenesis, but it may still occur if intensive and repetitive chemotherapy is used.

Chemotherapy is also a reason for increasing white spot lesions and enamel hypoplasia, specifically caused by interference to ameloblasts during the formation of dental crown. Cancer therapy can also delay the eruption of teeth in children, while also increasing the frequency of affected maxillary canines. Shortened root length can result in shortened alveolar processes, leading to a decreased vertical dimension of the mandible and the lower-third of the face. Additionally, damage to jaw-growth centers by treatment regimens can lead to decreased size (and mobility) of the jaw bones (Dahllof G, 1998).



Figure 4.3 Dental agenesis following radiotherapy

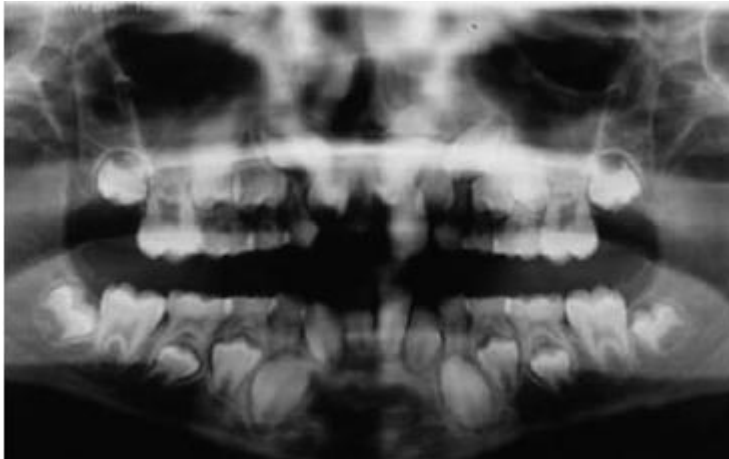


Figure 4.4 Orthopantomogram showing shortened roots

4.2.2.2. Dental caries

Children with cancer are at high risk of dental caries as a result of multiple factors (Dahllof G et al., 1997).

Damage to the salivary glands by radiotherapy and chemotherapeutic agents results in reduced salivary flow, which causes oral environment changes that favour caries-related microflora. Cancer therapy-induced enamel defects increase the risk of dental caries.

Other factors associated with the development of dental caries include poor oral hygiene, carbohydrate-rich diet, sucrose-rich pediatric medications, nausea and vomiting (causing acid erosion), prolonged hospitalization, and psychological factors.

4.2.2.3. Trismus

High doses of radiotherapy to the head and neck may cause fibrosis of the masticator muscles, which may lead to the development of trismus (Dijkstra PU et al., 2004).

Prevention and treatment of trismus

Stretches and exercises on a daily basis can be useful for trismus and committing to them in a habitual manner is advisable to begin before the treatment and to maintain for 3-6 months after the completion of radiation therapy (AAPD, 2013; Hong and da Fonseca, 2008).

Treatment of trismus revolves about the reduction of fibrosis, which is achieved by pain management strategies that include, but are not limited to, analgesics, prosthetic aids, muscle relaxants and trigger point injections (AAPD, 2013; Little et al., 2008; Scully and Epstein, 1996).

4.2.2.4. Oral graft-versus-host disease (GVHD)

The frequency of GVHD is usually lower in pediatric patients who undergo HSCT than in adult patients. The oral cavity can be involved with both acute and chronic forms of the disease.

Oral GVHD usually presents as part of multi-system involvement, but in numerous patients it is the first or only manifestation of the condition.

Treatment of Graft Versus Host Disease (GVHD)

GVHD develops into quite serious stages, and immunosuppressive agents are typically used for treatment. This is not easily achieved, and experts are still performing clinical trials in this area (NCI, 2013). A serious development is chronic GVHD, which is preceded by acute GVHD. Oral lesions are generally managed with systematic relief.

4.2.2.5. Second tumors

One of the most serious oral complications facing long-term survivors of HSCT is secondary oral malignancy, such as oral squamous cell carcinoma and Non-Hodgkin's lymphoma (Treister NS et al., 2005).

GVHD appears to be a significant risk factor for this complication. Secondary oral malignancies may also occur in other patients that have received systemic chemotherapy and head and neck radiotherapy (National Cancer Institute).

4.3. Oral Care Protocol for Pediatric Oncology Patients

Oral health care providers play an essential role in the management of pediatric patients undergoing cancer therapy. Pediatric dentists and dental hygienists should support the oncology team by providing basic oral/dental care, implementing oral hygiene measures, delivering emergency dental treatment, and assisting in managing oral complications from cancer therapy. The ultimate goals of the dental care team's

coordinated efforts are to reduce the incidence and severity of oral complications, improve patient comfort during cancer treatment, improve patient outcomes from cancer treatment, and help to reduce the overall cost of care (AAPD, 2013).

4.3.1. Referral to a Specialist Pediatric Dental Team

All cancerous patients are better assessed by a dentist without delay to discover any untreated dental disease that would otherwise lead to undesirable complications (Rubenstein et al., 2004; AAPD, 2013).

It is also recommended to identify patients that might develop oral complications in order to establish part of the complete initial management. It follows that patient-and-parent education about oral care should be eagerly provided to those who actually need this service. It would benefit patients to know that the oral cavity is especially sensitive to whatever effects radiotherapy or chemotherapy might have, and that it's accepted as a common cause of sepsis in the immunosuppressed cancer patient (NCI, 2013; AAPD 2013). Also, odontogenic infections may play the focus of septic infection in myelosuppressed patients (Hong and da Fonseca, 2008). Additionally, it has been reported that bacteremia that originates from the mouth leads to secondary infection of central venous lines (AAPD, 2013). Untreated dental caries is a possible cause of sepsis.

4.3.1.1. Pre-treatment dental assessments

The three objectives below are stated by The AAPD (2013) for the dental assessments in children with cancer prior to the therapy;

- Identifying and stabilising (or eliminating) any possible sources for local irritants and infection in the oral cavity; without causing unnecessary delays to the cancer treatment or prompting undesirable complications;
- Making sure dentists and oncologists are communicating concerning the oral health of their patient, as well as the time and the plan to be arranged for the treatment;
- Educating the patient and parents by reinforcing the significant role that optimal oral care plays in minimizing oral problems prior to, during, and after the therapy and by informing them of the potential severe and late effects of the treatment in both the craniofacial complex and the oral cavity.

This preliminary assessment is to make sure any active dental disease is discovered at this stage.

What is indispensable in detecting for any dental disease and the urgency needed for the treatment is a detailed and thorough evaluation that involves radiographic and clinical examination with an assessment to intraoral soft tissues and bony structures.

The initial records monitoring the effects of chemotherapy and radiotherapy on the oral/craniofacial and dental structures gives the opportunity in the future of assessing dental late effects that follow cancer treatment. This also includes an assessment for intraoral malignancy or leukemic infiltrates (Brennan et al., 2008).

4.3.1.2. Preventive strategies

A discussion on important preventive strategies should take place and cover the topics of both diet and oral hygiene. Advice is given to raise awareness of medications containing sucrose and of high cariogenic supplements (AAPD, 2013, Little et al., 2008). The discussion can also introduce a personalised fluoride program (AAPD, 2013). It might also cover trismus prevention where relevant (AAPD, 2013). Procedures to deal with soft tissue changes (xerostomia, mucositis, bleeding and infections) that would help decreasing patient morbidity also have to be included in the discussion. Including individualised care concerning the prevention of herpes simplex infections and candida is also recommended.

4.3.1.3. Standardised oral care regimen

The great importance of a standardised regimen for oral care is demonstrated by how indispensable it is in reducing the severity and prevalence of oral complications, like oral mucositis, that might occur in those patients who are receiving oncology therapy (Cheng et al., 2002; Cheng et al., 2004; Hogan, 2009; Qutob et al., 2013). An evidence was revealed, in five articles included in a systematic review by Qutob et al., 2013 that supports the positive effects that oral care protocols have in preventing oral mucositis in children. Four of these five articles showed that the rates of incidence of oral mucositis witnessed a reduction that is statistically significant, and it ranges from 22-40% (Qutob et al., 2013; Cheng et al., 2001; Cheng et al., 2004; Cheng & Chan 2003).

It was also shown that patients who committed to an oral care protocol experienced oral mucositis in a quite less severity (Cheng et al., 2001; Cheng et al., 2004).

Results reached by the systematic review mentioned and the observations from recent experiences press the importance and necessity of sufficient education for the patients and their parents on the advantages of preventative oral care in reducing oral complications and the importance, in general, of maintaining an optimal state of oral hygiene (Hong and da Fonseca, 2008; Petersen et al., 2011; AAPD, 2013).

A part of educating patients is encouraging them to brush their teeth with no discontinuities, despite hematological status, and to replace their tooth brush every month. Only in cases where neither brushing nor rinsing is possible, patients should use jumbo probe swabs to apply the 0.2% Alcohol-Free Chlorhexidine mouth rinse.

4.3.2. The treatment planning and management of dental disease in oncology patient

4.3.2.1. Restoration of Dental Caries in Primary Teeth

Where possible, oncology therapy better be initiated only after all caries in the primary dentition are restored. Stainless-steel crowns are an appropriate choice for restorative materials in primary teeth, as stated by the AAPD Guideline 2012. In cases where a primary molar is not heavily covered with caries and there is a need for minute proximal box restoration or a small buccal – or occlusal - cavity, it can help to apply a posterior composite resin (AAPD, 2012). It is usually not recommended to place amalgam in primary teeth for reasons related to environmental circumstances (NHMRC, 1999). However, if placing amalgam in primary teeth is nevertheless in practice in the institution conducting the therapy, the material would be suitable for smaller buccal, occlusal or proximal or cavities (AAPD, 2012).

When it comes to primary anterior teeth, small labial restorations were carried out by composite resins, which were found to be the most suitable material for this type of restoration (Lee J, 2002; AAPD, 2012). Another use of composite resin in primary anterior teeth is the role they play in restoring proximal caries of moderate sizes and smaller (Lee J, 2002). For primary anterior teeth of moderate to large carious lesions, or those with significant decalcification, full coverage restorations - such as composite resin strip crowns - are preferred. For young children with limited co-operative ability and extensive anterior caries, extraction may also be considered as the definitive and most appropriate option. This approach also reduces the risk of future infection. For primary anterior teeth of

moderate and larger carious lesions, or those with significant decalcification, composite resin strip crowns and other full coverage restorations are preferred. For young children with limited co-operative ability and extensive anterior caries, extraction can be the definitive and best option, and it also helps avoiding any future infections.

4.3.2.2. Restoration of Dental Caries in Permanent Teeth

Where possible, oncology therapy better be initiated only after all caries in the permanent dentition are restored. Decreased survival rates in restoring young permanent teeth, as well as larger pulp chambers form two of many factors that need to be considered when choosing restorative material for the newly-emerging permanent tooth (Vidnes-Kopperud et al., 2009).

Placement of fissure sealants is recommended in either or both of the two-following cases: When the fissures are particularly retentive and when it's established that patients are high caries risk having experienced caries in the past. Ahovou-Salaranta and colleagues found in a systematic review 2014 that permanent molars that were the first in fissure-sealing witnessed a reduction rate in caries of 87% at 12 months. At 48-54 months, this reduction was still maintained to as high as 60% (Ahovuo et al., 2017)

4.3.2.3. Pulp therapy in Primary Teeth

The safety of pulp therapy in primary teeth before chemotherapy and radiotherapy for pediatric patients is still not adequately assessed by a study. Therefore, extraction is the most comfortable option for most clinicians as infections during periods of immunosuppression are too dangerous that they might become life threatening (AAPD, 2013)

4.3.2.4. Endodontic Treatment

Careful consideration needs to be taken with endodontic therapy in permanent teeth. Doctors are advised to make sure they initiate the therapy and finish a lengthy endodontic dressing before oncology therapy, or to time the treatment appropriately otherwise.

A tooth needs to be extracted before initiating oncology treatment or at another acceptable time in cases where poor prognosis for endodontic treatment is expected or when maintaining the tooth is no longer necessary. It is also recommended to keep clear

distinction in the aetiology of periapical lesions between inflammatory reactions, pulpal infections, cysts and malignance, apical lesions (AAPD, 2013).

4.3.2.5. Orthodontic Appliances Including Space Maintainers

Patients planning for or undergoing active oncology therapy should have all of their orthodontic appliances removed. This should be done and completed before the initiation of active oncology treatment or, if not possible, at an appropriate time. However, this doesn't apply to all types of appliances. Exceptions include cases where patients have simple loop and band devices applied and are at an excellent state of oral hygiene and where their appliances are removable, retainers or fixed lower arches.

4.3.2.6. Extractions

Extraction of teeth should be executed before the initiation of oncology therapy and it includes retained roots, symptomatic impacted and periodontically compromised teeth, pulpally involved primary teeth, and all non-restorable teeth. It is recommended that the therapy starts only after 7-10 days from extracting the teeth when the mouth is healed (AAPD, 2013).

Should there be any difficulty in executing extractions before the commencement of therapy, extraction appointments are to be arranged such that there is sufficient time for healing before the recommencement of every next round of therapy, i.e. between immunosuppression periods. Mobile deciduous teeth do not need to be extracted. However, the necessity of extracting mobile teeth arises in cases where a general anaesthetic is present during dental treatment. The extraction of Symptomatic mobile teeth may be executed whenever it's deemed necessary such that the timing causes no negative consequences.

4.3.2.7. Periodontal Considerations

Before the commencement of oncology therapy, considerations need to be taken in regard to the periodontal parts. This means that the calculus, as well as the sources of irritation and infection in the gingival tissues - such as restoration overhangs - should be removed (Little et al., 2008). If in any case this was not possible before the therapy, it has to be completed at an appropriate time

4.3.3. Ongoing Dental Management and Identification of Those Patients at Risk of Late Effects

Right after the completion of oncology treatment, the three oral care objectives below are to be followed, as recommended by The AAPD 2013;

- Oral health is to be kept at its optimal state.
- The importance of the ultimate oral and dental care is to be reminded of and reinforced to patients and their parents; and
- Any dental issues which may result from the effects of cancer therapy are to be addressed and/or treated

The goal of management of patients post oncology therapy is to maintain good oral health by routine maintenance and dental treatment as needed (Brennan et al., 2008).

The review appointments are scheduled by the patient himself. It is of high importance that each patient has their dental issues specific to them identified (Brennan et al., 2008).

It is important to reinforce diet and fluoride program as well as oral hygiene. Once patients are in remission, 6 months is an acceptable gap between review appointments. However, in cases where patients are suffering from problems such as xerostomia, trismus or cGVHD, and/or when they are high caries risk, a different gap between appointments has to be scheduled (AAPD, 2013).

The initiation or continuation of orthodontic treatment is generally recommended only after the patient had stopped taking immunosuppressive medications and has been free from the disease for 2 years.

It is also important to note that, before the initiation or continuation of orthodontic treatment, a discussion with the physician assigned to each patient is recommended. This is due to the fact that risk of relapse, prognosis and residual effects of therapy on growth are variable (Berry et al., 1983)

5. MATERIAL AND METHOD

5.1. Material

This study was approved by the Ethics Committee of Marmara University in Istanbul, Turkey. A written informed consent in Turkish was signed by the parents/guardians of all individuals who participated in the research before starting any examination.

5.1.1. Patient selection and inclusion criteria

5.1.1.1. Inclusion criteria

A total of 50 children with confirmed malignancies were examined. The study group consisted of patients attending at Istanbul University Institute of Oncology, Istanbul, Turkey.

All of the patients were

- between 6 and 17 years of age
- diagnosed with cancer and currently undergoing chemotherapy.
- able to complete the oral screening

5.1.1.2. Exclusion criteria

Non-cooperative children and those who were unable to do the oral scan were excluded from the study.

5.1.1.3. Control group

A control group of 50 healthy school children was obtained to match the cancer children with respect to age and sex.

5.2. Method

5.2.1. Questionnaire

Parents of the patients were asked to complete a Turkish questionnaire which was distributed to them. The 2-page questionnaire consisted of three parts. The first part consisted of 7 questions on personal and Characteristic data including gender, age of the patient, parents' education and family monthly income, and a background of the type of cancer being examined and treatment history. The second part consisted of 7 questions on the awareness of the oral complications of the treatment and the way they react towards them. The last part assessed the oral hygiene routines used and the parents' dental satisfaction

Part 1

Q1- Child's age

Q2- Child's gender

Q3- Type of malignancy

Q4- Treatment duration

Q5- Treatment type

 Radiotherapy

 Chemotherapy

 Stem cell transplantation

Q6- What's the highest level of education you have completed?

 -university

 -secondary school

 -primary school

Q7- monthly income

 <1600 TL

 1600-4000 TL

 >4000 TL

Part 2

Q1- Before starting the treatment we've visited the dentist

Yes No

Q2- The oncologist informed us about the necessity of visiting the dentist before the treatment

Yes No

Q3- We've been informed about the mouth problems caused by the treatment before its start

Yes No

Q4-during the cancer treatment we have experienced oral side effects

Yes No

Q5- What mouth problems have you experienced during the treatment

-painful mouth and gum

-dry mouth

-burning, swelling tongue

-infection

-change in taste

-discomfort in swallowing

Q6- Has the treatment doses needed to be decreased or has the treatment stopped because of oral complications

Yes No

Q7- To whom do you go when face a mouth problem?

-oncologist

-nursing team

-dentist

Part 3

Q1- How often do you go to the dentist for your kid?

Every 6 months

Once a year

If necessary

Q2- The oncologist examine the patient oral mucosa routinely

Yes No

Q3- Are you satisfied with the oral health of your child?

Yes No

Q4- How do you maintain an appropriate level of oral hygiene?

-tooth brushing

Occasionally

Once daily

Twice daily

- dental floss -fluoridated toothpaste -rinses

5.2.2. CLINICAL EXAMINATION

Clinical examination was carried out by one examiner using a dental mirror #5 and blunt dental probe in daily light according to the criteria of the World Health Organization (WHO)(World Health,1987).

5.2.2.1. Caries Status

Caries status was determined by recording the number of decayed (d, D), missing (m, M), and filled (f, F) teeth in the primary and permanent dentition. With the DMFT index for permanent, and dmft index for primary dentition we assess the mean dental caries scores for every individual.

5.2.2.2. Oral Hygiene Status

Oral hygiene is a basic factor for oral health. Poor oral hygiene leads to dental plaque collections, which with times turns into the calculus as finally can cause gingivitis and periodontal diseases. That is why many studies, also ours, have been carried out focusing on the role of oral hygiene. Some indices have been developed for assessing individual levels of oral health status (J. C. Greene & Vermillion, 1960; O'Leary, Drake, & Naylor, 1972; Silness & L oe, 1964). In this study, we decided to use Simplified Oral Hygiene Index (OHI-S) by Green and Vermillion, 1964). The OHI-S differs from the original OHI (The Oral Hygiene Index) in the number of the tooth surfaces scored. Instead of 12, there are just six surfaces. The OHI-S has two components, the Debris Index and the

Calculus Index. Each of these indexes is based on numerical determinations representing the amount of the debris or calculus found on the tooth surfaces (J. G. Greene and Vermillion, 1964). The six surfaces examined for the OHI-S are selected from four posterior and two anterior teeth.

Evaluation of the clinical oral variables was performed on the buccal and lingual surfaces of the maxillary: right first permanent molar or right primary second molar; the primary or permanent left central incisor; left first permanent molar or left primary second molar and the mandibular: left first permanent molar or second primary molar; right center incisor; right first permanent molar or right second primary molar.

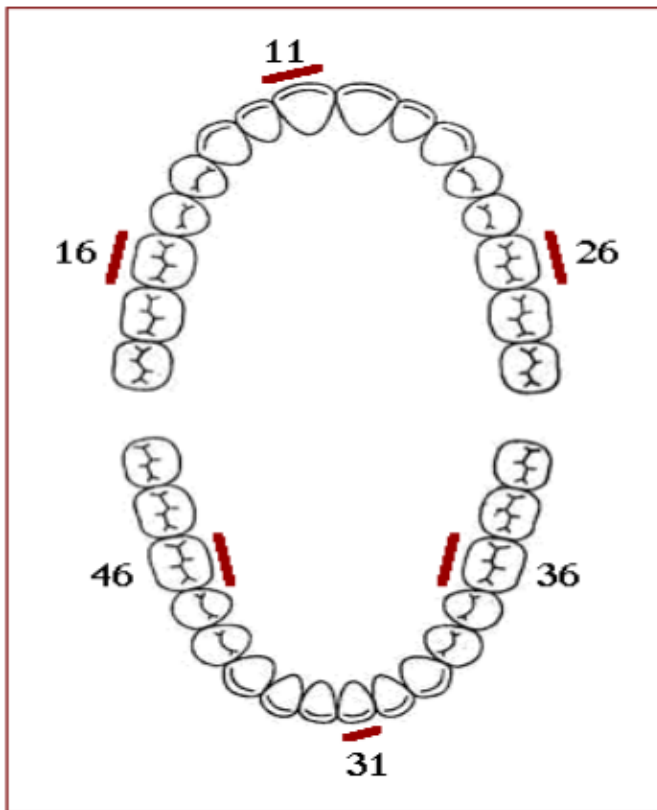


Fig 5.1 Selection of tooth and surfaces for OHI-S

Table 5.1 Criteria for classifying debris

Scores	Criteria
0	No debris or stain present
1	Soft debris covering not more than one third of the tooth surface, or presence of extrinsic stains without other debris regardless of surface area covered
2	Soft debris covering more than one third, but not more than two thirds, of the exposed tooth surface.
3	Soft debris covering more than two thirds of the exposed tooth surface.

Table 5.2 Criteria for classifying calculus

Scores	Criteria
0	No calculus present
1	Supragingival calculus covering not more than third of the exposed tooth surface.
2	Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both.
3	Supragingival calculus covering more than two third of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or both.

After the score for debris and calculus are recorded, the Index values are calculated. For each individual, the debris scores are totaled and divided by the number of surfaces scored. The average individual or group score is known as the Simplified Debris Index (DI-S). The same method is used to obtain the calculus scores or the Simplified Calculus Index (CI-S). The average individual or group debris and calculus scores are combined to obtain the Simplified Oral Hygiene Index (J. G. Greene and Vermillion, 1964).

The CI-S and DI-S values may range from 0-3; the OHI-S values from 0-6.

For the age 6 years, we selected labial surfaces of the 54, 61, 82 and the lingual surface of 75.

For the mixed dentition we added the labial surface of 26 and the lingual surface of 46

5.3. Statistical analysis:

The data collected in the investigation were analysed using SPSS (Version 21.0-For Windows; SPSS Inc., Chicago, IL,USA). In the statistical evaluation of the data, percentage, chisquare, Fisher exact chi-square test, mean, T test were used.

The statistical significance was set at ($p < 0.05$).

6. RESULTS

Table 6.1. Distribution of age and gender in the cancerous group

		N	%
Gender	Male	30	60.0%
	Female	20	40.0%
Age	6-8 years	16	32.0%
	9-11 years	13	26.0%
	12-17 years	21	42.0%

32% of the patients aged 6 to 8 years, 26% aged between 9 to 11, 42% aged between 12 to 17 years. Male patients take the percentage of 60% of the total number of the patients, females counted 40%.

Table 6.2. Duration and the type of the treatment

		N	%
Duration	0-6 months	9	18.0%
	6-12 months	18	36.0%
	more than one year	23	46.0%
Type	Chemotherapy	28	56.0%
	Chemotherapy+Radiotherapy	22	44.0%

18% of the patients started the treatment in the last 6 months, 36% of the patients started the treatment between 6 to 12 months ago, 46% of the patients started the treatment more than one year ago.

Table 6.3. Frequency of Dentist visit

		N	%
How often do you go to the dentist for your kid?	every 6 months	3	6.0%
	once a year	6	12.0%
	if necessary	41	82.0%
Before starting the treatment we've visited the dentist	yes	21	42.0%
	no	29	58.0%
The oncologist informed us about the necessity of visiting the dentist before the treatment	yes	11	22.0%
	no	39	78.0%

Dental visiting pattern differs between the patients: 6% of them visited the dentist every 6 months, 12% visited the dentist once a year, the rest 82% said they go to the dentist if there is a necessity.

42% of the patients said they visited the dentist before starting the treatment, the majority 58% have not visited the dentist before starting the treatment. 22% of the patients have been referred to the dentist before the treatment, the others 78% said that they have not.

Table 6.4. Frequency of patients who have experienced oral complications and been informed about it

		N	%
We've been informed about the mouth problems caused by the treatment before its start	yes	35	70.0%
	no	15	30.0%
The patient has experienced one of the oral complications at least	yes	39	78.0%
	no	11	22.0%

70% of the families said they have been informed about the oral complications that may happen during the treatment, 30 of the families said they have not been informed about the oral complications.

78% of the patients have experienced one of the oral complications of the treatment at least, 22% of the patients have not experienced any oral complication yet.

Table 6.5. Frequency of the oral complications during the treatment

		N	%
has experienced painful mouth and gum	yes	17	34.0%
	no	33	66.0%
has experienced dryness of the mouth	yes	14	28.0%
	no	36	72.0%
has experienced pain in the tongue	yes	6	12.0%
	no	44	88.0%
has experienced oral infection or mucositis	yes	23	46.0%
	no	27	54.0%
has experienced discomfort in swallowing	yes	17	34.0%
	no	33	66.0%
has experienced taste disturbance	yes	19	38.0%
	no	31	62.0%

46% of the patients have experienced oral infection or mucositis, 28% of the patients have experienced mouth dryness, 12% of the patients have experienced pain in the tongue, 34% of the patients have experienced discomfort in swallowing, 38% of the patients have experienced taste disturbance, 34% of the patients had pains in mouth and gingiva during the treatment.

Table 6.6. Parental Dental Satisfaction

		N	%
Are you satisfied with the oral health of your child?	yes	42	84.0%
	no	8	16.0%

84% of the families said they were satisfied with their child's oral health, 16% of the patients were not satisfied with their child's oral health.

Table 6.7. Oral hygiene habits

		N	%
Flossing	yes	0	0.0%
	no	50	100.0%
Use of mouth rinsing	yes	14	28.0%
	no	36	72.0%
Tooth brushing	less than once a day	14	28.0%
	once a day	7	14.0%
	twice a day	29	58.0%

58% of the patients were brushing their teeth twice a day, 14% of them were brushing their teeth once a day, 28% were brushing less than once a day, 28% of the children were using mouth wash daily, in 72% of the mouth wash was not part of the daily routines, the dental floss was not used by any patient in the study group.

Table 6.8. Parental education level

		N	%
Education	university	11	22.0%
	high school	11	22.0%
	primary school	28	56.0%

22% of the parents in the study had a university degree, 22% have finished high school, 56% have only finished primary school.

Table 6.9. Family income

		N	%
Income	1600	26	52.0%
	1600-4000	20	40.0%
	more than 4000	4	8.0%

52% of the participants had monthly income less than 1600 TL, 40% had monthly income between 1600 TO 4000 TL, only 4 participants 8% had monthly income more than 4000 TL.

Table 6.10. Clinical examination results for the cancerous group

	Mean	SD	Median	Min-Max
dmft	1.93	2.53	1	0-12
DMFT	1.31	1.65	1	0-8
OHI-S	0.43	0.69	0	0-3

The mean of DMFT score was 1.31

The mean of dmft score was 1.93

The mean of OHI-S was 0.34

Table 6.11. Correlation between DMFT, dmft, OHI-S index and experiencing oral complications of the treatment

Experienced oral complications	YES (n=39)		NO (n=11)		p
	Mean±SD	Median	Mean±SD	Median	
dmft	2.28±2.91	1.5	1.36±1.75	0.0	0.4
DMFT	3.21±3.44	2.0	0.91±1.04	1.0	0.03*
OHI-S	0.95±0.99	1.0	0.33±0.54	0.0	0.1

Patients who have experienced at least one oral complication of the treatment had higher DMFT mean than those who have not.

Table 6.12. Correlation between DMFT, dmft, OHI-S index and experiencing mouth dryness

Experienced mouth dryness	YES (n=14)		NO (n=36)		p
	Mean±SD	Median	Mean±SD	Median	
dmft	2.43±1.99	2.0	1.77±2.71	1.0	0.2
DMFT	3.5±3.76	2.0	2.39±2.98	2.0	0.3
OHI-S	0.85±0.76	0.8	0.79±1.02	0.2	0.4

Table 6.13. Correlation between DMFT, dmft, OHI-S index and experiencing pain in tongue

Experienced pain in tongue	Yes (n=6)		NO (n=44)		p
	Mean±SD	Median	Mean±SD	Median	
dmft	1.5±1.73	1.0	2±2.66	2.0	0.8
DMFT	3.17±3.43	1.5	2.64±3.22	2.0	0.7
OHI-S	0.94±1.04	0.8	0.79±0.94	0.3	0.7

Table 6.14. Correlation between DMFT, dmft, OHI-S index and experiencing infections

Experienced infections	YES (n=23)		NO (n=27)		p
	Mean±SD	Median	Mean±SD	Median	
dmft	2.33±3.34	1.0	1.65±1.84	2.0	0.8
DMFT	3.78±3.68	2.0	1.78±2.47	1.0	0.013*
OHI-S	0.84±0.84	1.0	0.79±1.04	0.3	0.5

DMFT score was 3.78±3.68 in those who had oral infections and 1.78±2.47 in those who had not. The difference between the two values was statistically significant (p=0.013).

Table 6.15. Correlation between DMFT, dmft, OHI-S index and experiencing discomfort in swallowing

Experienced discomfort in swallowing	YES (n=17)		NO (n=33)		P
	Mean±SD	Median	Mean±SD	Median	
dmft	1.57±1.27	1.0	2.05±2.84	1.5	0.9
DMFT	3.76±3.87	2.0	2.15±2.73	2.0	0.2
OHI-S	1.01±0.98	1.0	0.71±0.92	0.3	0.2

Table 6.16. Correlation between DMFT, dmft, OHI-S index and experiencing taste disturbance

Experienced taste disturbance	YES (n=19)		NO (n=31)		P
	Mean±SD	Median	Mean±SD	Median	
dmft	1.9±1.85	1.5	1.95±2.88	1.0	0.6
DMFT	3.47±3.82	2.0	2.23±2.74	2.0	0.2
OHI-S	1.05±1.07	1.0	0.66±0.85	0.0	0.2

Table 6.17. Oral complications prevalence among age groups

Age	Experienced oral complications		Total
	YES	NO	
6-8 years	9	7	16
9-11 years	9	4	13
12-17 years	21	0	21
Total	39	11	50

Chi-Square = 10.92 p=0.004

The results are statically significant at $p < 0,05$, the patients aged between 12-17 years had been more affected by the oral complications of the treatment.

Table 6.18. Oral complications prevalence in relation with duration of the treatment

		Experienced oral complications		Total
		YES	NO	
Duration	0-6 months	7	2	9
	6-12 months	10	8	18
	more than one year	22	1	23
	Total	39	11	50

Chi-Square = 9.46 p=0.009

The experience of oral complication is statically associated with the treatment duration, it was higher in the patients who have started the treatment for more than one year.

Table 6.19. Correlation between oral variables values in cancerous group

	Correlation	dmft	DMFT	OHI-S
dmft	Pearson	1	,151	,408*
	p		,436	,028
	N	29	29	29
DMFT	Pearson	,151	1	,276
	p	,436		,052
	N	29	50	50
OHI-S	Pearson	,408*	,276	1
	p	,028	,052	
	N	29	50	50

In cancerous group a statistically significant correlation (p= 0,0135; p <0,05) was found between dmft and OHI-S index. Patients with poor hygiene have higher dmft value.

Table 6.20. Correlation between oral variables values with toothbrushing, income, education level in the cancerous group

Correlation		toothbrushing	income	Education
dmft	Spearman's rho	-,145	,282	-,232
	p	,452	,139	,226
	N	29	29	29
DMFT	Spearman's rho	-,076	,168	-,077
	p	,600	,243	,596
	N	50	50	50
OHI-S	Spearman's rho	,062	,137	-,011
	p	,668	,344	,938
	N	50	50	50

There was no statistically significant correlation between dmft, DMFT, OHI-S with toothbrushing, income, Education ($p>0.05$).

Table 6.21. Oral variables values in cancerous group and control group in the age 6-8

		children with cancer (n=16)		control group (n=16)		p	
		Mean±SD	Median	Mean±SD	Median		
Age	6-8 years	dmft	1.75±3.07	1.0	3.19±3.53	2.5	0.26
		DMFT	0.88±1.02	0.5	1.25±1	1	0.27
		OHI-S	0.33±0.64	0.0	0.72±0.95	0.165	0.23

There was no statistical difference between groups.

Table 6.22. Oral variables values in cancerous group and control group in the age 9-11

		children with cancer (n=13)		control group (n=13)		p	
		Mean±SD	Median	Mean±SD	Median		
Age	9-11 years	dmft	2.15±1.77	2.0	2.38±2.14	3	0.73
		DMFT	1.85±2.12	1.0	2.69±1.6	2	0.09
		OHI-S	0.56±0.76	0.3	0.47±0.57	0.16	0.91

There was no statistical difference between groups

Table 6.23. Oral variables values in cancerous group and control group in the age 12-17

		children with cancer (n=21)		control group (n=21)		p	
		Mean±SD	Median	Mean±SD	Median		
AGE	12-17 years	dmft	-	-	-	-	-
		DMFT	4.62±3.85	4.0	2.71±2.43	2	0.11
		OHI-S	1.33±1.02	1.3	0.62±0.7	0.33	0.03*

The mean of OHI-S score in 12-17 age is higher and it is 1.33 in children with cancer while in control the value is 0.62 (p=0.03; p<0.5).

7. Discussion

In light of this aim, there were many studies investigating the oral complications of chemotherapy and radiotherapy and oral health status in general. Kung et al., 2015 has studied the oral health status of Chinese children and adolescents receiving chemotherapy in Hong Kong and found that about two-thirds of cancerous patients of children and adolescents actually had caries experience, and it was more common among patients who had completed chemotherapy.

The two most common complications of receiving chemotherapy were oral mucositis followed by petechiae. Arwa et al., 2016 found that cancerous patients of children had statistically significant higher caries in the primary dentition, but not in the permanent. Çubukçu et al., 2007 showed that caries level could be stabilized in leukemic children, who were not caries-free before undergoing chemotherapy. This can be achieved by caries prevention methods, such as fissure sealants and frequent topical fluoride applications, intensive oral care and improved self-care procedures. Mortazavi et al., 2015 found that patients undergoing cancer therapy had poorer oral status than children in the control group. No previous studies showed the parents' awareness of the oral complication of the cancer therapy.

The study included 50 children aged between 6 and 17

16 of them aged between 6 and 8 years, 13 between 9 and 11 years, 21 between 12 and 17 years.

There were 20 female and 30 males

ALL was the most presented followed by Non-Hodgkin's lymphoma, Neuroblastoma, Edwig sarcoma and brain tumor.

28 (56%) were treated by chemotherapy while the others (44%) followed combined treatment of radiotherapy and chemotherapy.

6 patients (12%) started the treatment in the last six months, 18 (36%) had been under treatment for more than 6 months and less than one year, 26 (54%) had been under treatment for more than one year.

11 (22%) of the parents in the study had a university degree, the others 11(22%) finished high school, 28 (56%) finished primary school only.

52% of the participants had monthly income less than 1600 TL which was the minimum wage, 40% had monthly income between 1600 and 4000 TL, only 4 participants had monthly income more than 4000 TL.

58% of the patients have not visited the dentist before starting the treatment.

Regular visits to the dentist are very rare, 82% of the parents said that they go only when they have emergency case.

78% have experienced one or more oral complication during the treatment, 12% of them the pain was so severe, so the chemotherapy had to be stopped for a while.

23 (46%) experienced oral pathology or mucositis, 14 (28%) experienced mouth dryness, 17 (34%) experienced discomfort in swallowing, 19 (38%) experienced taste changes.

6 (12%) experienced pain in the tongue.

The experience of oral complication is statically associated with the treatment duration, it was higher in the patients who have started the treatment for more than one year

Also, it was associated with the age of the patients, the children aged between 13 and 16 showed higher complications.

There was no statistically relation between the experience of oral complications and the gender, type of cancer, brushing and dental satisfaction

29 patients (58%) were brushing their teeth twice a day, 7 (14%) once a day,

14 (28%) were brushing less than once a day.

No reported use for dental floss and only 30% of the sample were using mouth rinse.

The results of the study were consistent with the results of other previous literature (Nemeth et al., 2014, Uderzo et al., 1997, Oguz et al., 2004, Fayle and Curzon, 1991, Arwa et al., 2016). Similar or a little higher prevalence of dental caries were reported for children undergoing cancer treatment when compared to healthy children,

The children were divided into 3 groups according to their age:

In the age group 6-8 years old, the dmft scores of the cancerous group and the control group showed no statically significant difference ($p= 0.26$).

In the age group 9-11 years old, the dmft, DMFT scores of the cancerous group and the control group showed no statically significant difference, ($p=0.73$) or ($p=0.09$) respectively.

In the age group 12-17 years, the DMFT scores of the cancerous group and the control group showed no statically significant difference ($p=0.11$).

68% of the Patients aged between 9 and 16 have at least one permanent decayed tooth.

Patients who experienced oral complication had higher DMFT scores than those who haven't experienced any complication. ($p= 0.03$)

Patients who experienced infections or mucositis had higher DMFT scores than those who haven't experienced them. ($p= 0.01$)

68% of the patients aged between 9 and 16 have at least one permanent decayed tooth.

In the age groups 6-8 and 9-11 years old, the oral hygiene of the cancerous group and the control group showed no statically significant difference with regards to OHI-S scores ($p=0.13$) ($p=0.65$) respectively.

In the age group 12-17 years, the oral hygiene of the cancerous group was significantly higher than in the control group with regards to OHI-S ($p=0.03$).

In cancerous group a statistically significant correlation ($p= 0.0135$; $p <0,05$) was found between dmft and OHI-S index. Patients with poor hygiene have higher dmft value.

There was no a statistically significant correlation between dmft, DMFT, OHI-S with toothbrushing, income, education level of the parents ($p>0.05$).

The world health organization (WHO) reports that caries prevalence in Turkey was high. This demonstrates a contrast with the developed countries where the entire population had low prevalence. Dental care the child population receives is far from sufficient, as they also lack the good awareness that would prevent caries from starting at an early age, which means that Turkey needs to treat dental care as a significant public health problem. Additionally, those in the child population suffering from blood diseases such as leukemia or hemophilia are not regularly recalled to the dentist as are those in healthy child population.

The possible reasons for caries rate in cancer patients being this high include: poor oral hygiene, ignorance of oral complications as parents are overwhelmed by the severity of

cancer, consumption of supplements enriched with carbohydrate as a part of eating regime to avoid weight increasing, enamel hypoplasia among other dental abnormalities caused by cancer therapy, diminished antibacterial effects of hyposalivation, and bacterial flora being shifted to cariogenic subtypes.

Even though the doctors in the hospital do a daily check-up for the mucosa there is no participation for the dentist in the treatment plan.

It was also found that the mouth is the principal source of sepsis in the immunosuppressed cancer patient. It follows that definitive dental involvement on an early stage, which includes comprehensive measures for oral hygiene, would be useful in reducing the risk for oral complications and whatever systemic complications associated with them. Before and during the treatment planning, an oral health protocol is needed to be followed so that parents and children are provided with appropriate instructions regarding oral health. Also, cancer therapy should be carried out simultaneously with dental treatment.

A multidisciplinary collaboration between oncology doctors, pediatric dentists and the nursing staff can make a major contribution in decreasing children morbidity and improving the patients' health and quality of life during and after treatment.

8. CONCLUSION

- 78% of the patients have experienced one or more oral complication during the treatment.
- 12% of them the pain was so severe, so the chemotherapy had to be stopped for a while.
- 46% experienced oral pathology or mucositis, 28% experienced mouth dryness, 34% experienced discomfort in swallowing, 38% experienced taste changes
- Only 58% of the patients were brushing their teeth twice a day.
- Only 30% were using mouth rinse.
- dmft and DMFT scores showed no statically significant difference between the cancerous group and the control group.
- Patients who have experienced at least one of the oral complications had higher DMFT scores than those who have not experienced any complication.
- Patients who have experienced infections or mucositis had higher DMFT scores than those who haven't experienced them.
- The OHI-S scores showed no statically significant difference between the cancerous group and the control group in the ages between 6 and 11, but they were higher in the cancerous group than in the control group in the patients aged 12 and older.
- The experience of oral complication is statically associated with the treatment duration, it was higher in the patients who have started the treatment for more than one year
- The experience of oral complication is statically associated with the age of the patients, the children aged between 13 and 16 showed higher complications.
- Evidence based oral care protocol has to be followed before and during the treatment.
- Proper education for the parents and nursing team about the oral complications of the treatment and the importance of daily oral care routines is required.

- It is possible to maintain oral health by the combined efforts of parents, pediatric hematologist-oncologists, pediatricians and pediatric dentists.

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10. CURRICULUM VITAE

Name	LEVENT	Surname	AKKAŞ
Place of Birth	Damascus	Date of Birth	19.01.1989
Nationality	Syrian	Tel	00905395496089
E-mail	Louay.akkash@gmail.com		

Educational Level

	Name of the Institution where he/she was graduated	Graduation year
Masters	Marmara University Faculty of Dentistry Department of Prosthodontics	
Undergraduate	Damascus University Faculty of Dentistry	2013
High school	Al Saade School	2007

Foreign Languages	Reading comprehension	Speaking*	Writing*
English	Very Good	Good	Good
Turkish	good	good	good
Arabic	Mother language	Mother language	Mother language

Foreign Language Examination Grade#								
YDS	ÜDS	IELTS	TOEFL IBT	TOEFL PBT	TOEFL CBT	FCE	CAE	CPE

	Math	Equally weighted	Non-math
ALES Grade			
(Other) Grade			

Computer Knowledge

Program	Use proficiency
Microsoft office	Good

*Evaluate as very good, good, moderate, poor.

ENCLOSURE 1: ETHICAL COMMITTEE APPROVAL



T.C.
MARMARA ÜNİVERSİTESİ
Diş Hekimliği Fakültesi
Klinik Araştırmalar Etik Kurulu

Projenin Adı: Oral Health Awareness Among Parents of Children Undergoing Cancer Therapy
Proje yürütücüsü: Prof. Dr. İlknur Tanboğa
Projedeki Araştırmacılar: Dt. Louay Akkash
Onay tarihi ve sayısı: 29.11.2018, 2018-232

Sayın Prof. Dr. İlknur Tanboğa
2018-239 Protokol nolu "Oral Health Awareness Among Parents of Children Undergoing Cancer Therapy" isimli anket çalışmamız Marmara Üniversitesi Klinik araştırmalar Etik kurulu tarafından incelenmiş ve etik yönden uygunluğuna karar verilmiştir.

M.Ü. Diş Hekimliği Fakültesi
Klinik Araştırmalar Etik Kurulu Başkanı

Prof. Dr. Nimet Gençoğlu

[Signature]
İmza

Adı Soyadı

Prof. Dr. Nimet Gençoğlu

Prof. Dr. İlknur Tanboğa

Prof. Dr. Ali Recai Menteş

Prof. Dr. Yaşar Özkan

Prof. Dr. Ahu Acar

Prof. Dr. Zühre Hale Cimilli

Doç. Dr. Buket Evren

Prof. Dr. Şebnem Erçalık Yalçinkaya

Prof. Dr. Filiz Onat

Dr. Zerrin Kurşun

Prof. Dr. Afife Binnaz Hazar Yoruç

Dr. Öğr. Üyesi G. Hale Özcömert Coşkun

Dr. Öğr. Üyesi Gediz Kocabaş

Nuri Sertaç Sırma (sivil üye)

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ENCLOSURE 2: TURKISH QUESTIONNAIRE

Ailelerin Anketi

1-Çocuğun yaşı

2-Çocuğun cinsiyeti

3-Tümörün cinsi

4-Tedavi süresi başladı ve ne kadar sürecek

5-Nasıl bir tedavi altında veya alıcak

-Radyoterapi

-Kemoterapi

-Kök hücre transplantasyonu

6- Tedaviye başlamadan önce diş hekimini ziyaret ettiniz mi

-Evet

-Hayır

7-Çocuğunuz için ne sıklıkla diş hekimine gidiyorsunuz

-6 ayda bir

-Yılda bir

-Gerekirse

8-Doktorunuz tedaviniz başlamadan önce diş hekimi kontrolü için sizi bilgilendirdi mi

-Evet -Hayır

9-Tedavi başlamadan önce ağızda meydana gelebilecek problemlerle ilgili bilgilendirildiniz

mi

-Evet -Hayır

10-Kanser tedavisi sırasında ağız içi yan etkiler yaşadınız mı

-Evet -Hayır

11-Kanser tedavisi sırasında ne tür ağız içi problemler yaşadınız

-Ağrılı ağız veya dişeti

-Ağız kuruluğu

-Dilde yanma ve şişlik

-Enfeksiyon-iltihaplanma

-Tat almada değişiklik

-Yutkunma güçlüğü

12-Ağız içi komplikasyonlar nedeniyle ilaç dozlarının azaltılması veya tedavinin durdurulması gerekti mi

-Evet -Hayır

13-Ağız içi bir problemle karşılaştığınızda kime başvurduunuz

Doktor

Yardımcı personel\hemşire\hasta bakıcı

Diş hekimi

14-Doktor düzenli olarak diş hekiminizle konsültasyon yaptı mı

-Evet -Hayır

15-Doktor hastanın ağız mukozasını rutin olarak kontrol etti mi

-Evet -Hayır

16-Çocuğunuzun ağız sağılığında memnun musunuz

-Evet -Hayır

17-Uygun seviyede ağız hijyenini nasıl sağladınız

-Çürük yapıcı olmayan diyet

-Diş fırçalama (Bazen Günde bir Günde iki Günde ikiden fazla)

-Diş ipi

-Fluoridli diş macunu

-Gargara

18-Eğitim durumunuz nedir

Üniversite

Lise

İlköğretim

19-Aylık Gelir düzeyiniz

<1600

1600-4000

>4000

20-Tedavinin ağız içi yan etkileriyle ilgili daha çok bilgi edinmek ister miydiniz

-Evet -Hayır

ENCLOSURE 3: PUBLISHED ABSTRACT

24th IADH Congress – August 2018 – Dubai

percutaneous endoscopic gastrostomy. After the clinical examination it was observed that he is caries-free and has gingival hyperplasia due to medications and poor oral hygiene. Detailed information about oral hygiene was given to the family and the patient is under clinical follow-up.

Comments: The oral manifestations are discussed considering the special health care needs in these patients so as to provide comprehensive dental care. Parents of children with CP have the most important role as the primary caretakers. For this reason, it must be ensured that high-level information and guidance are provided for the parents of children with CP.

Key words: Cerebral palsy, oral findings, percutaneous endoscopic gastrostomy

P:96 Oral health awareness among the parents of children undergoing cancer therapy

Louay Akkash,¹ Basak Durmus,¹ Rejin Kebudi,² Ilknur Tanboğa¹

1. Marmara University, School of Dentistry, Pediatric Dentistry Department; 2. Istanbul University, Cerrahpasa Medical Faculty & Istanbul University, Oncology Institute Pediatric Hematology-Oncology, Turkey

Aim: To assess the oral health awareness in parents of paediatric patients receiving chemotherapy/radiotherapy in Istanbul University, Oncology Institute, Division of Pediatric Hematology-Oncology. **Materials-Methods:** Parents were surveyed by means of a questionnaire written in Turkish to assess the following points: general information about the type of malignancy and the treatment they are receiving, oral complications that occurred due to the treatment and their information about the ways to maintain the oral hygiene of their child. Patients were orally examined, DMFT/dmft index and (OHI-S) scores and oral hygiene daily routines were noted. **Results:** Forty patients aged 6-17 years were examined; 24 were males and 16 females, 24 of them were receiving chemotherapy while the others were receiving combined chemotherapy and radiotherapy, 23 had visited the dentist before starting the chemotherapy. Twenty-four (58%) patients said that they had been informed about the oral complications related to the treatment and 30 (60%) patients had experienced oral complications during the treatment. Among those, 14 % reported that the treatment doses decreased or the treatment stopped for a while because of severity of oral complications. Oral complications mostly frequently suffered were infection, change in taste, discomfort in swallowing, dry mouth, burning or swelling of the tongue, respectively. **Conclusion:** Oral health status is compromised in children receiving chemotherapy/radiotherapy especially in the means of oral complications. But the findings revealed that the oral hygiene was not a priority for most of the families. Oral health can be maintained due to combined efforts of haematologists, paediatricians and paediatric dentists.

Key words: Oral health, chemotherapy, radiotherapy, oral complications, cancer

P:97 Oral Health education for people with intellectual disability

Imke Kaschke

Special Olympics Germany

People with intellectual disability learn slowly and often with difficulty. Also understanding and using health information is hard for many of them. Therefore, Special Olympics Germany developed various training materials in easy language for each Healthy Athletes discipline in order to educate the athletes on health. An integral part of this programme aims to educate multipliers. These are people with intellectual disability who have a keen interest in getting more individuals motivated to improve health measurements. The programme also includes oral health information as an integral component of Special Smiles. The proposals contain a presentation as well as interactive practical exercises. The multipliers were educated about: oral and dental anatomy, diseases of teeth and gums, materials for oral health measurements, correct tooth brushing techniques, healthy nutrition and dental visits. The practical exercises encourage the multipliers to instruct other people with intellectual disability in correct daily oral hygiene techniques. They were educated to show brushing techniques and to recommend preventive measures such as fluorides. This peer-to-peer programme is a low-threshold and promising approach.

Key words: Oral health, plain language, multipliers, people with intellectual disability

P:98 Oral health management for a patient with tuberous sclerosis complex who developed oral mucositis by using everolimus: A case report

Fujita Mirai,¹ Matsuo Koichiro,² Suzuki Hitomi,¹ Kito Norie,² Taniguchi Hiroshige²

1. Department of Dentistry and Oral Surgery, Fujita Health University Hospital; 2. Department of Dentistry and Oral Surgery, School of Medicine, Fujita Health University, Japan

Introduction: Tuberous sclerosis complex (TSC) is a rare genetic disorder characterised by the development of benign tumors in several organs of the body, and often accompanies neuropsychiatric disorders. Everolimus, a mammalian target of rapamycin (mTOR) inhibitor, has been recently approved for the treatment of subependymal giant cell astrocytoma (SEGA) and angiomyolipoma (AML) of TSC. However, it has been reported that oral mucositis is expressed as the most common adverse event by the use of everolimus. Here, we present the oral health management of a patient with TSC who developed oral mucositis by everolimus. **Case Report:** A 26-year-old man, who had been diagnosed TSC with SEGA, kidney AML, epilepsy and ASD, was referred to our hospital dental clinic to check oral hygiene before the use of everolimus. He had never had regular dental visits. At the first visit periodontal pocket depth was 2-4 mm, but his