

Original Article

Genesis of a novel pediatric oncological team in a Tertiary Care Hospital

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ABSTRACT

Objectives: Traditionally, oral health maintenance of patients diagnosed with a cancerous condition relied mainly on the patients themselves and the bedside nurses. Limited overlap of medical and dental expertise and curbed dental resources in typical oncology units baffles access to optimal dental care for children with cancer. Here, we outline the creation of a novel pediatric oncological team to address this predicament by furnishing primary prevention strategies for high-risk patients in a multispecialty center. To form an interdisciplinary team and implement a novel system aimed at optimizing oral health care for inpatient pediatric oncology patients in a hospital setting, and to study the effect of primary prevention on pediatric oncology patients after primary health education and oral hygiene demonstration by a pediatric dentist.

Material and Methods: After the genesis of a novel pediatric oncological team, this prospective longitudinal one-group (pre- and post) study assessed fifty-three 3-13-year-old inpatients undergoing treatment at a cancer super specialty institution. Primary health education was imparted to the participants, their caretaker, nurses, and the paramedical staff, along with giving case-specific oral hygiene maintenance modification measures. Oral hygiene status was recorded at baseline and 1, 3, and 6-month follow-up.

Results: The results demonstrated a significant plummeting in the OHIS score at 1, 3, and 6 months as compared to baseline, proving evidently that oncological role can potentially be an emerging arm of pediatric dentistry.

Conclusion: Conceding the importance of oral health for pediatric oncology patients and restraints in the traditional approaches, the role of the pediatric dentist in the oncological team represents an innovative solution. By integrating oncology and dental specialties, the team aims to improve oral health outcomes, reduce the risk of infection, and provide better support and education for patients and caregivers

Keywords: Health educator, Oncological team, Oral hygiene, Pediatric dentist, Pediatric oncology

INTRODUCTION

As per the UN Global Sustainable Development Goal Report (2023), every 3 minutes, a child is diagnosed with cancer somewhere in the world.^[1] If we compare the distribution by sex, females are affected more (57%) as compared to males (43%).^[2] In the Indian scenario, it contributes to almost 20% of the global share of childhood cancer and 4% of all cancers affecting up to 14 years.^[3] Dental issues in this population are more acute and have long-term effects.^[4] These children suffer dual attacks on the oral cavity, contributing to the underlying oncological disease, and the chemotherapeutic drugs, which suppress the subnormal immunity with additional

oral manifestations like mucositis, xerostomia, salivary gland dysfunction, and dehydration, adding to the existing dental problems and hygiene issues.^[5] It is noteworthy that the mucosal barrier injury poses an extremely dangerous complication of improper oral hygiene with high morbidity and mortality.^[6] Third-world countries have limited resources, scarce expert personnel, and substandard coordination between medical and dental expertise (typically exhibited in oncology wards), which prevents the proper care of children regarding dental hygiene. Normally, nurses are the sole oral healthcare providers for these children during their hospital stay, but their lack of adequate training in oral healthcare

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Figure 1: Oncidental team comprises nurses, pediatric dentists, paramedical staff, oncology consultant, and oncology resident. (Left to right).

maintenance curbs their role incredibly in this sector. Hence, we outline the creation of a pediatric oncidental team inspired by Bledsaw *et al.*,^[6] which will help to implement prevention strategies for these high-risk children in a super specialty center by integrating pediatric dentists, nurses, paramedical staff, medical oncologists, and caretakers. The aim of this study is to form an interdisciplinary team [Figure 1] and implement a novel system aimed at optimizing oral health care for inpatient pediatric oncology patients and to study the effect of primary prevention on pediatric oncology patients after primary health education on oral hygiene demonstration by a pediatric dentist.

MATERIAL AND METHODS

This was a single-arm prospective longitudinal (pre- and post) study conducted in the inpatient Department of a super-specialty Hospital, to assess and compare the oral hygiene status before and after primary health education and oral hygiene measures implementation by the novel oncidental team. The data was collected prospectively from 53 children aged 3-13 years and from their parents.

Required institutional ethical approval was obtained, and all ethical protocols were followed. This study was conducted in accordance with the Helsinki Declaration. Parental informed and written consent and child assent were taken before the participant's recruitment to the study.

Prior to including the patient, the purpose of the study was informed and explained to the parent and the patient through the information sheet. Various armamentaria used were a sterile mouth mirror, explorers/probes, tweezers, a kidney tray, an instrument pouch, disposable surgical gloves, a disposable mouth mask, a cotton holder, cotton, chlorhexidine mouth wash, Korsolex, pediatric typhodont set, toothbrush, pediatric dentifrices, floss, interdental brush, and saliva substitute. The inclusion criteria were the children who were diagnosed with any oncological disorder and

admitted to the inpatient ward falling in age 3 to 13 years, and who gave written consent for this study. The exclusion criteria were the children who were undergoing dental prophylaxis by an expert in the last 6 months or suffering from a systemic disease, which are known to influence the dental caries, like Down syndrome and diabetes. The principal investigator obtained prior permission from the hospital authorities, and the date and time of the first visit and subsequent visits of the principal investigator (pediatric dentist) in the oncology ward were confirmed at least a week in advance. The clinical examination was well planned at a particular time of the day for maximum efficiency and ease of examination. The recording of data included demographic details, history of oncological disorder, and current chemotherapeutic drugs (if any), after which a dental examination was carried out by using a mouth mirror and explorer by a single examiner who was a pediatric dentist. During the clinical examination [Figure 2], the children were seated either in bed, or wheelchair, or an ordinary chair, whichever made them feel comfortable. Torch was used for illumination, and extraoral as well as intraoral examination were conducted. The Oral Hygiene Index – Simplified (OHIS) score was calculated.^[7] After this, a health talk emphasizing the importance of oral hygiene in pediatric oncology patients was given by the pediatric dentist [Figure 3]. Demonstration of various dental aids with the help of pamphlets and typhodont models, soft bristle brushes, interdental brushes, chlorhexidine mouthwash, and floss was given. Various kid-friendly dentifrices were shown to increase compliance. We also reinforced the importance of motivation by nurses in regard to various ways to improve home care oral hygiene, including the role of nurses for children during their hospital stay and parents during the home stay of the children. Weekly motivation for the first month and monthly thereafter regarding the reinforcement of oral hygiene measures was done by the nursing staff/paramedical staff and carried out by the principal investigator over the telephone for each participant. Physical follow-up



Figure 2: (a-d) Pediatric dentist examining the patients and nurses recording the data.



Figure 3: (a-d) Pediatric dentist imparting education to patients/parents about various dental hygiene materials and techniques.

was carried out at 1, 3, and 6 months, and the OHIS score was recorded in all participants to study the effectiveness of the medical education intervention by the oncidental team at the primary education level. During each visit by the pediatric dentist at 1, 3 and 6 months, the training of the nursing/paramedical staff [Figure 4] for reinforcement of oral hygiene measures were imparted and various dental materials which can be used by the children were taught so that during the hospital stay, the children get proper care and correctable measures can be imparted to the children's and their parents. Point-wise summary of the Intervention done in the participants:

1. The Participants underwent dental examination at baseline, and the OHI-S score was calculated
2. The participants, their parents & guardians were taught
 - a) the importance of brushing twice a day;
 - b) how to do



Figure 4: (a and b) Pediatric dentist imparting education to nurses/paramedical staff (dental kit marked as arrow, and pamphlet as double arrow) and (c and d) Pediatric dentist interaction with oncologist (kid-friendly dental kits kept in examination/demonstration table marked as arrow).

proper brushing; c) different types of brushes and their usage; d) how to use floss; e) the importance of dental hygiene; f) how to identify common dental and oral cavity diseases

3. Weekly reinforcement via telephonic conversation was given for a month
4. Monthly reinforcement via telephonic conversation was given for the next 5 months
5. The participants were called at 1, 3, and 6 months for a dental check-up and calculation of the OHIS score

Sample size estimation:

Sample size estimation was done by using GPower software (version 3.0). Sample size was estimated for the t-test, and the means: Difference between two dependent means (matched pairs) was chosen.

A minimum total sample size of 52 was found to be sufficient for an alpha of 0.05, power of 80%, and 0.4 as the effect size (assessed for the difference in OHI-S scores from pre to post intervention).

Statistical analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) version 21 and an Excel worksheet. The study variables, which were measured on an interval or ratio scale, were summarized as means and standard deviations. Student t t-test was used to calculate the p-value between various samples.

RESULTS

A total of 53 patients were recruited according to the inclusion and exclusion criteria. Table 1 shows the demographic profile

Table 1: Demographic profile of study population.

| | | Frequency | Percentage (%) |
|---------------------------------|-------------------|-----------|----------------|
| Gender | Males | 31 | 58.5 |
| | Females | 22 | 41.5 |
| Age group | Upto 5 years | 14 | 26.4 |
| | 6-8 years | 18 | 33.9 |
| | 9-11 years | 12 | 22.6 |
| | 12 years & above | 9 | 16.9 |
| Oncological disorders diagnosed | neuroblastoma | 1 | 1.8 |
| | retinoblastoma | 4 | 7.5 |
| | ALL | 19 | 35.8 |
| | Wilms Tumor | 5 | 9.4 |
| | Hodgkin Lymphoma | 5 | 9.4 |
| | Osteosarcoma | 2 | 4 |
| | Ewing Sarcoma | 4 | 7.5 |
| | Hepatoblastoma | 4 | 7.5 |
| | Soft Tissue Tumor | 1 | 1.8 |
| | Rhabdomyosarcoma | 3 | 5.6 |
| | AML | 3 | 5.6 |

ALL: Acute lymphocytic anemia, AML: Acute myeloid leukemia

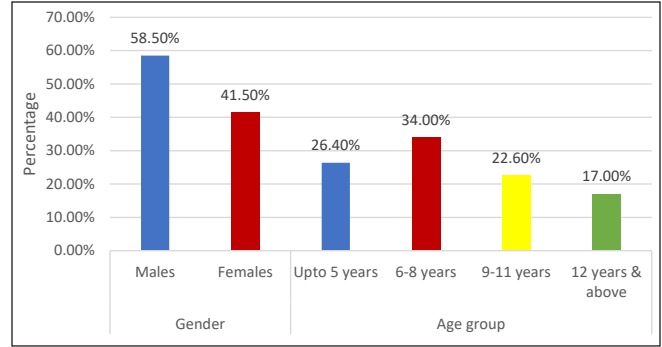


Figure 5: Demographic distribution of study population according to age and gender.

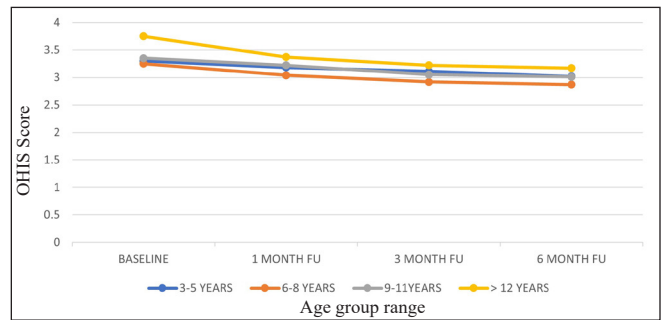


Figure 6: Trend in the OHIS score at baseline and subsequent follow-up period of children according to various age groups. (OHIS: Oral Hygiene Index – Simplified, FU: Follow up).

of the study population. Males were 58.5 % and most of the children belonged to the 6-8 years age group[Figure 5].

At the baseline examination, the OHI-S score was 3.37 ± 1.2 SD. After follow-up at 1 month, the OHI S score decreased to 3.17 ± 1.1 SD, which was statistically significant. The difference is maintained at 3 and 6 months with mean OHI S Score of 3.05 ± 1.08 and 3.00 ± 1.08 , respectively.

There was significant difference in OHI-S score at baseline as compared to follow-up after intervention at 1, 3, and 6 months in all age groups [Figure 6] suggesting that children of all age groups are positively affected by the primary education and dental hygiene demonstration, the effect of which is maintained till 6 months of follow up as compared to baseline OHI-S score in different age groups, as illustrated in Table 2.

DISCUSSION

Childhood cancer represents a major health burden and psychosocial disturbance in the child along with their family. Due to immunosuppressive therapy/chemotherapy, the child's immunity is compromised, and thus, the dental infection/caries gets aggravated.^[8,9] The drug-induced mucositis and other oral-related diseases tend to occur, which further affects the oral and dental care, thus affecting the oral hygiene.^[10] OHIS score is a good indicator for the assessment of oral health and dental problems.^[7] A poor OHI-S score in children with cancer can have significant clinical implications,

Table 2: Age-wise comparison of OHI-S scores at baseline & 1, 3, and 6 months after intervention

| OHI-S | | | | | |
|-------------|-----------------|----|--------|----------------|---------|
| Timeline | Age group range | N | Mean | Std. deviation | P value |
| At baseline | 3-5 years | 14 | 3.3286 | 1.11108 | |
| | 6-8 years | 18 | 3.2500 | 1.35484 | |
| | 9-11 years | 12 | 3.3500 | .93371 | |
| | 12 yrs & above | 9 | 3.7556 | 1.51254 | |
| At 1 month | 3-5 years | 14 | 3.1857 | 1.00603 | 0.05 |
| | 6-8 years | 18 | 3.0444 | 1.23203 | 0.004 |
| | 9-11 years | 12 | 3.2250 | 1.01276 | 0.05 |
| | 12 yrs & above | 9 | 3.3778 | 1.32832 | 0.003 |
| At 3 months | 3-5 years | 14 | 3.11 | 1.03 | 0.001 |
| | 6-8 years | 18 | 2.92 | 1.15 | <0.001 |
| | 9-11 years | 12 | 3.05 | 0.90 | 0.001 |
| | 12 yrs & above | 9 | 3.22 | 1.29 | 0.001 |
| At 6 months | 3-5 years | 14 | 3.02 | 1.01 | <0.001 |
| | 6-8 years | 18 | 2.87 | 2.87 | <0.001 |
| | 9-11 years | 12 | 3.01 | 3.01 | <0.001 |
| | 12 yrs & above | 9 | 3.17 | 3.17 | 0.001 |

OHIS: Oral Hygiene Index – Simplified, Significant p value (<0.05)

especially considering their immunocompromised state due to chemotherapy. Poor oral hygiene in these patients is associated with an increased risk of various complications, including:

1. Increased risk of febrile neutropenia (FN)

- **Mechanism:** Poor oral hygiene leads to increased bacterial load in the oral cavity, which can serve as a source of systemic infection, especially during periods of neutropenia.
- **Clinical Impact:** Bacteremia originating from oral infections (e.g., gingivitis, periodontitis, dental caries) can lead to febrile neutropenia, requiring hospital admission, IV antibiotics, and potential treatment delay.^[11,12]

2. Higher Propensity for Sepsis in Children with Cancer and Poor Oral Health

Mechanism

- In children with cancer, oral infections such as periodontitis, abscesses, and ulcerative lesions create an entry point for bacteria and fungi into the bloodstream. Since these children are often immunocompromised due to chemotherapy or radiation therapy, their bodies have a reduced ability to fight infections. Increased Bacteremia: Research has shown that children undergoing chemotherapy with poor oral hygiene have a significantly higher incidence of bacteremia originating from oral pathogens.
- Sepsis Development: In immunocompromised hosts, particularly those with neutropenia (low neutrophil counts), oral infections act as a primary source of bloodstream infections, which can rapidly escalate into sepsis and septic shock.
- Association with Febrile Neutropenia (FN): Many cases of febrile neutropenia in pediatric cancer patients are linked to oral infections, with *Streptococcus viridans* sepsis being a well-documented complication.
- Oral Mucositis as a Risk Factor: Children with severe mucositis (often worsened by poor oral hygiene) experience more frequent bacterial translocation, increasing the likelihood of sepsis.

Key opportunistic pathogens that originate from the oral cavity and can cause septicemia include:

- *Streptococcus viridans* – A common oral commensal that can become invasive, leading to bacteremia and infective endocarditis.
- *Candida* spp. – Fungal infections that can start as oral candidiasis but progress to disseminated candidiasis in immunosuppressed patients.
- Enterobacteriaceae – Gut-associated bacteria that can colonize the oral cavity in patients with poor

oral hygiene and mucositis, leading to bloodstream infections.

Clinical implications:

- Early oral care interventions (such as chlorhexidine mouth rinses, dental prophylaxis, and antifungal prophylaxis) can reduce the incidence of bloodstream infections.
 - Routine oral health assessments in pediatric oncology settings help identify high-risk patients and initiate early treatment to prevent sepsis.
 - Multidisciplinary management involving oncologists, dentists, and infectious disease specialists is essential to mitigate the risks associated with poor oral health in immunocompromised children.^[13-16]
3. Increased severity and frequency of mucositis
 - Mechanism: Chemotherapy-induced mucositis disrupts the oral mucosal barrier, and poor oral hygiene exacerbates it by increasing microbial colonization, prolonging healing, and worsening inflammation.
 - Clinical Impact: Severe oral mucositis can lead to intense pain, difficulty eating, dehydration, and secondary infections, further increasing the risk of sepsis and requiring supportive care, including opioids, IV hydration, and enteral nutrition.^[17-25]
 4. Treatment Disruptions
 - Poor oral health may necessitate delays in chemotherapy or radiation therapy due to infections or complications requiring additional medical interventions.^[19,26]
 5. Higher Risk of Fungal Infections
 - A compromised oral environment with poor hygiene predisposes children to oral candidiasis, which can extend systemically in immunosuppressed patients.^[27-29]

A Poor OHI-S score in pediatric oncology patients significantly increases the risk of febrile neutropenia, sepsis, and mucositis, all of which can worsen prognosis, increase hospitalization rates, and delay cancer treatment. Regular oral assessments, prophylactic dental care, and rigorous oral hygiene protocols are essential to minimize these risks.

Primary health education regarding the technique and materials needed for maintaining oral health hygiene has positive effects on dental health in pediatric oncology patients, as discussed in previous literature.^[30-32] However, there is a lack of coordination between dentistry and pediatric oncology specialists; thus, there is a need for a dedicated interdepartmental team along with trained oral health educators who can demonstrate measures for children and their parents for maintaining oral health

hygiene.^[6] In this study, our aim was to make an oncidental team inspired by Bledsaw *et al*^[6] and to assess its effectiveness in the improvement of dental hygiene in a super specialty hospital. A team of pediatric dentists, oncologists, nurses, and paramedical staff was formed. The children who qualified the inclusion and exclusion criteria were examined at baseline, and the mean OHI S score was 3.37 +/- 1.21 among a group of 53 patients. There were 58.5% male children and 41.5% female children. The average age of the child was 7.9 years. The paramedical staff and nurses were given training pediatric dentist regarding the materials and techniques which are helpful in maintaining dental and oral health care and hygiene. After that, a live demonstration on the child was imparted by a pediatric dentist, along with in hand experience to nurses and paramedical staff. After one month, the pediatric dentist examined the oral cavity, and the mean OHIS score was calculated. It showed a significant decrease in the main OHIS score to 3.17. The improvement persisted at 3 and 6 months of follow-up. In earlier literature also it was shown that after primary health education and demonstration, the oral health/mucositis improved in children with oncologic/leukemic disease.^[30,32] When gender wise comparison was made between the baseline and follow-up OHIS score, there was a significant reduction in the main OHIS score at 1, 3, and 6 months for both male and female. This suggests that both the genders were benefited by this intervention. In the subgroup analysis, according to the child age group, all age groups showed improved OHIS score at 1, 3, and 6 months as compared to the baseline. This suggests that all children of all age groups benefited from health education by a health educator (who was given training by a pediatric dentist) who demonstrated and positively reinforced the practice of good dental care to the children and their parents through telephonic consultation. This included a live demonstration by a pediatric dentist during their hospital follow-up. Recent studies also suggest that integrated oral healthcare improves the dental health of pediatric oncology patients.^[32,33] Here are the four pillars of our novel approach, pediatric dentist- who imparted health education, recorded OHIS and trained the permanent staff; Medical oncologist-who briefed the primary investigator and informed me about any adverse effects pertaining to any dentifrice/mouthwash used; Nursing staff and family who were motivators during the hospital stay and home, respectively.

Studies have consistently shown that pediatric oncology patients tend to have poor Oral Hygiene Index Scores (OHIS) throughout their treatment. This is primarily due to the unique challenges faced by children undergoing chemotherapy, radiation, and other immunosuppressive treatments.

Barriers to attaining a good OHIS score:

1. **Mucositis and oral pain**
 - Many pediatric cancer patients develop oral mucositis as a side effect of chemotherapy.
 - Pain and ulceration make routine brushing and oral care difficult, leading to plaque accumulation and worsening oral health.
2. **Immunosuppression and infection risk**
 - Parents and caregivers may avoid brushing or using dental floss due to fear of causing bleeding or secondary infections in an already immunocompromised child.
 - This leads to a vicious cycle where poor oral hygiene increases the risk of infections like oral candidiasis and gingivitis.
3. **Fatigue and treatment side effects**
 - Cancer treatments often cause extreme fatigue, nausea, and vomiting, making it difficult for children to adhere to oral hygiene routines.
 - Loss of appetite and xerostomia (dry mouth) further contribute to bacterial growth and poor oral health.
4. **Lack of awareness and training**
 - Caregivers and healthcare providers may not always be fully educated on proper oral hygiene measures specific to pediatric oncology patients.
 - Lack of clear oral care protocols in some oncology centers can lead to inconsistent dental care practices.
5. **Limited access to dental care**
 - Many pediatric cancer patients have restricted access to dental professionals during their treatment due to hospitalization, immunosuppression, or financial barriers.
 - o Delayed dental visits result in untreated conditions like caries, gingivitis, and periodontal disease.
6. **Aversion to oral care products**
 - Taste alterations and nausea from chemotherapy make children averse to toothpaste and mouth rinses, leading to a reluctance to maintain oral hygiene.
 - Some children find flavored oral care products unpalatable, making compliance even more challenging.

The limitations of the study were the time span of 6 months of follow-up. A longer follow-up might help in better evaluation of the long-term effects of oncidental teamwork. The second limitation was the limited sample size to calculate the response of individual age groups; however, this was not our primary aim. Thus, a larger sample size with a longer follow-up period and a feedback questionnaire are needed in the future for detailed evaluation of long-term effects of the interventions by the oncidental team in various age groups of children affected by cancer.

CONCLUSION

According to our study findings, primary dental care education by the oncological team and positive reinforcements by trained oncological educators were found to be effective in improving oral health and reducing OHIS score in children with oncological disease.

Author contribution: SP and MS: Prepare the manuscript; SP, BGS and NS: Provide the detail about team formation imparted; SP, MS and BSG: Final edit and proof read the manuscript; RR and SB: Edit the images for the manuscript and input for manuscript preparation.

Ethical approval: The research/study approved by the Institutional Review Board at NIMS University Rajasthan Jaipur, number IEC/P-330/2023, dated 2nd August 2023.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

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