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ORAL HEALTH STATUS AMONG PATIENTS WITH HEAD AND CANCER IN EGYPT

Ghada Abd-Ellatif Bediwy*, Rabab Ebrahim Eldesoky Salama** *and* Rasha Ibrahim Ramadan***

ABSTRACT

Background: The treatment of head and neck cancer by Radiotherapy, Chemotherapy, or the combination of both has dire consequences for the patient during oral health procedures. Patients diagnosed with head and neck cancer develop dental cavities, plaque, gingival inflammation, and mucositis during the course of these treatments, which further deteriorates their quality of life.

Objective: To examine oral health conditions amongst head and neck cancer patients and to obtain experiences on oral health issues during treatment.

Methods: Three hundred and eighteen patients were randomly selected and divided into three equal groups: Radiotherapy (n=150), Chemotherapy (n=70), and Combination (n=98). The primary method for obtaining data was a set questionnaire alongside clinical observation involving the Caries Index – DMFT, Gingival Index – GI, Plaque Index – PLI, and Oral Mucositis Index OMI. Statistically relevant correlations were analyzed with the Spearman test.

Results: The group which received combination treatment exhibited the highest DMFT score (6.6±1.19), severe gingival inflammation (GI: 2.98 ±0.6), heavy plaque accumulation (PLI: 2.01±0.61), and advanced mucositis (OMI: 2.99 ±0.56). After the treatments had been done, it was determined that Radiotherapy had stronger negative correlations with oral health indices than Chemotherapy. There were some differences noticed in dental visitation patterns and hygiene practices from group to group, however, the difference in oral health indices was noticeable at a statistically significant level ($P < 0.0001$).

Conclusion: The patients with the combined treatment approach to head and neck cancer had the worst outcomes for all other health indicators and the greatest complications to oral health. Improved coordination of oral preventive care, timely action before a medical condition escalates, and teamwork between various health professionals is pivotal to symptom relief, better quality of life, and enhanced patient outcomes.

KEY WORDS: Head and neck cancer, radiotherapy, chemotherapy, oral health, caries index, gingival index, plaque index, oral mucositis.

* BDS, Mansoura University, Egypt
** Professor of Dental Public Health and Preventive Dentistry, Department of Pediatric Dentistry and Dental Public Health, Faculty of Dentistry, Mansoura University, Mansoura, Egypt.
*** Associate Professor of Dental Public Health and Preventive Dentistry, Department of Pediatric Dentistry and Dental Public Health. Faculty of Dentistry, Mansoura University, Egypt.

INTRODUCTION

HNC refers to malignancies that are categorized into an umbrella term which involves the larynx and hypopharynx, nasal cavity, paranasal sinuses, nasopharynx, oropharynx, oral cavity, and salivary glands. Approximately 500,000 new cases are reported every year. [1] Of the total HNCs around 90% are of epithelial origin and are squamous cell carcinomas. [2]

The etiology of cancer has multiple factors. The main risk factors are smoking and alcohol. In some cases of solar ultraviolet radiation in lip cancer, infections, diets low in fruit and vegetables, immunodepression, bad oral hygiene and the presence of genetic factors can have a relevant effect. [3]

The incidence and severity of oral complications are affected by many factors, cancer treatment modality used, anatomic location and stage of the cancer. It is affected also by the extent of oral or dental diseases prior to treatment, comorbidities and genetic risk, oral hygiene and nutrition. [4]

Radiotherapy and chemotherapy remain the most widespread approaches to treat HNCs. These methods utilize high energy radiation to kill cancer cells, preventing them from growing, dividing or spreading. Nevertheless, the use of both processes inevitably leads to the irradiation of normal tissues, especially the tissues surrounding the tumor. This type of treatment, is, therefore, often complicated and, as is frequently the case, is associated with significant short- and long-term complications including some oral complications. [5]

Complications include mucositis, dysgeusia, dysphagia, weight loss, malnutrition, hypo-salivation, increased risk of dental caries, increased risk of progression of periodontal disease, dental hypersensitivity, infections, mucosal atrophy, trismus, neuropathic pain and osteoradionecrosis (ORN). [6]

A reduction in salivary function is a common side-effect of radiotherapy to the head and neck region [7]. When major salivary glands are subject to high radiotherapy doses, hypo-salivation becomes a problem and the resulting dry mouth environment makes retention of intact dentition a significant challenge. [8] Dental extractions as a result of dental caries place post-radiotherapy patients at risk of ORN with potentially serious consequences [7, 9].

Management of the oral complications in this population typically requires multidisciplinary collaboration among different professionals and healthcare providers, including head and neck surgeons, medical oncologists, radiation oncologists, and dental professionals with special knowledge and training in the field of oral oncology. HNC may present with oral manifestations, which necessitates recognition and appropriate referral/treatment. [10, 11]

The complications of cancer treatment are increasing forming huge dental and medical problems. Such problems are rarely addressed in Egypt, so this study will be performed to overcome this gap. Preventing care before cancer treatment begins and treating problems as soon as they appear may make oral complications less severe. When there are fewer complications, cancer treatment may work better and these patents may have a better quality of life.

This study seeks to understand the oral condition of head and neck cancer patients in Egypt, including any oral complications that they faced during treatment in greater detail.

METHODOLOGY

Patients and Study Design

A self-administered closed ended questionnaire was used with oral cancer patients as the cross sectional primary data collection method, which as the title suggests, focused on oral hygiene practices.

This study was carried out in the oncology center of Mansoura, Tanta and Menuufia Universities. Using the convenience sampling technique.

Inclusion criteria

It included the patients who suffer from head and neck cancers and received chemo or radiotherapy or received both of with age range from 40 to 60 years old. The patients included received radiotherapy or chemotherapy for 3 weak.

Exclusion criteria

Patients at the end stage of cancer were excluded.

Sample size calculation:

The power of the achieved sample was calculated using the G*Power sample size calculator (http://www.gpower.hhu.de/). The post hoc sample power was determined for a model with three groups. The final sample of 318 participants, with an effect size of 0.1815 and an alpha of 0.05, yielded an actual power of 0.95. The noncentrality parameter was calculated as 15.61, with a critical F value of 3.01, and degrees of freedom for the numerator and denominator were 2 and 316, respectively. So, the final sample size will be 318 participants with neck and head cancer.

Infection Control Measures

In order to follow absolute infection control procedures cross-contamination was avoided by employing multifaceted approaches during the study. Each dental examination was completed using disposable dental mirrors and probes (Hu-Friedy, U.S.) so no tools were reused. All patient interactions were done while wearing PPE, including white coats, gloves, and masks (3M, U.S.). Waste was collected in specialized tight plastic bags and sharp containers so cleanliness was achieved. Periodontal probes (PDT, U.S.) were held in disinfectant solution (Merck, Germany) prior to sterilization to facilitate safe reuse.

Conduction of the Study

1. Validity and Reliability

The study's validity and reliability were thoroughly evaluated to guarantee the trustworthiness of the findings. The first step involved circulating the questionnaire to subject matter experts at the oncology center for feedback, which was then integrated into the final version. A pilot study was conducted among 25 patients in order to see if the questions were easily understandable so that all of them can answer. In the end, all the modifications were made before the actual study was conducted.

To ensure consistency in clinical examination, the examiner was calibrated for intra-examiner variability by re-examining 20 patients one week apart. The kappa statistic was applied to measure reliability, demonstrating low variability with a kappa value of 0.925.

2. Methods of data collection

A/Questionnaire

To calculate reliability, the kappa statistic was used and had minimal variability with a kappa of 0.925. Methods of data collection: A/Questionnaire To ensure that the data collected would be reliable, the usage of close-ended questionnaires that were conducted verbally was used. The questionnaires were first created in English and then translated to Arabic for the patient's understanding and convenience. The researcher carried out the interviews during the treatment sessions of the patients in order to ensure that the questions were completed to the best of the patients ability to understand them. The tool was structured into two main sections (Appendix I). The General Information section, during profiling, consisted of eight questions that provided demographic information, which covered the patient's age, gender, occupation, where they lived, as well as the time they were admitted to the hospital. Moreover,

it focused on lifestyle factors including smoking, alcohol consumption, the type of cancer treatment received, and any systemic diseases the patient had. Oral Health Information. The second category Oral Health Information was subdivided into several sections. The first type, Dental Visit History, included two questions regarding 'the frequency and timing of dental visits in the year before and after chemotherapy and radiotherapy. The Oral Symptoms section included twelve questions that were to evaluate symptoms such as bleeding and infected gums, mouth pain, dryness, tooth pain, decay, calculus formation, difficulty swallowing, and other related issues before and after treatment.

The subsection "Dietary Habits" asked respondents two questions which were: the kinds of foods eaten and volumes of water and juices taken. The Oral Hygiene Practices portion included nine questions regarding the use of toothbrushes including how often they were used, rinsing, flossing, using toothpicks, and lip balm application.

B/Clinical Examination

The clinic examination was conducted in the clinic of an oncology center as part of a research study under complete protective measures to guarantee the safety of the patient and examiner. Each examination was conducted with the use of disposable diagnostic devices. Patients were placed on a chair straight to the opening with additional light in order to see better. The artificial light was switched on as well. All results were entered into preprinted sheets (Appendix II).

According to an approach that utilizes quantitative research, the team devised and employed four indices of measurement that provided for the greatest variation in oral health. Information regarding dental caries was collected using the Caries Index (DMFT), which is based on World Health Organization (WHO) criteria that explained to categorize teeth as sound, decay, missing, or filled. Each patient had his/her DMFT score calculated by summing the numbers of decayed (D), missing (M), and filled (F) teeth. Then, the total received for the population was divided to get the average score.

The severity and extent of gingival inflammation and gum disease was recorded using the Gingival Index (GI). The tooth surfaces covered with dental plaque were recorded in the Plaque Index (PLI).

Moreover, the treatment process was assessed by the Oral Mucositis Index based on the degree of inflammation in the mucosa.

Gingival Index (GI) [12]

The GI has a scoring system where a score of 0 means no inflammation is present and the gingiva is normal, firm and light pink in color. A score of 1 indicates mild inflammation, with slight redness and swelling with bleeding on gentle probing. A score of 2 is moderate inflammation and means the gingiva is red, swollen, and bleeds easily when probed or brushed. Finally, a score of 3 means there is severe inflammation, now the gingiva is red, swollen, and is possibly ulcerated and bleeds spontaneously or with light contact.

To calculate the GI, the examiner assesses six specific teeth in the oral cavity which are the upper right first molar, upper right lateral incisor, upper left first premolar, lower left first molar, lower left lateral incisor, and lower right first premolar. All the teeth score are summed and divided by four to get the tooth score.

After examining the individual's teeth, the GI is derived by adding the scores from all the teeth and then dividing it by the total number of teeth that were analyzed. The calculation is done by applying this formula:

Equation 1: Gingival Index (GI) formula

$$GI = \frac{\Sigma\ (Gingival\ scores\ for\ six\ selected\ teeth)}{Total\ number\ of\ tooth\ examined}$$

The GI scores are interpreted as follows: a score between 0 and 1 indicates mild gingivitis, scores ranging from 1.1 to 2 reflect moderate gingivitis, and scores between 2.1 and 3 represent severe gingivitis.

Plaque Index (PLI) [13]

The scoring criteria for the PLI are as follows:

Score 0: No visible plaque on the tooth surface; Score 1: A thin film of plaque adheres to the free gingival margin and adjacent tooth surface, visible only with the use of a probe; Score 2: A moderate accumulation of plaque on the tooth surface, visible to the naked eye; Score 3: An abundance of soft matter within the gingival pocket and/or on the tooth and gingival margin.

To calculate the PLI is similar to that of gingival index. The formula for the PLI is:

Equation 2: Plaque Index (PLI) formula

$$PLI = \frac{\Sigma\ (Plaque\ scores\ for\ six\ selected\ teeth\ surfaces)}{Total\ number\ of\ tooth\ examined}$$

The interpretation of PLI scores is as follows: Score 0–0.9: Indicates mild plaque accumulation, Score 1–1.9: Indicates moderate plaque accumulation.

Oral Mucositis Index (OMI) [14]

The Oral Mucositis Index (OMI) is a tool used to assess the severity of mucositis in patients, evaluating conditions such as atrophy, erythema, edema, pseudomembrane formation, or ulceration in the oral cavity. The index examines 11 specific regions of the oral cavity, each rated on a scale from 0 to 4, with higher scores indicating greater severity.

The World Health Organization (WHO) scale for oral mucositis was employed in this study, providing the following grading system:

Grade 0: No mucositis is present; Grade 1: Erythema is observed without the presence of lesions; Grade 2: Ulcers are present, but the patient is still able to eat solid food; Grade 3: Painful ulcers are present, and the patient can only consume liquid food with analgesic support; Grade 4: Severe mucositis requiring parenteral or enteral nutrition and continuous analgesia for pain management.

Statistical analysis

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov-Smirnov was used to verify the normality of distribution of variables, Paired t-test was used to compare two periods for normally distributed quantitative variables while ANOVA with repeated measures was used for comparing the different studied periods for normally distributed quantitative variables and followed by Post Hoc test (Bonferroni adjusted) for pairwise comparison. Pearson coefficient to correlate between two normally distributed quantitative variables. Significance of the obtained results was judged at the 5% level.

RESULTS

The table1 shows clinical characteristics of 150 patients treated with radiotherapy, 70 patients treated with chemotherapy, and 98 patients who received both radiotherapy and chemotherapy were analyzed, with significant findings highlighted by P values.

The mean age of patients was significantly different among groups (P = 0.0391). Patients treated with radiotherapy alone had a slightly younger mean age (40.99±5.94 years) compared to those receiving chemotherapy (42.47±6.1 years) or combined treatment (42.81±5.7 years).

Gender distribution showed no significant difference (P = 0.8115). Males represented 45.33% of the radiotherapy group, 50% of the chemotherapy group, and 46.94% of the combined group, with females slightly predominating across all groups.

Smoking and alcohol use were prevalent but not significantly different across groups (P = 0.323). Smoking was most common in the radiotherapy group (34.67%), while alcohol use was higher in the chemotherapy (35.71%) and combined (33.67%)

groups. Approximately 40% of the radiotherapy group reported no habits.

Chronic diseases were common among patients, with diabetes, hypertension, and chest diseases being most prevalent. No significant differences were observed in disease distribution (P = 0.9615). Diabetes was reported in 62% of the radiotherapy group, hypertension in 55.71% of the chemotherapy group, and chest diseases in 58.67% of the radiotherapy group.

The use of chronic disease treatments, including hypertension pills and diabetes or chest disease treatments, showed no significant differences among groups (P = 0.3515). The highest use of hypertension pills was in the chemotherapy group (27.14%), while diabetes treatment was most common in the combined treatment group (23.47%).

Table 2 shows the Caries Index (DMFT), Gingival Index (GI), Plaque Index (PI), and Oral Mucositis Index (OMI) among the studied population.

Caries Index (DMFT): The combined radiotherapy and chemotherapy group exhibited the highest DMFT score (6.6±1.19), compared to 4.29±1.51 in the chemotherapy group and 4.04±1.43 in the radiotherapy group. The decayed teeth (DT), missing teeth (MT), and filled teeth (FT) components were consistently higher in the combined group, indicating a greater burden of dental caries.

Gingival Index (GI): Severe gingivitis (GI score 2.1–3) was present in all patients in the combined group (100%), with an average GI score of 2.98±0.6. Conversely, the radiotherapy and chemotherapy groups had lower GI scores, with mild and moderate gingivitis observed in 64.67% and 72.86% of patients, respectively.

Plaque Index (PI): The combined group had the highest PI (2.01±0.61), with 45.92% of patients showing heavy plaque accumulation. Mild plaque accumulation was predominant in the radiotherapy (42.67%) and chemotherapy (60%) groups, with lower average PI scores (1.02±0.58 and 0.84±0.57, respectively).

TABLE (1) The Clinical Characteristics of the Patients

	Radiotherapy	***Chemotherapy***	***Radiotherapy and Chemotherapy***	**P value**
	N=150	***N=70***	***N=98***	
Age	Mean±SD 40.99±5.94	Mean±SD 42.47±6.1	Mean±SD 42.81±5.7	0.0391*
Gender	**n (%)**	**n (%)**	**n (%)**	
Male	68(45.33%)	35(50%)	46(46.94%)	0.8115
Female	82(54.67%)	35(50%)	52(53.06%)	
Special habits				
Smoking	52(34.67%)	23(32.86%)	30(30.61%)	0.323
Alcohol	37(24.67%)	25(35.71%)	33(33.67%)	
None	61(40.67%)	22(31.43%)	35(35.71%)	
Chronic diseases				
Diabetes	93(62%)	36(51.43%)	51(52.04%)	0.9615
Hypertension	79(52.67%)	39(55.71%)	47(47.96%)	
Chest diseases	88(58.67%)	35(50%)	47(47.96%)	
Others	89(59.33%)	38(54.29%)	41(41.84%)	
Treatment for chronic diseases				
Hypertension pills	27(18%)	19(27.14%)	19(19.39%)	0.3515
Treatment for diabetes	28(18.67%)	9(12.86%)	23(23.47%)	
Treatment for chest allergies	28(18.67%)	17(24.29%)	20(20.41%)	
Others	36(24%)	11(15.71%)	20(20.41%)	

TABLE (2) Multiple comparisons test between Caries index (DMFT) Score, Gingival index (GI), Plaque index, Oral mucositis index among the studied population

	Radiotherapy	*Chemotherapy*	*Radiotherapy and Chemotherapy*	P value
	N=150	*N=70*	*N=98*	
Caries index (DMFT)				
DT	0.89±0.75	1.14±0.79	1.93±0.63	<0.0001
MT	1.06±0.76	1.06±0.7	1.87±0.59	<0.0001
FT	2.1±1.06	2.09±1.26	2.79±0.69	<0.0001
DMFT	4.04±1.43	4.29±1.51	6.6±1.19	<0.0001
Gingival index (GI)				
0-1 indicate mild gingivitis	51(34%)	27(38.57%)	0(0%)	<0.0001
1.1-2 moderate gingivitis	46(30.67%)	24(34.29%)	0(0%)	
2.1-3 severe gingivitis	53(35.33%)	19(27.14%)	98(100%)	
Gingival index (GI)	1.54±0.89	1.44±0.87	2.98±0.6	
Plaque index				
0-0.9 indicate mild Pl. Accumulation	64(42.67%)	42(60%)	0(0%)	<0.0001*
1-1.9 moderate pl. accumulation	86(57.33%)	28(40%)	53(54.08%)	
2-3 heavy pl. accumulation	0(0%)	0(0%)	45(45.92%)	
Plaque index	1.02±0.58	0.84±0.57	2.01±0.61	
Oral mucositis index				
Grade 0 no mucositis	23(15.33%)	15(21.43%)	0(0%)	<0.0001*
Grade 1 erythema without lesions	47(31.33%)	17(24.29%)	0(0%)	
Grade 2 = ulcers	54(36%)	28(40%)	20(20.41%)	
Grade 3 = painful ulcers	26(17.33%)	10(14.29%)	57(58.16%)	
Grade 4 = requires parenteral or enteral support and continuous analgesia	0(0%)	0(0%)	21(21.43%)	
Oral mucositis index	1.56±0.86	1.53±0.9	2.99±0.56	

Oral Mucositis Index (OMI): The combined group experienced the most severe mucositis, with Grade 3 (58.16%) and Grade 4 (21.43%) predominating, and a mean OMI score of 2.99±0.56. Lower mucositis severity was observed in the chemotherapy and radiotherapy groups, with mild to moderate mucositis being more common.

The table 3 shows the Spearman correlation analysis examined the relationship between the type of treatment (radiotherapy or chemotherapy) and oral health indices, including the Caries Index (DMFT), Gingival Index (GI), Plaque Index (PI), and Oral Mucositis Index (OMI). Significant negative correlations were observed across all indices for both treatment groups ($P < 0.0001$).

For radiotherapy-treated patients, the Caries Index (DMFT) showed a strong negative correlation ($r = -0.445$), indicating that higher exposure to radiotherapy was associated with worse caries outcomes. Similarly, the Gingival Index (GI) ($r = -0.3785$) and Plaque Index (PI) ($r = -0.3312$) also showed moderate negative correlations, suggesting that radiotherapy negatively impacted gingival health and plaque accumulation. The strongest negative correlation was with the Oral Mucositis Index (OMI) ($r = -0.3984$), emphasizing that radiotherapy contributed significantly to mucositis severity.

For chemotherapy-treated patients, weaker negative correlations were observed compared to

the radiotherapy group. The Caries Index (DMFT) showed a mild negative correlation (r = -0.1773), while the Gingival Index (GI) (r = -0.2647) and Plaque Index (PI) (r = -0.3085) had moderate negative correlations, indicating less severe but still significant impacts on oral health. The Oral Mucositis Index (OMI) also showed a moderate negative correlation (r = -0.2399), reflecting the adverse effects of chemotherapy on mucosal health

TABLE (3) Correlation analysis using Spearman test for the relation between Radiotherapy and Chemotherapy treated patients and index score and Questionnaire.

	r Value	P value
Radiotherapy		
Caries index (DMFT)	-0.445*	<0.0001*
Gingival index (GI)	-0.3785*	<0.0001*
Plaque index	-0.3312*	<0.0001*
Oral mucositis index	-0.3984*	<0.0001*
Chemotherapy		
Caries index (DMFT)	-0.1773*	0.0015*
Gingival index (GI)	-0.2647*	<0.0001*
Plaque index	-0.3085*	<0.0001*
Oral mucositis index	-0.2399*	<0.0001*

DISCUSSION

The present study aimed is to assess the oral health status among patients diagnosed with head and neck cancer. This assessment will encompass various aspects of oral health, including but not limited to dental caries, periodontal health, oral mucosal conditions, and oral hygiene practices. By comprehensively evaluating the oral health status of these patients, we aim to gain insights into the prevalence and severity of oral complications associated with head and neck cancer.

The significantly higher DMFT score in the combined radiotherapy and chemotherapy group compared to the other two groups suggests a greater prevalence of dental caries among patients undergoing both treatment modalities. Several studies support the observation that radiotherapy and chemotherapy negatively impact oral health, consistent with the elevated DMFT scores observed in this study. For example, ***Bezerra de Melo et al. (2019)*** [15] emphasized the deterioration in oral health caused by chemotherapy and radiotherapy, noting significant impacts on quality of life among cancer patients. Following this, ***Gunathilake et al. (2021)*** [16] reported that head and neck cancer patients often experience poor oral health outcomes, exacerbated by limited access to dental care, which aligns with this study's findings of increased DMFT scores. Similarly, ***Maqbool et al. (2021)*** [17] observed that radiotherapy significantly affects oral health-related quality of life, suggesting the importance of regular dental assessments during treatment. More recently, ***Nishi et al. (2023)*** [18] found that treated patients showed higher levels of dental caries and missing teeth, supporting this study's findings. Additionally, ***Tasoulas et al. (2023)*** [19] highlighted the link between poor oral health and reduced survival outcomes in cancer patients, stressing the importance of maintaining dental health through treatments. [15-19]

On the other hand, some studies did not focus directly on DMFT scores but rather on broader quality of life metrics. ***Maghsudlu et al. (2016)*** [14] investigated quality of life impacts from treatment but did not specifically assess DMFT scores, suggesting that these impacts might not always translate directly to oral health metrics. More recently, ***Soldera et al. (2020)*** [20] examined factors affecting oral health-related quality of life without direct measurement of DMFT, instead highlighting the role of socio-demographic factors in influencing oral health outcomes.

In our study, we observed variations in the Gingival Index (GI) scores across different treatment groups. Specifically, the mean GI scores were 1.54±0.89 in the radiotherapy group, 1.44±0.87 in the chemotherapy group, and 2.98±0.6 in the combined radiotherapy and chemotherapy group. Notably, the combined radiotherapy and chemotherapy group exhibited a significantly higher GI score, indicating a higher severity of gingival inflammation compared to the other two groups.

Study by ***Aranti et al. (2013)*** [21] support our finding that cancer treatments, especially combined therapies, contribute to severe gingival inflammation by compromising immune function and increasing the risk of oral infections. ***Song et al. (2019)*** [23] observed that Porphyromonas gingivalis infection can increase resistance to chemotherapy and trigger stronger inflammatory responses, which parallels our findings of heightened Gingival Index scores. Similarly, ***Park et al. (2013)*** [24] found that elevated levels of inflammatory markers, such as IL-6, correlate with severe gingival inflammation in cancer patients. ***Sordi et al. (2023)*** [25] further demonstrated that gingival fibroblasts exposed to cancer cell lysates became highly inflammatory, producing IL-1, IL-6, and IL-8, which reflects the increased inflammation seen in our combined treatment group. These studies emphasize the importance of preventive oral care in managing inflammation during cancer treatment. [22-25]

In contrast, some studies did not directly assess Gingival Index (GI) scores or focused more on other oral health factors. [20, 21]

In our study, the combined radiotherapy and chemotherapy group exhibited the highest Plaque Index (PLI) scores, indicating significant plaque accumulation and periodontal challenges in these patients. This finding aligns with several studies that address the impact of intensive cancer treatments on oral health.

Studies highlight that cancer treatments, particularly combined radiotherapy and chemotherapy, worsen oral health by increasing plaque accumulation. ***Maier et al. (1993)*** [25] reported that head and neck cancer patients had poorer oral hygiene and dental status, supporting our findings of elevated Plaque Index (PLI) scores in patients receiving combined therapies. ***Chang et al. (2013)*** [26] linked poor oral hygiene with a higher risk of head and neck cancer, emphasizing that cancer treatments may further deteriorate oral health and underscore the need for targeted dental care. [26, 27]

More recent research confirms these trends. ***Al-Kubaisi et al. (2024)*** [28] observed heightened PLI scores in post-radiotherapy cancer patients, mirroring our findings of increased plaque in patients with combined therapies. ***Jiang et al. (2024)*** [29] demonstrated that an oral health support program during radiotherapy reduced PLI scores, reinforcing the importance of dental care in managing plaque accumulation for head and neck cancer patients. [28, 29]

Our study observation of significantly higher Oral Mucositis Index (OMI) scores in the combined radiotherapy and chemotherapy group aligns with findings indicating that intensified treatment modalities elevate mucosal toxicity and oral health challenges in head and neck cancer patients.

For instance, McGuire et al. (2002) [14] reported that patients undergoing both chemotherapy and radiation therapy consistently exhibited higher mean OMI scores and prolonged recovery compared to those receiving chemotherapy alone. Similarly, Sonis et al. (2004) [30] emphasized the increased risk and heightened severity of oral mucositis in patients treated with both modalities, underscoring the importance of targeted interventions.

Moreover, a randomized study by Lalla et al. (2012) [31] highlighted significantly greater differences in OMI scores among patients undergoing head and neck radiation therapy combined with chemotherapy, reflecting the compounded effects of dual treatment. Furthermore, a comprehensive review by Biala (2022) [32] affirmed that patients

subjected to combined therapies face a heightened risk of oral mucositis, characterized by consistently elevated OMI scores and extended recovery durations. These findings collectively underscore the critical need for effective strategies to mitigate the adverse oral health outcomes associated with combined radiotherapy and chemotherapy. [31, 32]

CONCLUSION

The findings of this study highlight the significant impact of head and neck cancer treatments on oral health. Patients undergoing radiotherapy, chemotherapy, or combined treatments face substantial challenges related to oral health, with pronounced effects observed in those receiving combined therapies. Tthe study revealed statistical differences in oral health indices, including the DMFT and Oral Mucositis Index. These variations were most pronounced among patients receiving combined treatments, underscoring the heightened risk of oral complications in this group.

The results emphasize the need for enhanced oral health management, with a focus on developing targeted strategies to address the unique complications arising from cancer treatments. Early and proactive care interventions are essential to alleviate symptoms and prevent long-term oral health issues, improving patient outcomes in the process.

To achieve this, the study advocates for interdisciplinary collaboration among healthcare professionals, including oncologists, dentists, and nurses, to provide comprehensive care that addresses both cancer treatment and oral health management. Such an approach can ensure that oral health is prioritized throughout the treatment journey.

By integrating oral health into the broader care plan, healthcare providers can alleviate symptoms, enhance the quality of life, and improve the overall well-being of patients undergoing treatment for head and neck cancer. This proactive approach to oral health is crucial for achieving better clinical and patient-centered outcomes.

REFERENCE

1. Jemal A, Bray F, Center MM, Ferlay J, Ward E, Forman D. Global cancer statistics. CA: a cancer journal for clinicians. 2011;61(2):69-90.
2. Brunotto M, Zarate A, Bono A, Barra JL, Berra S. Risk genes in head and neck cancer: a systematic review and meta-analysis of last 5 years. Oral oncology. 2014;50(3):178-88.
3. Ivanova N, Gugleva V, Dobreva M, Pehlivanov I, Stefanov S, Andonova V. We are IntechOpen, the world's leading publisher of Open Access books Built by scientists, for scientists TOP 1%. Intech, i (tourism). 2016;13.
4. Supportive P, Board PCE. Oral Complications of Chemotherapy and Head/Neck Radiation (PDQ®). PDQ Cancer Information Summaries [Internet]: National Cancer Institute (US); 2022.
5. Lee H-J, Han D-H, Kim J-H, Wu H-G. The effect of comprehensive oral care program on oral health and quality of life in patients undergoing radiotherapy for head and neck cancer: A quasi-experimental case-control study. Medicine. 2021;100(16):e25540.
6. Epstein JB, Thariat J, Bensadoun RJ, Barasch A, Murphy BA, Kolnick L, et al. Oral complications of cancer and cancer therapy: from cancer treatment to survivorship. CA: a cancer journal for clinicians. 2012;62(6):400-22.
7. Deasy JO, Moiseenko V, Marks L, Chao KC, Nam J, Eisbruch A. Radiotherapy dose–volume effects on salivary gland function. International Journal of Radiation Oncology* Biology* Physics. 2010;76(3):S58-S63.
8. Deng J, Jackson L, Epstein JB, Migliorati CA, Murphy BA. Dental demineralization and caries in patients with head and neck cancer. Oral oncology. 2015;51(9):824-31.
9. Benn A, Thomson W. Saliva: an overview. NZ Dent J. 2014;110(3):92-6.
10. Kubota K, Kobayashi W, Sakaki H, Nakagawa H, Kon T, Mimura M, et al. Professional oral health care reduces oral mucositis pain in patients treated by superselective intra-arterial chemotherapy concurrent with radiotherapy for oral cancer. Supportive care in cancer. 2015;23:3323-9.
11. Islam NM, Bhattacharyya I, Cohen DM. Common oral manifestations of systemic disease. Otolaryngologic Clinics of North America. 2011;44(1):161-82.
12. Kawamura M, Fukuda S, Inoue C, Sasahara H, Iwamoto Y. The validity and reproducibility of an oral rating index as a measurement of gingival health care and oral hygiene level in adults. Journal of clinical periodontology. 2000;27(6):411-6.

13. Mander CI, Mainwaring PJ. Assessment of the validity of two plaque indices. Community Dentistry and Oral Epidemiology. 1980;8(3):139-41.
14. McGuire DB, Peterson DE, Muller S, Owen DC, Slemmons MF, Schubert MM. The 20 item oral mucositis index: reliability and validity in bone marrow and stem cell transplant patients. Cancer Investigation. 2002;20(7-8):893-903.
15. de Melo N-B, de Sousa V-M, de Melo D-P, Bento P-M. Oral health related quality of life and determinant factors in patients with head and neck cancer. Medicina oral, patologia oral y cirugia bucal. 2019;24(3):e281.
16. Gunathilake S, Engelbrecht H, Smith M, Derbi H. Oral health implications in patients with head and neck cancer. International Dental Journal. 2021;71:S37.
17. Maqbool S, Siddique S, Mehak A, Ali Q, Asghar SK, Shahid F. Evaluation of Oral Health Related Quality of Life in Patients Diagnosed with Head and Neck Cancer Receiving Radiotherapy. Ultrasound.3(2.0).
18. Nishi H, Obayashi T, Ueda T, Ohta K, Shigeishi H, Munenaga S, et al. Head and neck cancer patients show poor oral health as compared to those with other types of cancer. BMC Oral Health. 2023;23(1):647.
19. Tasoulas J, Farquhar DR, Sheth S, Hackman T, Yarbrough WG, Agala CB, et al. Poor oral health influences head and neck cancer patient survival: an International Head and Neck Cancer Epidemiology Consortium pooled analysis. JNCI: Journal of the National Cancer Institute. 2024;116(1):105-14.
20. Soldera EB, Ortigara GB, Bonzanini LI, Schulz RE, Danesi CC, Antoniazzi RP, et al. Clinical and sociodemographic factors associated with oral health-related quality of life in survivors of head and neck cancer. Head & Neck. 2020;42(5):886-97.
21. Maghsudlu S, Nafarzadeh S, Moslemi D, Foroghi R, Sistani MMN. Oral health related quality of life in patients with head and neck tumors undergoing chemo and radiotherapy. Journal of Craniomaxillofacial Research. 2016:196-201.
22. Aranti R, Kemal Y. Efek samping pada rongga mulut akibat terapi siklosporin Side effect in oral cavity due to cyclosporine therapy. Journal of Dentomaxillofacial Science. 2013;12(1):49-53.
23. Song JM, Woo BH, Lee JH, Yoon S, Cho Y, Kim Y-D, et al. Oral administration of Porphyromonas gingivalis, a major pathogen of chronic periodontitis, promotes resistance to paclitaxel in mouse xenografts of oral squamous cell carcinoma. International journal of molecular sciences. 2019;20(10):2494.
24. Park MH, Park JS. Difference of oral mucositis in hospitalized cancer patients receiving chemotherapy. Asian Oncology Nursing. 2013;13(2):76-84.
25. Sordi MB, Panahipour L, Gruber R. Oral squamous carcinoma cell lysates provoke exacerbated inflammatory response in gingival fibroblasts. Clinical oral investigations. 2023;27(8):4785-94.
26. Chang JS, Lo H-I, Wong T-Y, Huang C-C, Lee W-T, Tsai S-T, et al. Investigating the association between oral hygiene and head and neck cancer. Oral oncology. 2013;49(10):1010-7.
27. Maier H, Zöller J, Herrmann A, Kreiss M, Heller W-D. Dental status and oral hygiene in patients with head and neck cancer. Otolaryngology—Head and Neck Surgery. 1993;108(6):655-61.
28. Al-Kubaisi AA, Nabeel Z, Adem Ş, Mula-Hussain L. Changes and Roles of IL-6, hsCRP, and proCT in Patients with Chronic Periodontitis in Head and Neck Cancer Pre/Post Radiotherapy. Al-Rafidain Journal of Medical Sciences (ISSN 2789-3219). 2024;7(1):248-54.
29. Jiang N, Zhao Y, Mårtensson J, Stensson M. The effects of an integrated supportive programme on oral health in patients with head and neck cancer undergoing radiotherapy: A randomized controlled trial. International Journal of Dental Hygiene. 2024.
30. Sonis ST, Elting LS, Keefe D, Peterson DE, Schubert M, Hauer-Jensen M, et al. Perspectives on cancer therapy-induced mucosal injury: pathogenesis, measurement, epidemiology, and consequences for patients. Cancer: Interdisciplinary International Journal of the American Cancer Society. 2004;100(S9):1995-2025.
31. Lalla RV, Gordon GB, Schubert M, Silverman S, Hutten M, Sonis ST, et al. A randomized, double-blind, placebo-controlled trial of misoprostol for oral mucositis secondary to high-dose chemotherapy. Supportive Care in Cancer. 2012;20:1797-804.
32. Biala M. Low-level laser therapy: A literature review of the prevention and reduction of oral mucositis in patients undergoing stem cell transplantation. Number 3/June 2022. 2022;26(3):293-9.