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*Corresponding author

Fatma Yuce, Dentomaxillofacial Radiology, Istanbul Kent University, Türkiye

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Research Article

# Oral Health in Cancer Patients After Radiotherapy and Chemotherapy: DMFT Index Findings

**Fatma Yuce[1*] and Cansu Buyuk[2]**

[1]*Dentomaxillofacial Radiology, Istanbul Kent University, Türkiye*

[2]*Dentomaxillofacial Radiology, Istanbul Okan University, Türkiye*

## Abstract

**Objective:** This study aims to determine the relationship between the DMFT (decayed, missing, filled) index in cancer patients with variables such as cancer type and treatment type.

**Material and method:** Cancer patients who were examined in the Okan University Faculty of Dentistry between 2021-2023 and underwent radiotherapy/chemotherapy (RT/CT) were detected retrospectively via system. Patients with a history of cancer; demographic information, type of cancer, time spent on treatment, type of treatment (RT/CT/RT+CT), and DMFT index determined. A control group was formed, and demographic information and DMFT index were noted. All results were analyzed using IBM SPSS, and $p<0.05$ significance level was accepted.

**Results:** 102 individuals (33 males 69 females) with a history of cancer, mean age 56; the control group consisted of 110 individuals (61 males 49 females) with an average age of 50 years. The most common type of cancer was breast cancer (45%). There was no significant difference in D/M/F and DMFT index of cancer treatment types. The DMFT index determined a significant difference between healthy and cancer patients ($p<0.05$). While the incidence of caries did not show a significant difference between healthy and cancer patients, the number of missing and filled teeth showed a significant difference. The DMFT index has a significant relationship with age and time since treatment but is insignificant with cancer types.

**Conclusion:** Regardless of cancer history, types, and treatment modality, it has a significant effect on the DMFT index.

## Introduction

Cancer is defined as an illness resulting from the uncontrolled growth or proliferation of cells in any organ/tissue in the body [1]. The International Association of Research on Cancer, in its 2020 world cancer statistics, has recorded that there were an estimated 19.3 million new cases of cancer and 10 million cancer-related deaths worldwide in 2020 [2]. Based on data from the Ministry of Health in Turkey, on average, there are 163,000 new cases of cancer each year with approximations of 450 new cases of cancer daily being recorded in our nation. Based on the statistics of 2020, it has been recorded that the highest cases occur in breast, lung, colon, prostate, and stomach cancers with percentages of 11.7%, 11.4%, 10%, 7.3%, and 5.6% respectively [3]. The ratio of oral cancers is the same in the world and in our nation with percentages of 1-2% in total cancers in our geographic location [4].

While new cancer treatments are being developed, chemotherapy (CT), radiotherapy (RT), and surgery are still the most widely used methods. Surgery and RT are used to control the disease locally, while CT aims to eliminate the disease throughout the body [5]. Head and neck RT and CT can weaken the immune system, which raises the risk of infection. Complications from cancer treatments, such as mucositis, reduced saliva production, oral infections, increased cavities, changes in taste, and trismus, may greatly affect quality of life [6]. All cancer types, especially oral cancer, cause significant side effects in the mouth that impact quality of life and may require changes in treatment methods. Therefore, dentists play a crucial role in assessing and maintaining oral health for patients with a history of cancer.

The DMFT index (decayed teeth, missing teeth, filled teeth, and total) is one of the most useful indices in establishing the oral health status of any given population. The index is very useful, most employed in the evaluation of the oral healthcare status of populations across the globe [7]. The index calculates the number of decayed teeth, the number of treated teeth, and the number of lost teeth resulting from decayed teeth in the community [8]. The index may be utilized to design oral healthcare programs by assessing the oral healthcare interventions provided in the community [9,10]. The purpose of this study was to determine the DMFT index level of patients who previously had cancer, to compare these with healthy individuals, and to evaluate what parameters affect the DMFT index.

## Materials and Methods

This study was carried out at the Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Istanbul Okan University, with approval from the Institutional Ethics Committee (Approval No. 23/171). The study adhered to the principles outlined in the Declaration of Helsinki. All orthopantomograms (OPGs) were obtained from patients who presented to the clinic for various diagnostic reasons between 2018 and 2023. OPGs were obtained using a Planmeca Promax 2D S3 unit (Planmeca, Helsinki, Finland) according to the standard protocol recommended by the manufacturer (66 kVp, 8 mA, 16 s). Two groups were created for the study: a 'healthy group' consisting of healthy individuals and a 'patient group' consisting of patients with a history of cancer.

## Patient Selection Criteria

This study aimed to compare values between the healthy group and the patient group. The first group comprised patients with a history of cancer, identified retrospectively from the electronic patient records of the Department of Dentomaxillofacial Radiology at Istanbul Okan University's Faculty of Dentistry. We collected demographic data for 190 individuals with a cancer history between 2021 and 2023, regardless of the specific cancer diagnosis. This demographic data included:

- **Cancer Type:** Categorized into ten groups: breast, prostate, lung, cervical, thyroid, colon, head and neck, stomach, lymphoma, and metastatic cancer.
- **Time spent on treatment:** Divided into four periods: 0-1 year, 2-5 years, 6-10 years, and over 10 years.

Treatment Modality: The three categories include CT only, RT only, and combined CT and RT.

Patients with other types of cancer diagnosis or who did not receive cancer treatment were excluded. A total of 102 patients who met these criteria were included in the final analysis.

The control group consisted of 110 healthy individuals with no reported systemic diseases, also identified from the Department's patient records between 2021 and 2023. In this control group, demographic data were also collected.

## Radiological Assessment

Following the delineation of study cohorts, panoramic radiographs were obtained from each participant and subsequently evaluated. Image analysis was performed utilizing the Planmeca Romexis imaging software (Helsinki, Finland), to which the radiographic system was interfaced. Image interpretation was performed in a controlled low-illumination environment using a high-resolution medical-grade monitor (Eizo, RadiForce MX242W, 24.1-inch, 2.4 MP, Ishikawa, Japan). The DMFT index was measured by an experienced examiner (F.Y.), who has five years of professional experience in clinical and radiological practice, on panoramic radiographs. DMFT components were evaluated by scores as follows:

**D score:** Indicates the presence of carious lesions or existing restorations in teeth.
**M score:** Teeth that were absent (missing).
**F score:** Those teeth that are restoration and have no evidence of decay.
**T score:** Refers to the total number of teeth evaluated.

The aggregate DMFT score was obtained by summing the D, M, and F component scores. All teeth, with the exemption of third molars (tooth number 8), were considered for examination and their status was recorded. DMFT scores were categorized into four classes according to the WHO criteria: very low, low, moderate, and high (Table 1) [11].

**Table 1:** Classifications of the DMFT score according to the WHO criteria [11].

| DMFT Index | Classification |
|---|---|
| <5.0 | Very Low |
| 5.0- 8.9 | Low |
| 9.0- 13.9 | Moderate |
| >13.9 | High |

## Statistical Analysis

Statistical analyses were performed using SPSS version 21.0 software (SPSS Inc., Chicago, IL, USA). The normality assumption for continuous variables was examined through the Shapiro-Wilk test. Normally distributed data are presented as mean ± standard deviation, whereas non-normally distributed data are presented as median (interquartile range). Inter-group differences were investigated using the Analysis of Variance (ANOVA) test, with the Tukey post-hoc test employed for pairwise comparisons in instances of significant overall group differences. Associations between continuous variables were explored using Spearman correlation analysis. The threshold for statistical significance was predetermined at $p \leq 0.05$.

## Results

DMFT scores of healthy subjects and cancer patients were compared retrospectively using panoramic radiographs. The control group consisted of 110 healthy subjects-61 males and 49 females-with an age average of 50 years, whereas the patient population included 102 subjects-33 males and 69 females-with a mean age of 56 years (Table 2).

**Table 2:** Distribution and demographic information of the individuals examined within the scope of the study.

| | Patient Group | | Healthy Group | |
|---|---|---|---|---|
| | 33 male | 69 female | 61 male | 49 female |
| Total | n=102 | | n=110 | |
| Average years | 56 | | 50 | |

## Patient Demographics

The study cohort, encompassing ten distinct cancer diagnoses, exhibited a predominance of breast cancer cases, representing 45% of the sample (n=46). Neoplasms of the head and neck constituted the second most frequent malignancy, accounting for 10.7% (n=11) of the observed cases. Conversely, lymphoma represented the lowest proportion, comprising only 2.9% (n=3) of the cohort (Table 3).

Participants were further stratified by therapeutic modalities applied: CT as a monotherapy, RT as a monotherapy, and combined. The overwhelming majority of the patients (49%) received combined chemotherapy and RT. As many as 29.4% of patients received CT alone, whereas 21.6% of the patients were treated with RT as a single therapeutic approach (Table 3).

**Table 3:** Distribution of cancer types and treatments received in patients with a history of cancer.

| Cancer Types | Frequency (=n) |
|---|---|
| Breast | 46 |
| Head and Neck | 11 |
| Colon | 9 |
| Cervix | 8 |
| Prostate | 8 |
| Stomach | 5 |
| Lung | 4 |
| Metastasis | 4 |
| Thyroid | 4 |
| Lymphoma | 3 |
| Total | 102 |
| Treatment Type | Frequency (=n) |
| Radiotherapy | 22 |
| Chemotherapy | 30 |
| Radiotherapy + Chemotherapy | 50 |
| Total | 102 |

Temporal analysis showed that 36.3% of cases, n=37, were in the 2-5 year post-treatment period. The smallest fraction of cases belonged to the 6-10 years interval and accounted for 15.7%, n=16, of the study population (Table 4).

**Table 4:** Table 4: Four categories of time since treatment: 0-1, 2-5, 6-10 and 10+.

| Time Since Treatment | İndividuals | % Percentage |
|---|---|---|
| 0-1 years | 32 | 31,4 |
| 2-5 years | 37 | 36,3 |
| 6-10 years | 16 | 15,7 |
| 10+ years | 17 | 16,6 |
| Total | 102 individuals | 100% |

## DMFT Index Assessment

DMFT scores were independently determined for both the patient and control groups to facilitate intra- and inter-group comparisons. The DMFT index was assessed based on WHO standards, categorized into four levels: very low, low, moderate, and high. A statistically significant positive correlation was observed between the DMFT index and age, irrespective of disease status (p=0.000). In the control group, the 'low' and 'moderate' categories comprised a comparable number of individuals (36/37), representing the largest segment (approximately 64%). The 'high' DMFT score category was most prevalent (55%) within the patient group (Table 5). Furthermore, a statistically significant difference was identified in the DMFT index between the control and patient groups, with the patient group exhibiting significantly elevated DMFT scores (p=0.000).

**Table 5:** DMFT score distributions of both groups.

| | | | Gender | | Total |
|---|---|---|---|---|---|
| Patient Group | | | Male | Female | |
| | | Very Low | 15 | 8 | 23 |
| Healthy | DMFT_group | Low | 19 | 17 | 36 |
| | | Moderate | 18 | 17 | 35 |
| | | High | 9 | 7 | 16 |
| | Total | | 61 | 49 | 110 |
| Patient | DMFT_group | Very Low | 2 | 6 | 8 |
| | | Low | 4 | 12 | 16 |
| | | Moderate | 5 | 16 | 21 |
| | | High | 22 | 35 | 57 |
| | Total | | 33 | 69 | 102 |

When the D/M/F indices were compared separately between the two groups;

- There was no significant difference in the rate of caries between healthy and cancer patients (p=0.370), but there were significant differences in the rate of missing teeth (p=0.000) and the rate of fillings (p=0.000).
- Within the patient cohort, analysis of the relationship between the DMFT index and other variables indicated no significant difference in the overall DMFT index or its individual components among patients receiving CT, RT, or a combination of CT+RT (p = -0.279).
- Furthermore, no statistically significant association was found between the specific type of cancer and the DMFT index (p = 0.860).
- In contrast, a strong and significant association was identified between the duration since cancer treatment and the DMFT index (p = 0.000), with the DMFT index increasing as the time elapsed since treatment.
- This increase was comparatively more pronounced in patients who had undergone CT alone.

## Discussion

The incidence of cancer worldwide and its related side effects increase daily. Advances in technological and medical research have improved survival rates, but there is still a strong need for the continuation of patients' social integration, life quality, and general well-being after cancer treatment [12]. Poor oral health might be influenced by various factors during the time of diagnosis and treatment of cancer disease, such as inadequate oral hygiene habits, invasive dental procedures before some surgeries, and lack of motivation in performing self-care [13]. In this study, it was found that there was a significant difference between the DMFT values of healthy individuals and those who have had cancer in the past, with higher DMFT indices in the latter group (p = 0.00). The literature about oral health conditions among cancer patients reports a significant increase in the gingival index, plaque index, and DMFT index consistently [14]. In fact, these studies, with different populations and sample sizes, came up with a conclusion that a history of cancer significantly affects the DMFT index independently of other confounding factors [15].

Aging as a physiological process affecting the whole organism leads to changes in the oral cavity, such as reduced salivary flow, increased tooth loss, atrophy of oral mucosa and muscles, and impaired taste perception [16]. Generally, older age is considered a high-risk group for oral and dental health problems, and DMFT scores are expected to increase as time goes by. In the study conducted by Moradi et al. [7], targeting only a younger adult population of [15-45 years) and excluding elderly individuals, increasing age was considered as one of the factors contributing to high DMFT levels. Thus, with regard to increasing age, DMFT scores also went up in both healthy and patient groups. Age is an independent and positive predictor of DMFT, and the DMFT can be expected to go up with age in healthy adults as well as adults with cancerous history. Our results confirm this [7,12].

New therapeutic modalities are available to complement and supplement the conventional cancer treatments due to advances in technology. Although vaccines, biological therapies, hormonal therapies, targeted therapies, and gene therapies are becoming increasingly important treatments for cancer, conventional therapies such as CT, RT, and surgery remain the cornerstone of treatment [17]. Hong et al. [14], in a two-decade literature review, analyzed studies that reported DMFT, dental plaque, and gingival indices in patients with a history of cancer and found the highest increase in DMFT in patients treated with RT. The present study also found a moderate elevation in DMFT levels in RT patients compared to CT+RT and RT groups. There are indications that both CT and RT may result in changes in the oral microflora by affecting the salivary glands [12,18]. Thus, treatment duration, proximity of RT to the salivary glands, and individual oral hygiene status could be better predictors of the DMFT score. Hong et al. [14] and Moore et al. [18] pointed out that the enhanced DMFT in RT patients was doseand proximity-dependent, while the effect of CT was said to be mediated through sialochemical changes that were transient in nature; our findings agree with this distinction [14,18].

Although more than 100 types of cancer are scientifically recognized, and standardized methods have been established for some kinds of cancer, cancer is also a personal disease. Because of each individual's personal genetic background, there is often variation in the expression and treatment of the disease [17]. The present study considered only the ten most common forms of cancer; cancers affecting fewer than three participants were excluded. As the largest subgroup, breast cancer made up 45% of the sample (n=46). Today, breast cancer remains one of the three most common malignancies worldwide and is the most common cancer diagnosis among women. While lung, colon, and prostate cancers are typically diagnosed in men, our data provide support for this observation [19]. Our study did not demonstrate any statistically significant relationship between cancer type and DMFT index. The single-center design and relatively small number of participants are potential limitations in this regard.

The DMFT index, a long-established and widely used measure in dental epidemiological studies, quantifies oral health status based on the number of teeth decayed, extracted, and filled in each individual, then averages for populations [7]. Primarily a clinical index, the DMFT has been retrospectively calculated from panoramic radiographs in many investigations. In concert with our methods, radiological images have been used in previous work to quantify DMFT when creation of a specific patient cohort would be otherwise too time consuming [20,21]. Our cancer history cohort-the main focus of this work-reached 102 participants in roughly five years. Our work also shows that the DMFT increase is greater with increased time since treatment, and the literature indicates this increase is enhanced by measures of poor oral hygiene [12-14]. Future work should involve clinical data collection across multiple centers to hasten the participant recruitment process.

## Conclusion

The findings from this study indicate that the DMFT index, as a dental health parameter, tends to deteriorate after cancer therapies. This seems inevitable due to long-term changes in salivary gland performance and oral hygiene behavior, with dental health scores becoming worse as the post-therapy period prolongs. No particular malignancy

showed a definitive correlation with the DMFT index; however, all these findings indicate an increasing vulnerability of dental health in survivors of cancer. Hence, routine follow-up after therapy should include regular dental check-ups, prophylaxis, and timely restorative management. Multi-institutional prospective studies are also needed to confirm these observations and to explain the influence of diet and nutritional status, general health status, and socioeconomic factors in this phenomenon.

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