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ORIGINAL ARTICLE

Assessment of oral health and care in head and neck oncology patients in King Faisal Specialist Hospital and Research Center-Jeddah

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Abstract *Objectives:* To assess oral hygiene indices, dental status, and oral health practices among head and neck cancer patients at King Faisal Specialist Hospital and Research Center (KFSHRC)-Jeddah.

Materials and Methods: The charts of 117 patients with head and neck cancer were reviewed to identify the decayed/missing/filled teeth (DMFT) index, calculus index (CI), gingival index (MGI), and oral hygiene index. The type of cancer, other systemic diseases, and sex data were extracted from the records and analyzed using SPSS statistical software for descriptive statistics, Student's *t*-test, analysis of variance (ANOVA), and Spearman correlation statistical analyses.

Results: The total mean DMFT index was 14.33. The significant caries index (SiC) for the studied sample was 25.87. Men had a mean DMFT of 14.11 (SD 9.8). The mean DMFT index for women was 14.63 (SD 9.7). The DMFT score for patients with systemic disease was 17.47 (SD 9.9). Patients with no other diseases had a mean DMFT score of 12.82 (SD 9.3). The DMFT index was not significantly different between men and women ($p = 0.925$). One-way ANOVA ($F = 1.729$) revealed no significant difference ($p = 0.110$) between DMFT scores according to the location of the cancer. DMFT with systemic disease showed no significant difference ($p = 0.6$) in comparison to patients without systemic disease.

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The Spearman rho statistic revealed no correlation between the DMFT score and CI ($p = 0.383$).

Conclusions: The total DMFT score was 14.33. The total SiC was 25.87. The DMFT scores of men and women were not significantly different. Cancer location and presence or absence of systemic diseases did not affect the DMFT score. The DMFT score and CI were not correlated, but a correlation was found between the DMFT score and MGI and the oral hygiene index.

1. Introduction

Assessment of oral hygiene indices, dental status, and oral health practices among head and neck cancer patients before initiating their cancer therapies or treatments are lacking in the literature.

A strong connection between oral disease and poor oral hygiene has been reported (Glickman and Carranza, 1990). Lack of proper tooth brushing and interdental cleaning can result in bacterial build-up and the formation of microbial biofilms that could lead to periodontal disease and dental caries (Glickman and Carranza, 1990). A clear association has been reported between poor oral health and systemic disorders (Mattila, 1993; Beck, Pankow et al., 1999; Bloemenkamp, van den Bosch et al., 2002; Bokhari and Khan, 2006; Rech, Nurkin et al., 2007; Chen, Umeda et al., 2008).

In addition, oral tissue has been reported to frequently reflect the state of general health and often indicates the presence of systemic diseases such as the toxic effects of cancer treatments on the oral mucosa. Oral mucosal cells are susceptible to therapies such as chemotherapy or radiotherapy because of their rapid proliferation rate, which results in multiple oral complications (Dose, 1995; Miller and Kearney, 2001). Oral complications such as mucositis, xerostomia (from salivary hypofunction), oral opportunistic infections, dysgeusia (altered taste), dental caries, trismus, and osteonecrosis during or after chemotherapy and/or radiotherapy can affect morbidity and mortality (Dose, 1995; Miller and Kearney, 2001; Brown and Wingard, 2004) and quality of life. Mucositis is one of the major nonhematologic adverse effects of cancer treatment (Verdi, 1993; Naidu, Ramana et al., 2004).

The presence of oral or dental disease is considered a major risk factor for the development of mucositis during cancer treatment (Brown and Wingard, 2004). Therefore, strict oral care, including professional care and a standardized oral hygiene protocol is important for patients undergoing cancer treatment to reduce contamination levels in the oral cavity.

Regarding the oral health assessment and its relationship with systemic diseases, a retrospective analysis assessed the oral health status of patients in Saudi Arabia using decayed/missing/filled teeth (DMFT). An association was found between systemic illness and the oral health status of individuals, especially when age was taken into consideration (Alnafisah, Alharbi et al., 2020).

Most previous studies in literature have described the oral manifestations of cancer in general, including the head and neck, or have described the oral complications of cancer therapy (Busjan, Hasenkamp et al., 2018; Yenugadhati, Albalawi et al., 2018). However, few studies have reported the oral hygiene status of cancer patients (Miller and Kearney, 2001; Kubota, Kobayashi et al., 2015; Friemel, Foraita et al., 2016; Farquhar, Divaris et al., 2017; Chang, Lee et al., 2019) or the self-perception of oral health (Ahmed, Albalawi et al., 2018).

Most previous studies have been conducted on patients after cancer therapy; however, Busjan et al. reported the DMF score in newly diagnosed cancer patients (Busjan, Hasenkamp et al., 2018).

No other studies were found in the Saudi Arabian literature that assessed baseline oral health indices and practices for head and neck oncology patients who will undergo cancer therapy. In addition, because of the significant prevalence of oral complications in patients with head and neck cancer and because many cancer treatments will result in unavoidable patients with oral conditions, oral care should be a priority for healthcare providers.

Therefore, the aim of the present study was to assess the oral hygiene indices, dental status, and oral health practices among patients with head and neck cancer in King Faisal Specialist Hospital and Research Center (KFSHRC)-Jeddah since knowledge and research in this part of Saudi Arabia is lacking.

2. Material and Methods

2.1. Study design and population

This was a retrospective study. The Institutional Review Board of KFSHRC-Jeddah approved this study (2017–66). Data were collected from the charts of 117 patients in KFSHRC-Jeddah. Patients meeting the following criteria were included in the study: 18 years or older; male and female patients diagnosed with head and neck cancer including nasopharyngeal, laryngeal, oropharyngeal, oral cavity, hypopharynx, salivary gland, thyroid, or nasal cavity cancer; and had not started chemotherapy or radiotherapy. Other head and neck conditions, such as right or left jugular tumor, neck lymph node, pituitary macroadenoma, medulloblastoma of the fossa, brain tumor, and nodular lymphocyte-predominant Hodgkin lymphoma, were excluded from this study.

2.2. Data collection and indices

One hundred and seventeen dental charts and radiographs were reviewed, and data were extracted by three investigators trained by one supervising investigator before data extraction. The supervising investigator reviewed all charts and records and collected data once again after the three investigators. Dental hygiene visits were performed and

information was extracted by only one individual, the dental hygienist, and reviewed again by the supervising investigator.

In this chart review, data from the initial examination, radiographs, and dental hygiene visits were collected to measure the following dental indices.

1) DMFT index and significant caries index (SiC)

The DMFT index is a measurement of decayed, missing, and filled teeth. It is applied to permanent teeth only. It was introduced in 1938 by Klein, Palmer, and Kluston and later modified by the World Health Organization in 1986 (Klein and Palmer, 1938; WHO, 1962).

In 2000, a new index, the SiC, was introduced by Bratthall (Bratthall, 2000). It was proposed to complement the mean DMFT value by paying attention to individuals with the highest caries scores in each population. It is calculated using an Excel sheet by sorting individuals according to their DMFT value. After selecting the third of the population with the highest caries value, the mean DMFT for that subgroup was calculated.

2) Calculus index (CI)

The CI was developed in 1964 by Greene and Vermillion as part of the Oral Hygiene Index (Greene and Vermillion, 1964), which also includes the Debris Index. (Table 2).

The total is calculated by dividing the total score by the total number of teeth present.

3) Modified gingival index (MGI)

Developed by Lobene et al. in 1986 (Lobene, Weatherford et al., 1986), the MGI assesses the prevalence and severity of gingivitis. Strictly based on a noninvasive approach (Table 2).

4) Level of oral hygiene (OH) care

This was assessed by the dental hygienist according to the oral hygiene habits of the patient and effectiveness of plaque removal and calculus prevention (Table 2).

5) The presence and absence of other systemic diseases were also recorded.

2.3. Assumptions and statistical analysis

Sample size calculation and post-hoc power tests were performed for the Student's *t*-test, analysis of variation (ANOVA), and correlations using G*Power software (Heinrich Heine Universität Düsseldorf, Düsseldorf, Germany).

The assumptions of the ANOVA and correlation analyses were detailed in Table 4 and 6.

Descriptive statistics, Student's *t*-test, ANOVA, and Spearman correlation statistical analyses were performed using the SPSS 25 software package (IBM Corp, Armonk, NY).

3. Results

The charts of 117 patients diagnosed with head and neck cancer were reviewed for the DMFT index, CI, MGI, and oral hygiene index. The types of cancer, other systemic diseases, and sex data were extracted from patient records.

For the *t*-test sample, an a priori sample size calculation was performed with an effect size of 0.5 and power of 0.80. Therefore, the required sample size was 120. The post-hoc power for sex comparisons in the *t*-test for the studied sample size was 0.758. For the ANOVA test, for an effect size of 3.056 calculated from sample means and group sizes, the post hoc power was 1.000. For correlation analyses, the a priori sample size calculation for an effect size of 0.5 and a power of 0.80 gave a minimum required sample size of 26.

The patients included 66 men and 51 women. The total mean DMFT index for the studied sample was 14.33. The total SiC was 25.87. Men had a mean DMFT of 14.11 (SD 9.8). The mean DMFT index for women was 14.63 (SD 9.7). Table 1 shows the location of cancer among the studied population. The total mean for decayed (D) teeth was 4.23 (SD 4.92), the total mean for missing teeth was 7.78 (SD 7.81), and the total mean for filled teeth was 2.32 (SD 3.30). Each component of the DMFT index is detailed in Table 2 according to the location of cancer, type of therapy, presence of systemic disease, CI, MGI, and oral hygiene level.

Seventy-nine patients had not been diagnosed with other systemic diseases, while 38 patients had other systemic diseases. The DMFT score of patients who had a systemic disease was 17.47 (SD 9.9), and patients who had no other disease had a mean DMFT score of 12.82 (SD 9.3).

There were 37 CI, 45 MGI, and 27 OH index data missing from the records. Therefore, comparisons were not performed and were excluded for cases with missing data in the correlation tests.

A comparison of the DMFT index between male and female patients using Student's *t*-test (2-tailed) revealed no significant difference ($p = 0.925$) (Table 3).

One-way ANOVA ($F = 1.729$) found no significant difference ($p = 0.110$) between the DMFT scores according to the location of the cancer (Table 4).

Student's *t*-test of DMFT with systemic disease showed no significant difference ($p = 0.6$) (Table 5). The Spearman rho statistic revealed no correlation between the DMFT score and CI ($p = 0.383$).

A significant weak direct correlation was found between the DMFT index and MGI ($\rho = 0.273$, $p < 0.05$) (Table 6).

A significant weak direct correlation was found between the DMFT score and OH level index ($\rho = 0.308$, $p < 0.01$).

4. Discussion

There was no significant difference in the DMFT score index between male and female patients, the location of the cancer, and in patients with or without systemic disease. There was no association between the DMFT score and CI, but there were associations between the DMFT score and MGI and oral hygiene.

Table 1 DMFT score in male and female patients divided by type of cancer; type of treatment; presence or absence of systemic diseases; and according to CI, MGI, and oral hygiene level.

	Gender											
	F DMFT Score						M DMFT Score					
	Count	Row N %	Mean	Standard deviation	Maximum	Minimum	Count	Row N %	Mean	Standard deviation	Maximum	Minimum
Location of Cancer	Nasopharyngeal	20	48.8%	16.95	9.89	32	0	21	51.2%	15.67	11.95	32	0
	Laryngeal	2	16.7%	11.50	14.85	22	1	10	83.3%	19.60	9.92	32	4
	Oropharyngeal	1	50.0%	29.00	.	29	29	1	50.0%	8.00	.	8	8
	Oral cavity	18	41.9%	11.83	8.68	32	2	25	58.1%	11.24	7.93	32	2
	Hypopharynx	3	100.0%	21.67	9.45	29	11	0	0.0%	.	.	.	.
	Salivary gland	5	55.6%	9.80	8.53	22	1	4	44.4%	13.75	6.90	21	5
	Thyroid	0	0.0%	.	.	.	.	2	100.0%	19.50	2.12	21	18
	Nasal cavity	2	40.0%	14.00	11.31	22	6	3	60.0%	7.67	5.69	14	3
Type of therapy	Radiotherapy	30	41.1%	12.73	8.12	29	1	43	58.9%	13.72	9.17	32	0
	Chemotherapy	1	33.3%	31.00	.	31	31	2	66.7%	10.50	9.19	17	4
	Radiotherapy and chemotherapy	19	50.0%	16.00	10.97	32	0	19	50.0%	16.16	11.49	32	0
	Only surgery	1	33.3%	29.00	.	29	29	2	66.7%	6.50	4.95	10	3
Other systemic diseases	None	38	48.1%	13.47	9.22	32	0	41	51.9%	12.22	9.44	32	0
	Other systemic diseases	13	34.2%	18.00	10.61	32	1	25	65.8%	17.20	9.78	32	0
Calculus index	No calculus	4	36.4%	10.00	8.79	20	0	7	63.6%	20.57	9.50	32	4
	Mild calculus	7	41.2%	12.71	9.98	32	3	10	58.8%	14.50	9.31	27	1
	Moderate calculus	10	37.0%	15.00	8.64	27	1	17	63.0%	9.18	7.58	28	0
	Heavy calculus	8	32.0%	10.38	9.07	26	1	17	68.0%	13.65	6.95	25	2
Modified gingival index	Healthy	0	0.0%	.	.	.	.	0	0.0%	.	.	.	.
	Mild inflammation	7	43.8%	8.57	7.70	20	0	9	56.3%	9.11	5.40	17	2
	Moderate inflammation	12	41.4%	15.83	9.54	32	1	17	58.6%	11.29	9.18	32	1
	Severe inflammation	11	40.7%	15.55	11.68	32	1	16	59.3%	16.75	9.10	32	0
Oral hygiene level	Very good oral hygiene	2	66.7%	3.00	4.24	6	0	1	33.3%	17.00	.	17	17
	Good oral hygiene	3	30.0%	10.00	7.81	15	1	7	70.0%	12.43	6.40	22	4
	Fair oral hygiene	4	30.8%	10.75	7.93	20	1	9	69.2%	7.00	7.26	21	0
	Poor oral hygiene	27	42.2%	17.37	8.67	32	4	37	57.8%	14.95	9.62	32	1

Table 2 Detailed DMFT score of male and female patients divided by type of cancer; type of treatment; presence or absence of systemic diseases; and according to CI, MGI, and oral hygiene level.

		Sex																																	
		F																	M																	
		Decay						Missing						Fillings					Decay						Missing						Fillings					
Location of cancer	**Nasopharyngeal**	**5.75**	**6.51**	**2**	**0**	**17**	**0**	**7.85**	**8.86**	**5**	**0**	**27**	**0**	**3.35**	**3.50**	**2**	**0**	**11**	**0**	**3.71**	**4.58**	**2**	**0**	**15**	**0**	**9.62**	**10.12**	**4**	**0**	**29**	**0**	**2.33**	**3.97**	**0**	**0**	**12**	**0**
	Laryngeal	**.00**	**.00**	**0**	**0**	**0**	**0**	**9.00**	**11.31**	**9**	**1[a]**	**17**	**1**	**2.50**	**3.54**	**3**	**0[a]**	**5**	**0**	**6.20**	**5.14**	**5**	**1[a]**	**16**	**1**	**9.10**	**7.58**	**7**	**3**	**26**	**2**	**4.30**	**4.42**	**4**	**0[a]**	**13**	**0**
	Oropharangeal	**1.00**	**.**	**1**	**1**	**1**	**1**	**28.00**	**.**	**28**	**28**	**28**	**28**	**.00**	**.**	**0**	**0**	**0**	**0**	**.00**	**.**	**0**	**0**	**0**	**0**	**3.00**	**.**	**3**	**3**	**3**	**3**	**5.00**	**.**	**5**	**5**	**5**	**5**
	Oral cavity	**3.33**	**5.25**	**3**	**0**	**22**	**0**	**7.56**	**4.97**	**8**	**3**	**17**	**0**	**.94**	**1.11**	**1**	**0**	**3**	**0**	**3.16**	**2.91**	**3**	**0**	**10**	**0**	**6.72**	**7.08**	**5**	**5**	**32**	**0**	**1.36**	**2.72**	**0**	**0**	**11**	**0**
	Hypopharynx	**8.33**	**7.51**	**8**	**1[a]**	**16**	**1**	**13.33**	**10.50**	**13**	**3[a]**	**24**	**3**	**.00**	**.00**	**0**	**0**	**0**	**0**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**
	Salivary gland	**4.00**	**5.96**	**1**	**0**	**14**	**0**	**3.80**	**2.59**	**3**	**1[a]**	**7**	**1**	**2.00**	**1.58**	**2**	**0[a]**	**4**	**0**	**6.75**	**5.68**	**7**	**1[a]**	**13**	**1**	**3.50**	**5.07**	**2**	**0[a]**	**11**	**0**	**3.50**	**4.73**	**2**	**0**	**10**	**0**
	Thyroid	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**7.00**	**.00**	**7**	**7**	**7**	**7**	**6.50**	**.71**	**7**	**6[a]**	**7**	**6**	**6.00**	**1.41**	**6**	**5[a]**	**7**	**5**
	Nasal cavity	**1.50**	**.71**	**2**	**1[a]**	**2**	**1**	**5.50**	**7.78**	**6**	**0[a]**	**11**	**0**	**7.00**	**4.24**	**7**	**4[a]**	**10**	**4**	**3.67**	**3.06**	**3**	**1[a]**	**7**	**1**	**3.33**	**1.53**	**3**	**2[a]**	**5**	**2**	**.67**	**1.15**	**0**	**0**	**2**	**0**
	Total	**4.39**	**5.83**	**2**	**0**	**22**	**0**	**8.02**	**7.67**	**6**	**3**	**28**	**0**	**2.22**	**2.88**	**1**	**0**	**11**	**0**	**4.11**	**4.13**	**3**	**0**	**16**	**0**	**7.59**	**7.97**	**5**	**0[a]**	**32**	**0**	**2.41**	**3.62**	**0**	**0**	**13**	**0**
Type of therapy	**Radiotherapy**	**4.17**	**5.38**	**2**	**0**	**17**	**0**	**6.80**	**6.19**	**5**	**3**	**24**	**0**	**1.77**	**2.27**	**1**	**0**	**11**	**0**	**4.37**	**3.87**	**3**	**0[a]**	**13**	**0**	**7.12**	**7.18**	**5**	**0**	**32**	**0**	**2.23**	**3.12**	**0**	**0**	**11**	**0**
	Chemotherapy	**.00**	**.**	**0**	**0**	**0**	**0**	**26.00**	**.**	**26**	**26**	**26**	**26**	**5.00**	**.**	**5**	**5**	**5**	**5**	**8.00**	**9.90**	**8**	**1[a]**	**15**	**1**	**2.50**	**.71**	**3**	**2[a]**	**3**	**2**	**.00**	**.00**	**0**	**0**	**0**	**0**
	Radiotherapy and chemotherapy	**5.16**	**6.74**	**1**	**0**	**22**	**0**	**7.95**	**7.68**	**6**	**6**	**27**	**0**	**2.89**	**3.63**	**1**	**0**	**10**	**0**	**3.32**	**4.26**	**2**	**0**	**16**	**0**	**9.53**	**9.99**	**5**	**0[a]**	**29**	**0**	**3.32**	**4.73**	**1**	**0**	**13**	**0**
	Only surgery	**1.00**	**.**	**1**	**1**	**1**	**1**	**28.00**	**.**	**28**	**28**	**28**	**28**	**.00**	**.**	**0**	**0**	**0**	**0**	**2.00**	**1.41**	**2**	**1[a]**	**3**	**1**	**4.50**	**3.54**	**5**	**2[a]**	**7**	**2**	**.00**	**.00**	**0**	**0**	**0**	**0**
	Total	**4.39**	**5.83**	**2**	**0**	**22**	**0**	**8.02**	**7.67**	**6**	**3**	**28**	**0**	**2.22**	**2.88**	**1**	**0**	**11**	**0**	**4.11**	**4.13**	**3**	**0**	**16**	**0**	**7.59**	**7.97**	**5**	**0[a]**	**32**	**0**	**2.41**	**3.62**	**0**	**0**	**13**	**0**
Other systemic diseases	**None**	**4.79**	**5.96**	**2**	**0**	**22**	**0**	**6.76**	**7.09**	**5**	**0**	**28**	**0**	**1.92**	**2.75**	**1**	**0**	**11**	**0**	**3.68**	**3.94**	**2**	**0[a]**	**15**	**0**	**6.15**	**7.25**	**3**	**2**	**29**	**0**	**2.39**	**3.68**	**0**	**0**	**13**	**0**
	Other systemic diseases	**3.23**	**5.51**	**1**	**0**	**16**	**0**	**11.69**	**8.39**	**11**	**3[a]**	**27**	**1**	**3.08**	**3.17**	**3**	**0**	**10**	**0**	**4.80**	**4.42**	**3**	**0**	**16**	**0**	**9.96**	**8.64**	**7**	**4**	**32**	**0**	**2.44**	**3.58**	**0**	**0**	**12**	**0**
	Total	**4.39**	**5.83**	**2**	**0**	**22**	**0**	**8.02**	**7.67**	**6**	**3**	**28**	**0**	**2.22**	**2.88**	**1**	**0**	**11**	**0**	**4.11**	**4.13**	**3**	**0**	**16**	**0**	**7.59**	**7.97**	**5**	**0[a]**	**32**	**0**	**2.41**	**3.62**	**0**	**0**	**13**	**0**
Calculus index	**No calculus**	**4.75**	**8.18**	**1**	**1**	**17**	**0**	**2.00**	**2.83**	**1**	**0**	**6**	**0**	**3.25**	**2.87**	**3**	**3**	**7**	**0**	**6.14**	**5.08**	**4**	**0[a]**	**13**	**0**	**11.71**	**10.31**	**11**	**0[a]**	**29**	**0**	**2.71**	**4.11**	**0**	**0**	**11**	**0**
	Mild calculus	**5.29**	**7.52**	**3**	**2[a]**	**22**	**0**	**6.29**	**4.79**	**6**	**3**	**14**	**0**	**1.14**	**1.95**	**0**	**0**	**4**	**0**	**4.60**	**4.97**	**3**	**3**	**16**	**0**	**5.10**	**5.43**	**3**	**1**	**16**	**0**	**4.80**	**5.14**	**3**	**0**	**13**	**0**
	Moderate calculus	**4.10**	**4.68**	**3**	**0[a]**	**14**	**0**	**7.70**	**6.33**	**7**	**1[a]**	**18**	**1**	**3.20**	**4.13**	**1**	**0[a]**	**11**	**0**	**3.06**	**3.03**	**2**	**1**	**11**	**0**	**4.41**	**3.91**	**4**	**0[a]**	**13**	**0**	**1.71**	**2.78**	**0**	**0**	**9**	**0**
	Heavy calculus	**4.25**	**6.45**	**0**	**0**	**16**	**0**	**5.13**	**5.36**	**4**	**4**	**17**	**0**	**1.00**	**1.20**	**1**	**0**	**3**	**0**	**4.53**	**4.43**	**3**	**0**	**15**	**0**	**6.59**	**4.87**	**6**	**6**	**18**	**0**	**2.53**	**3.12**	**2**	**0**	**11**	**0**
	Total	**4.52**	**6.08**	**2**	**0**	**22**	**0**	**5.86**	**5.42**	**4**	**0[a]**	**18**	**0**	**2.10**	**2.96**	**1**	**0**	**11**	**0**	**4.27**	**4.22**	**3**	**3**	**16**	**0**	**6.27**	**6.01**	**5**	**0**	**29**	**0**	**2.73**	**3.69**	**1**	**0**	**13**	**0**
Modified gingival index	**Healthy**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**	**.**
	Mild inflammation	**3.57**	**6.19**	**1**	**0**	**17**	**0**	**2.29**	**2.75**	**1**	**0**	**6**	**0**	**2.71**	**2.56**	**3**	**0[a]**	**7**	**0**	**3.78**	**4.21**	**2**	**1**	**13**	**0**	**2.44**	**2.30**	**3**	**0**	**6**	**0**	**2.89**	**4.51**	**0**	**0**	**11**	**0**
	Moderate inflammation	**3.42**	**4.52**	**2**	**0**	**14**	**0**	**9.25**	**8.00**	**7**	**1[a]**	**27**	**1**	**3.17**	**3.83**	**1**	**1**	**11**	**0**	**2.47**	**2.55**	**2**	**1[a]**	**10**	**0**	**6.24**	**6.58**	**4**	**2**	**26**	**0**	**2.59**	**3.91**	**1**	**0**	**13**	**0**
	Severe inflammation	**4.45**	**7.54**	**1**	**0**	**22**	**0**	**8.82**	**7.77**	**6**	**2[a]**	**26**	**1**	**2.27**	**3.07**	**2**	**0**	**10**	**0**	**6.19**	**5.02**	**6**	**0**	**16**	**0**	**7.88**	**7.06**	**6**	**6**	**27**	**0**	**2.69**	**3.24**	**2**	**0**	**11**	**0**
	Total	**3.83**	**5.96**	**1**	**0**	**22**	**0**	**7.47**	**7.43**	**6**	**1[a]**	**27**	**0**	**2.73**	**3.22**	**2**	**0**	**11**	**0**	**4.17**	**4.25**	**3**	**0[a]**	**16**	**0**	**6.05**	**6.35**	**4**	**0**	**27**	**0**	**2.69**	**3.71**	**1**	**0**	**13**	**0**
Oral hygiene level	**Very good oral hygiene**	**1.00**	**1.41**	**1**	**0[a]**	**2**	**0**	**.00**	**.00**	**0**	**0**	**0**	**0**	**2.00**	**2.83**	**2**	**0[a]**	**4**	**0**	**.00**	**.**	**0**	**0**	**0**	**0**	**6.00**	**.**	**6**	**6**	**6**	**6**	**11.00**	**.**	**11**	**11**	**11**	**11**
	Good oral hygiene	**2.00**	**2.65**	**1**	**0[a]**	**5**	**0**	**4.33**	**2.89**	**6**	**6**	**6**	**1**	**3.67**	**3.51**	**4**	**0[a]**	**7**	**0**	**5.43**	**3.78**	**5**	**6**	**13**	**1**	**5.57**	**5.65**	**3**	**3**	**14**	**0**	**1.43**	**1.81**	**1**	**0**	**4**	**0**
	Fair oral hygiene	**2.75**	**4.19**	**1**	**1**	**9**	**0**	**5.00**	**4.69**	**5**	**1**	**10**	**1**	**3.00**	**5.35**	**1**	**0**	**11**	**0**	**2.67**	**3.00**	**2**	**3**	**10**	**0**	**2.56**	**3.88**	**1**	**0**	**11**	**0**	**1.78**	**3.38**	**0**	**0**	**10**	**0**
	Poor oral hygiene	**6.22**	**6.53**	**3**	**0**	**22**	**0**	**8.93**	**6.86**	**7**	**3[a]**	**26**	**0**	**2.22**	**2.64**	**1**	**0**	**8**	**0**	**4.41**	**4.43**	**3**	**0[a]**	**16**	**0**	**8.00**	**7.66**	**5**	**4**	**29**	**0**	**2.54**	**3.34**	**1**	**0**	**11**	**0**
	Total	**5.19**	**6.08**	**3**	**0**	**22**	**0**	**7.61**	**6.61**	**6**	**6**	**26**	**0**	**2.42**	**2.96**	**1**	**0**	**11**	**0**	**4.17**	**4.16**	**3**	**3**	**16**	**0**	**6.74**	**7.07**	**5**	**0**	**29**	**0**	**2.43**	**3.36**	**1**	**0**	**11**	**0**

a. **Multiple modes exist. The smallest value is shown**

Table 2 (*continued*)

	Sex					
	F			M		
	Decay	Missing	Fillings	Decay	Missing	Fillings

- **CI is scored as 0 - no calculus present., 1 - supragingival calculus covering not more than 1/3 of the exposed tooth surface. 2 - supragingival calculus covering more than 1/3 but not more than 2/3 of the exposed tooth surface or presence of individual flecks of subgingival calculus around the cervical portion of the tooth or both. 3 - supragingival calculus covering more than 2/3 of the exposed tooth surface or a continuous heavy band of subgingival calculus around the cervical portion of the tooth or roots.**
- **MGI is scored as: 0 - normal/ absence of inflammation. 1 - mild inflammation (slight change in color, little change in texture) of any portion of the gingival unit. 2 - mild inflammation of the entire gingival unit. 3 - moderate inflammation (moderate glazing, redness, edema, and/or hypertrophy) of the gingival unit. 4 - severe inflammation (marked redness and edema/hypertrophy, spontaneous bleeding, or ulceration) of the gingival unit.**
- **OH Level is scored as: 1 - very good - regular brushing and interdental care present and appropriate. 2 - good - regular brushing and interdental care but ineffective. 3 - fair - brushing is not regular or ineffective and absence of proper interdental care. 4 - poor - no regular brushing or interdental care.**

M: Mean, SD: Standard Deviation, Me: Median, Mo: Mode, Max: Maximum, Min: Minimum.

Table 3 Student's *t*-test of DMFT scores between sexes.

Independent samples test of DMFT score between sexes										
		Levene test for equality of variances		*t*-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of difference	
									Lower	Upper
DMFT	Equal variances assumed	0.009	0.925	−0.287	115	0.775	-0.521	1.818	−4.123	3.080
	Equal variances not assumed			−0.287	108.245	0.775	-0.521	1.816	−4.120	3.077

Table 4 ANOVA of DMFT score between types of cancers.

ANOVA test of DMFT score between various types of cancers					
DMFT					
	Sum of squares	df	Mean square	F	Sig.
Between groups	1093.829	7	156.261	1.729	0.110
Within groups	9852.171	109	90.387		
Total	10946.000	116			

Assumptions for ANOVA Analysis were as follows:

1- Samples were independent
2- Findings were normally distributed
3- The homogeneity of variance according to Levene's test was not significant (0.925).

4.1. DMFT score compared with other studies of healthy individuals

The current study reported a mean DMFT score of 14.33, with a SiC of 25.87, which was higher than that reported in DMFT studies of healthy adult Saudi populations (Almas, Afzal et al., 1993; Almas and Al-jasser, 1996; Al Jasser and ALmas, 1997; Akbar, Baig et al., 2016); however, it was comparable to the study by Al Ghannam et al. (Al Ghannam, Khan et al., 2005). The authors are unaware of studies on the DMFT score among Saudi populations with cancer in general or head and neck cancer specifically. The current study reported lower DMFT scores than that in a study of DMFT in a population aged 65 years and older (AL-Zahrani, 2005; Al-shehri, 2012).

4.2. Head and neck cancer patients before therapy

When comparing the DMFT score of the current study with studies of head and neck cancer patients before starting cancer therapy, Bachok et al. reported a DMFT score of 13.7 (Bachok, Biswal et al., 2018), Moraes et al. reported a score of 18.1, and Rouers et al. reported a score of 16.1 (Moraes, Dias et al., 2016; Rouers, Dubourg et al., 2016).

4.3. DMFT scores compared with those of patients with cancer after therapy

Some studies that recorded the DMFT score after cancer therapy reported higher scores than those in the present study (Joyston-Bechal, Hayes et al., 1992; Tezal, Scannapieco et al., 2013; Quispe, Cremonesi et al., 2018; de Pauli Paglioni, Palmier et al., 2019), while others have reported lower DMFT scores (Dreizen, Brown et al., 1977; Schwarz, Chiu et al., 1999; Michelet, 2012; Dholam, Somani et al., 2013; Venkataraghavan, Majithia et al., 2014; Gupta, Marwaha et al., 2016). One study recording DMFT scores after cancer therapy reported results comparable to those in the current study (Bachok, Biswal et al., 2018).

4.4. DMFT scores comparing male and female patients

When comparing DMFT scores between male and female patients, the current study found no difference in contrast with the findings in studies by Lukacs, Mansbridge, and Cahen et al., who found that women had significantly higher DMFT scores than men in a healthy population (Mansbridge, 1958; Cahen, Caubet et al., 1977; Lukacs and Largaespada, 2006; Lukacs, 2011a,b).

Table 5 Student's *t*-test of DMFT score between patients with or without systemic diseases.

Independent samples test of DMFT score between patients with or without systemic diseases										
		Levene test for equality of variances		-test for equality of means			*t*			
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of difference	
									Lower	Upper
DMF	Equal variances assumed	0.277	0.600	−2.478	115	0.015	−4.651	1.877	−8.368	−0.934
	Equal variances not assumed			−2.421	68.927	0.018	−4.651	1.921	−8.484	−0.818

Table 6 Spearman rho correlation between DMFT score and CI, MGI, and OH level.

			DMFT	CI	MGI	Oral Hygiene level
Spearman rho	DMFT	Correlation Coefficient	1.000	−0.099	0.273*	0.308**
		Sig. (2-tailed)		0.383	0.020	0.003
		N	117	80	72	90
	CI	Correlation Coefficient	−0.099	1.000	0.537**	0.341**
		Sig. (2-tailed)	0.383		0.000	0.003
		N	80	80	65	76
	MGI	Correlation Coefficient	0.273*	0.537**	1.000	0.553**
		Sig. (2-tailed)	0.020	0.000		0.000
		N	72	65	72	65
	Oral hygiene level	Correlation Coefficient	0.308**	0.341**	0.553**	1.000
		Sig. (2-tailed)	0.003	0.003	0.000	
		N	90	76	65	90

**Correlation is significant at the 0.01 level (2-tailed).
*Correlation is significant at the 0.05 level (2-tailed).
The assumptions of the correlational analyses were as follows:
1-The measure is a continuous scale (DMFT) or ordinal scale (CI, MGI, and OH level). Thus, it is non-parametric. Therefore, Spearman rho correlation was used.
2-Independent observations: each patient has an independent oral health status.
3-Each variable was normally distributed.

4.5. Studies of the correlation between DMFT, MGI, CI, and oral hygiene

There was no difference in the CI between healthy men and women, which is comparable with what is reported in the current study. Plaque is an important cause of caries and periodontal diseases, but appears to be an independent process. Positive correlations between caries and gingival disease have been suggested in several studies, but they have not been substantiated (Glickman and Carranza, 1990).

It should be noted that the highest component of the DMFT in the current study was the missing teeth (M) with a total mean of 7.78 (SD 7.81). The high mean of missing teeth could be attributed to poor oral hygiene care in the Saudi population, as indicated by the oral hygiene level index in the studied population in the current study. In a survey of individuals 15 years of age and older, El Bcheraoui et al. estimated that 16.3% of a Saudi Arabian population never brushed their teeth, 85% never flossed their teeth, 11.5% received routine dental checkups, and that 48.6% had visited a clinic for a dental complaint in the previous year (El Bcheraoui, Tuffaha et al., 2016).

The current study found that the DMFT score and CI were not correlated, which seems logical because calculus would lead to periodontal disease and the missing teeth in the DMFT score were most probably a result of decay rather than mainly due to periodontal disease. This could not be verified because the missing component of the DMFT score could not be extracted from the records as the reason for tooth loss or extraction was not stated in most dental records.

The weak direct association between the DMFT score and each oral hygiene index and MGI could be due to the presence of poor oral hygiene and plaque. Records of plaque index (PI) were not complete in the dental records; therefore, the plaque index was not reported in this study.

The strong positive correlation between the CI and MGI appears logical and confirms the current knowledge that calculus is associated with gingival inflammation that can progress to periodontal disease.

The strong direct correlation between the MGI and oral hygiene index confirms the current knowledge that oral

hygiene plays an important role in the progression of gingival disease.

Oral hygiene is known to affect the development of calculus and was confirmed in the current study by the moderate direct correlation between them.

There was no association between sex and oral hygiene index and the presence of calculus in the current study.

The current study reported the DMFT score, CI, MGI, and OH indices in head and neck cancer patients before cancer therapy in a Saudi adult population aged between 18 and 89, which has not been previously reported. Additionally, it confirmed the relationship between these variables and periodontal disease and caries, as previously reported. It also confirmed that the components of the DMFT scores were principally derived from the presence of local factors and partially due to the lack of oral hygiene from the lack of motivational, psychological, and educational drives. We did not attempt to measure the later drives as it could not be measured in the current retrospective study.

4.6. Limitations

Although the limitations of retrospective studies are known, the current study has established the current oral health status of Saudi adult patients with head and neck cancer in KFSHRC-Jeddah and confirmed the relationship between the variables of oral health and disease processes. This will help in the introduction of new and important interventional programs for this category of patients in the dental department, helping them to improve their quality of life.

4.7. Future studies

Future studies could include a prospective clinical study in which an educational, psychological, and motivational program is introduced and the DMFT, CI, MGI, PI, Bleading index (BI), and OH index are measured before and after interventional programs.

5. Conclusions

Within the limitations of the study, we can conclude the following for the study of head and neck cancer patients in KFSHRC-J:

- The total DMFT score was 14.33.
- The total SiC was 25.87.
- DMFT scores in male and female patients were similar.
- Cancer location and presence or absence of systemic diseases did not affect the DMFT score.
- DMFT score and CI were not correlated, but there was a correlation between the DMFT score and MGI and oral hygiene index.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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