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Original/*Cáncer*

Oral physiology and quality of life in cancer patients

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Abstract

Introduction: **Cancer treatment can affect the health of the teeth and support structures, which are essential to the chewing process, which may change the nutritional status of the patient.**

Objective: **The aim of this study was to evaluate the impact of oral physiology changes on quality of life (QoL) of patients submitted to cancer treatment.**

Design: **Initially 84 cancer patients were screened and only those presenting at least 15 natural teeth were selected for oral physiology and quality of life tests. The final sample comprised 30 patients. Twenty subjects were selected as controls paired by age and gender. Dental caries status, salivary flow, masticatory performance (MP), location of tumor, duration of chemo and radiotherapy and World Health Organization Quality of Life (WHOQOL-bref) questionnaire were assessed. Linear regression models were used to test the relationship between the WHOQOL-bref domains (physical, psychological, social relationship, environmental and overall QoL) and independent variables under study.**

Results and Discussion: **Number of teeth, MP and salivary flow were lower in cancer patients, as well as for the scores obtained in Social Relationship, Environment and Overall QoL domains ($p<0.050$). Breast cancer caused a negative impact on Psychological ($p<0.001$) and Overall QoL scores ($p=0.017$). A similar negative effect was found for the duration of radiotherapy on Psychological ($p=0.012$) and Environmental ($p=0.039$) domains. On the other hand, the maintenance of teeth had a positive impact on Psychological ($p=0.012$) and Environmental ($p=0.024$) scores.**

Conclusion: **Oral physiology changes may impact the QoL of oncological patients. The maintenance of teeth was of positive importance, especially for the psychological aspects.**

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FISIOLOGÍA ORAL Y CALIDAD DE VIDA EN PACIENTES CON CÁNCER

Resumen

Introdución: **El tratamiento del cáncer puede afectar la salud de los dientes y estructuras de apoyo, que son esenciales para el proceso de masticación, que pueden cambiar el estado nutricional del paciente.**

Objetivo: **El objetivo de este estudio fue evaluar el impacto de los cambios fisiológicos orales sobre la calidad de vida (QoL) de los pacientes sometidos a tratamiento contra el cáncer.**

Metodos: **Inicialmente 84 pacientes con cáncer fueron examinados y sólo los que presentan al menos 15 dientes naturales fueron seleccionados para la fisiología oral y la calidad de las pruebas de la vida. La muestra final quedó conformado por 30 pacientes. Veinte sujetos fueron seleccionados como controles emparejados por edad y sexo. Dental estado de la caries, el flujo salival, rendimiento masticatorio (MP), la ubicación del tumor, la duración de la quimioterapia y la radioterapia y lo cuestionario de La Organización Mundial de la Salud Calidad de Vida (WHOQOL-BREF) cuestionario fueron evaluados. Se utilizaron modelos de regresión lineal para probar la relación entre los dominios del WHOQOL-BREF (psicológicos relación física,, social, ambiental y de calidad de vida en general) y variables independientes bajo estudio.**

Resultados y Discusión: **Número de dientes, MP y el flujo salival fueron menores en los pacientes de cáncer, así como para las puntuaciones obtenidas en la relación social, medio ambiente y dominios de calidad de vida general ($p <0,050$). El cáncer de mama causó un impacto negativo en la psicológica ($p <0,001$) y las puntuaciones de calidad de vida global ($p = 0,017$). Un efecto negativo similar se encontró para la duración de la radioterapia sobre psicológica ($p = 0,012$) y ambientales ($p = 0,039$) dominios. Por otra parte, el mantenimiento de dientes tuvo un impacto positivo en la psicológica ($p = 0,012$) y del Medio Ambiente ($p = 0,024$) resultados.**

Conclusión: **los cambios orales fisiología pueden afectar la calidad de vida de los pacientes oncológicos. El mantenimiento de dientes fue de importancia positiva, sobre todo por los aspectos psicológicos.**

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Palabras clave: *La quimioterapia. Rendimiento masticatorio. La calidad de vida. Oncología. Sabor.*

Introduction

The term cancer is used to describe a group of malignancies characterized by the presence of tumor masses with a high risk of metastasis. Once it is diagnosed, undoubtedly profound social changes are generated, such as impaired capacity and ability to perform routine activities[1]. Besides, its treatment modalities can deeply affect a patient's nutritional status[2].

Among the recommended cancer treatments, chemotherapy is often the first choice and may act alone or in combination with radiotherapy and surgery depending on the type, location and staging of the tumor[3]. Irrespective of treatment, changes in physical and emotional integrity by discomfort, pain, disfigurement, dependence and loss of self-esteem are reported by these individuals, with consequent reduction in quality of life (QoL) in short time[4].

Especially due to cancer therapy, patients often report changes in taste[5], are more prone to tooth decay[6] with consequent changes in the number of teeth and they also complain about changes in salivary flow, directly interfering on oral physiology[7,8]. These, in turn, can promote changes in food choices causing nutritional disturbances to the patient, as well as affecting their QoL[9].

Studies evaluating the impact of changes in oral physiology of cancer patients' QoL – especially those with history of tumors localized out of the head and neck areas - are rare and of importance, so that interventions can be planned, resulting even in more favorable response to treatment and prognosis[4].

The objective of this study was to evaluate the impact of oral physiology changes on QoL of patients undergoing cancer therapy that presented tumors in different areas of the body in comparison to matched controls.

Materials and methods

Sample characteristics and study design

Patient selection and procedures in order to collect data regarding oral physiology parameters were described previously for this sample[8]. Briefly, the study received approval from the Human Research Ethics Committee of the Lavras University Center (Brazil) under process number CAEE- 0137.0.189.000-08.

A total of 84 patients who had been submitted to cancer treatment were evaluated from the institute "Lar Mateus Loureiro Ticle" in the city of Lavras, state of Minas Gerais, Brazil. Only those who have received radiotherapy and/or chemotherapy were selected. Data collection was carried out during home/institutional visits.

After initial contact, patients were examined and those who wore any kind of dental prosthesis were excluded to avoid its influence on mastication parameters. All volunteers presented at least 15 teeth and 4 occlusal units (one pair of molars in occlusion was considered two units and one pair of premolars in occlusion was considered one unit)[10]. Ten cancer patients were excluded for having received only surgical treatment and 35 were excluded because of dental prosthesis or for not complying inclusion criteria regarding the number of teeth. Also, nine patients were excluded for not being able to complete all experimental phases or answering the questionnaires appropriately (Figure 1).

Thus, the final sample consisted of 30 cancer patients. The tumors had been located in different areas of the body, the most frequent of which were in the breast (n=10), uterus (n=8), prostate (n=7) and head/neck (n=5).

For the control group, 50 volunteers were examined at the public health centers in the same city. Of those, twenty subjects were selected based on the same criteria in relation to number of teeth applied to cancer patients. Besides, gender and age matching was conducted.

Sample size was calculated according to a previous study[11] taking into account a power of the test of 80% and alpha level of 0.05. According to that study, it would be necessary 44 subjects to evaluate the correlation between masticatory performance and oral-health related quality of life. Thus, the final sample comprised 50 volunteers (30 oncological patients and 20 controls).

Determination of salivary flow

The procedures were conducted two hours after a meal[12]. For convenience, all saliva collections were carried out in the afternoon[13]. Non-stimulated and sti-

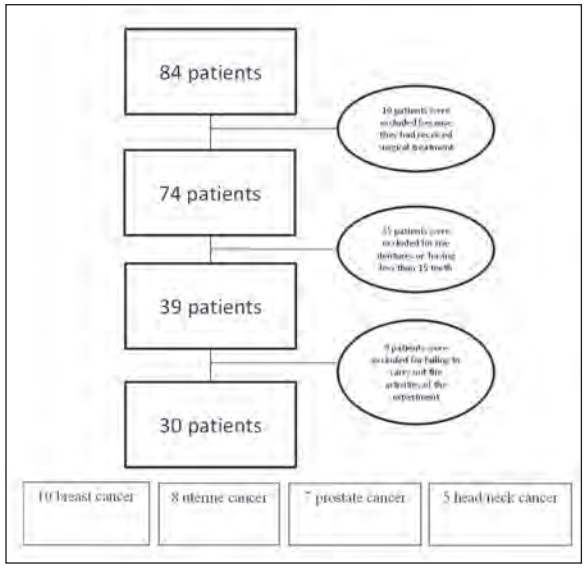

Fig. 1.—Criteria for patient selection and distribution of tumors

mulated salivary flow were collected as described previously[8].

Determination of dental caries status

The assessment of dental status was carried out using the ordinal Decayed/Missing/Filled Teeth (DMFT) index. A previously calibrated examiner performed all exams (inter-examiner Kappa > 0.85, very good agreement) using a tongue depressor, mouth mirror and no. 05 ball point probe under natural light.

Determination of masticatory performance (MP)

MP was assessed through the determination of individual fragmentation capacity of the chewing test material (Optosilsilicona - Optosil, HeraeusKulzer, South Bend, IN)[14]. Each subject received 17 cubes, which were masticated for 20 masticatory cycles. The number of cycles was visually quantified by the examiner[8] . After drying, the particles were removed from the paper filter, weighed and passed through a series of 10 granulometric sieves interconnected in decreasing order with mesh sizes ranging from 5.6 to 0.71 mm and closed at the bottom by a metal base. The particles retained in each sieve were removed and weighed on an analytical scale with a precision of 0.001 g. The distribution of the particles by weight was described by the cumulative function of the median sizes of the particles using the Rosin-Rammler equation (X50)[8,13,15]. MP was determined based on the median size of the particles, with smaller sizes denoting a better performance.

Assessment of Quality of Life

QoL was assessed using the WHOQOL-Bref in its validated Portuguese version, composed of 26 items that represent facets, which in turn, refer to four domains: Physical, Psychological, Social Relationships and Environment. The physical and psychological domains include the levels of independence and spirituality from the original full version, respectively. The domains consist of the same 24 facets of the original format, assessed by single questions, and two questions of general assessment of QoL[16].

Data were collected by means of household/institution interviews, in a situation of privacy, using as reference the last two weeks. The answers to all questions were obtained in a rating scale of five points, in which scores could range from 1 to 5, and two additional questions about overall QoL generate a single separate score, called "overall QoL". The domain scores were measured in the positive direction, i.e., higher scores denotes better QoL.

Statistical analysis

Statistical analysis was performed using SigmaPlot 12 (Sigma Stat Software Inc., Richmond, CA, USA) and SPSS 18.0 (SPSS Inc., Chicago, USA), with a 5% significance level. Normality was assessed using Kolmogorov-Smirnov/Shapiro-Wilk tests. The characteristics of the studied variables were evaluated using descriptive statistics, and they consisted of means, standard deviations, medians, interquartile ranges and proportions. The distribution of genders in each group was verified by means of the Fisher Exact test. Differences in the mean or median values were assessed using *t*-test or Mann-Whitney test, respectively. To assess the internal consistency of the WHOQOL-bref, i.e., correlation and homogeneity among the items we used the Cronbach α coefficient. Correlations (Spearman r) between the four domains and the overall QoL domain were also explored.

Linear regression models were used to test the relationship between the WHOQOL-bref domains (physical, psychological, social relationships, environmental and overall QoL) and the independent variables studied. The initial models consisted of 12 independent variables as follows: age, gender, breast cancer, uterus cancer, prostate cancer, head/neck cancer, duration for chemo and radiotherapies, MP (X50), salivary flow rate, DMFT index and number of teeth, which were regressively dropped until only those with $p<0.05$ remained in the model (stepwise backward elimination).

Results

The subject's age and gender did not differ between groups (p=0.063 and p=0.317, respectively). DMFT index did not differ between groups either. However, cancer patients showed significant decrease in the number of teeth, masticatory performance and salivary flow rates (Table I).

We found significant differences between cancer patients and controls for the Social Relationship and Environment domains and also for the overall QoL. The Cronbach Alfa internal consistency of WHOQOL-bref was considered satisfactory (0.88). Most of the WHOQOL-bref domains showed strong correlation with the overall QoL, being the Physical Health domain the most significant one (Table II).

Stepwise linear regression models showed negative impact for breast cancer on the psychological domain and on the overall QoL score. The duration of radiotherapy also had a negative impact on the psychological and environmental domains. On the other hand, the maintenance of teeth had a positive impact on the psychological and environmental domains (Table III).

Table I
Demographic data, clinical variables and discriminant validity of the WHOQOL-BREF assessment of the studied sample

Group	*Age*	*Gender*	*Number of teeth*	*DMFT*	*D*	*M*	*F*	*X50*	*S*	*US*	*Physical Domain*	*Psychological Domain*	*Social Relations Domain*	*Enviroment Domain*	*Overal QoL*
	Mean (SD)	(♀/♂)	*Mean (SD)*	*Mean (SD)*	*Média (DP)*	*Média (DP)*	*Média (DP)*	*Median (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*	*Mean (SD)*
Cancer (n=30)	47.93 (11.22)	(21/9)	20.67* (6.31)	17.53 (7.14)	1.70* (2.39)	7.90* (6.13)	7.93* (6.67)	6.57* (6.26)	0.83* (0.30)	0.47* (0.24)	12.93 (3.41)	14.51 (2.68)	14.71* (2.00)	13.35* (1.69)	14.80* (2.66)
Control (n=20)	42.15 (9.38)	(17/3)	26.80* (2.24)	17.25 (5.30)	0.75* (3.35)	1.80* (2.09)	14.70* (5.92)	5.60* (5.06)	2.61* (1.86)	1.97* (1.75)	14.11 (1.30)	14.60 (1.43)	16.60* (1.47)	15.78* (1.58)	15.60* (3.02)

SD, standard deviation; DMFT, decayed (D)/missing (M)/filled (F) teeth index; X50, median particle size; S, stimulated saliva flow; US, Unstimulated saliva flow. * p<0,05 (Mann-Whitney test)

Discussion

The evaluation of QoL is usually determined according to the functional health status of an individual, including self-assessments and also the level of interaction with the environment[17]. The nutritional profile becomes important as nutritional status was strongly correlated with health quality of life of cancer patients[18]. We found that cancer diagnosis in different areas of the body and its treatment caused oral physiology changes that impacted on the QoL of patients.

DMFT index did not differ between groups. However, cancer patients presented decreased number of teeth, poorer masticatory performance and lower salivary flow rates in comparison to controls. It is likely to presume that controls presented higher number of filled teeth in contrast to cancer patients who presented higher number of missing teeth (Table I). Chemotherapy, radiotherapy and the entire situation involving cancer diagnosis and treatment are normally correlated to immunosuppression, predisposing subjects to oral manifestations, such as oral mucositis, xerostomia, tooth loss and chewing difficulty[6,7,10]. Chemotherapeutic drugs can alter salivary flow and viscosity as well as the amount of lysozyme, lactoperoxidases, immunoglobulins, histamine and lactoferrins which present antimicrobial activity[6].These modifications can cause difficulty in swallowing, biofilm accumulation, and consequent changes to a pasty carbohydrates rich diet, increasing the incidence of cavities. The onset and progression of this type of decay can lead to tooth loss in a matter of weeks or months[19]. A very interesting result of the present study was that the maintenance of teeth had a positive impact on the psychological and environmental domains. This fact highlights the importance of preventive measures in order to prevent teeth loss during cancer treatment - not only as an infection control procedure but also as a quality of life benefit tool. Besides, it is well known that patients with poor oral hygiene, or the presence of infections from odontogenic and/or periodontal origin prior to chemotherapy are at high risk of developing oral infection during treatment, which can be spread via blood and compromise other organs[20].

People with cancer are at high risk of experiencing changes in mastication. The reduction of masticatory function can affect the QoL of individuals especially by influencing food choice. Soft or pasty foods that do not have adequate nutrient content can result in lower doses of essential nutrients and hence result in weight loss[21] influencing the success of anticancer treatment. So when teeth are lost, the MP decreases[8] and if the teeth are not replaced, patients tend not to compensate chewing more times, but rather swallow large particles [21], contributing to difficulties in absorbing nutrients and inappropriate choice of food[10].

Cancer patients presented lower values in the Social Relationship, Environment and the overall QoL domains. These results were expected since cancer treatment discomfort and consequences are known to promote changes in physical and emotional integrity and loss of self-esteem, with consequent reduction in quality of life (QoL)[4].

We found a negative impact of breast cancer on the psychological field and general quality of life. Thus, the present results corroborate the assumption that women undergoing chemotherapy tend to have symptoms of anxiety, depression, pain, fatigue and morbidity in the arm. In addition, patients who underwent surgical proce-

Table II
Correlation matrix between the different domains of the WHOQOL-BREF in relation to overall quality of life

Domains	*General Quality of Life*	
	*r**	*P*
Physical Health	0.4390	0.0015
Psychological health	0.4300	0.0019
Social Relationships	0.3310	0.0192
Environment	0.1880	0.1910

* Spearman correlation test

Table III
Linear regression models (with stepwise elimination) used to test the relationship between the domains of WHOQOL (dependent variables) and studied independent variables

Domain	*Independent variables*	*Coef.*	*p*	*Significance of the model*		
				R^2	*P*	*Power of the test*
Overall	constant Breast cancer	15.700 -2.367	- 0.017	0.192	0.017	0.669
Physical Health	All variables were eliminated from the model	-	-	-	-	-
Psychological health	constant Breast cancer Duration of radiotherapy Number of teeth	13.760 -3.384 -0.052 0.156	- <0.001 0.012 0.012	0.503	<0.001	0.995
Social Relations	constant (In) X_{50}	11.670 1.522	- 0.024	0.175	0.024	0.622
Environment	constant Duration of radiotherapy Number of teeth	12.052 -0.031 0.104	- 0.039 0.024	0.280	0.014	0.852

ln, log transformation; X_{50}, median particle size.
Constant Variance Test: passed (p>0.05)"

dures report lower body esteem and difficulty in sexual relationship[22]. Our results support the idea that management strategies need to be developed against psychological symptoms in patients with breast cancer as described previously[23].

Additionally, the duration of radiotherapy also had a negative impact on the psychological and environmental domains of the assessed individuals. Probably the direct beam of radiation to the tumor also causes toxicity to surrounding normal tissues causing undesirable effects[24], reducing individual's quality of life when compared to healthy people[25].

It can be seen that the presence of cancer undoubtedly changes many aspects of one's life, and that the absence of teeth can decline quality of life. This relationship may be linked to changes of physical-emotional integrity by discomfort, pain, disfigurement and loss of self-esteem[4].

Conclusions

Oral physiology changes may lead to impact on quality of life of oncological patients independent of the original area of the tumor. The maintenance of teeth was of great importance for these patients, especially for the psychological aspect.

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