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Original Research Article

OCCURRENCE OF DENTAL CARIES AND SALIVARY FLOW RATE AMONG PATIENTS WITH ORAL CARCINOMA TREATED USING CHEMOTHERAPY AND RADIATION THERAPY: A HOSPITAL-CENTERED INVESTIGATION

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Abstract: ***Background:*** -One frequent side effect of radiation therapy for patients with oral cancer is xerostomia. Patient quality of life may be significantly lowered by both acute and long-term adverse effects. Our study's objective was to analyse patients' salivary flow and pH following radiation therapy. ***Methodology:*** Clinical and laboratory assessments were conducted out between 2014 and 2019; 28 patients with oral cancer were chosen after radiotherapy amongst an aggregate of 58 individuals around the ages of 45 and 84. ***Results:*** Following radiation therapy, patients had significantly lower mean salivary hydrogen ion concentration (pH) values ($p < 0.001$), with a pH value of 4.580 (±1.051). The crew of individuals receiving radiation therapy had a considerably reduced mean resting salivary flow (MRSF) value (MRSF = 0.145 mL/min). Various endodontic and periodontal procedures were carried out in 89.29% of cases (25 post-radiation instances) in order to carry out oral complex rehabilitation procedures. In all, 78.57% of the cases underwent sophisticated oral rehabilitation using either solutions that last or mobile or hybrid prosthetics. ***Conclusion:*** Understanding post-radiotherapy salivary biochemic modifications in patients with oral cancer could be of critical importance, in view of related oral disorder prevention.

Keywords: Oral Cancer, Post-Radiotherapy (RT); Salivary Ph.

INTRODUCTION

Among of the sixteen most prevalent cancers in the world is oral cancer. Chemotherapy, surgery, and radiation therapy are used to treat the majority of patients. When ionising radiation is utilised to cure head and neck tumours, it can cause oral adverse effects include mucositis, changes in saliva quality, and tooth structural loss. In these situations, infection of the oral cavity can be fatal in people with poor health. Throughout the past few years, radiation therapy procedures have progressively advanced. More is known about determining radiation dosages, and treatments now more accurately address the tumours. These advances are expected to decrease the number of secondary neoformation pathologies and other complications that result from radiation therapy.[1,2]

Oral fluid that lubricates the oral cavity, in case of xerostomia, hyposialia, and sicca syndrome (decreased or absent salivary flow measured by tests), may induce burning sensations. Decreased salivary flow and dry mouth (xerostomia) can have consequences on both mastication and speech. In addition, less saliva means less protection of the teeth and oral cavity.[3]

Hyposialia encourages the development of cavities, infections, and changes within oral tissue. Because hyposalivation affects habits of eating, dietary status, phonation, flavour senses, and prosthesis tolerance, it can result in major detrimental implications on the individual's quality of life. A typical side effect of radiation therapy for patients with oral cancer is xerostomia, which is brought on by salivary gland dysfunction and raises the risk of oral cavity infections, which can lead to the emergence of candida albicans.[4]

Most of the oral tissues are protected by saliva, that is supplied as an aqueous, hypotonic fluid. Many minor salivary glands as well as the major salivary glands—the parotid, submandibular or submaxillary, and sublingual—secrete it. An essential component of oral homeostasis is saliva.[5] Physiologic salivary functions include bacterial regulation, support for other oral functions, and preservation of the homeostasis of oral soft and hard tissues. Saliva also helps in taste, swallowing, and digestion in the mouth and gastrointestinal tract. It is crucial for lubricating oral tissues and regulating the salivary potential of hydrogen (pH). The effects of a loss or reduction in salivary function can be severe, and can have a significant impact on common activities.[6]

We assessed salivary pH, rate of stimulated saliva (MRSF), and saliva rest flow drooling (RSF) in individuals who had received radiation therapy for oral cancer. These the results of patients were contrasted with those of people in a control group who did not have cancer.

Methodology

58 individuals among ages of 45 and 84 participated in this research, which was conducted across 2020 and 2025 at the Department of Public Health Dentistry, Sardar Patel Post Graduate Institute of Dental and Medical Sciences, Lucknow. Of these patients, 28 underwent head and neck radiation therapy for oral cancer. The case-control research methodology was used to construct the study design. We utilised clinical and paraclinical data extracted from the publication observed records of the patients who were available at our study's request, to which we supplemented data from salivary flow and pH measurements, respectively. The following criteria were used to include the cases: patients suffering from oral cancer post-radiotherapy, that had a dose of irradiation between 60 Gray (Gy) and 70 Gy, depending on the specifics of each patient, presenting after a minimum interval of 2–3 months post-radiotherapy cure.

Doses are expressed as 60 Gy/30 fractions/6 weeks, 70 Gy/35 fractions/7 weeks, or 66 Gy/33 fractions/6.5 weeks, 2 Gy/fraction. Patients with advanced or terminal illnesses, non-cancer patients (other pathologies may occur), non-cooperating patients, patients unable to undergo planned procedures, and patients using medications that cause hyposalivation were all excluded from the study. In individuals who have oral cancer, the SFR is a sign of xerostomia following radiation therapy. Sialometry is a crucial component of the rehabilitation a treatment strategy and includes a variety of diagnostic tests intended to assess the rate of salivary secretion and analyse its structure (qualitative sialometry). Sialometry and salivary pH monitoring were required in patients with oral cancer following radiation therapy in order to determine the risk of dental caries and to create a comprehensive oral rehabilitation strategy. Individuals were told not to eat, drink, or smoke before saliva was collected.

Determination of the salivary pH was carried out directly using a digital pH meter (APH 20 model). The accuracy of the pH meter was calibrated using standard buffers (pH 4.7 and 10) to ensure the correct measured values.

The individual was instructed to gulp down the saliva that had collected in their oral cavity while sitting in a dental chair with their head slightly bent forward. A timer was then activated in order to determine the RSF rate (the procedure was carried out in triplicate, recording the mean value). Each minute, the individual collected deposited saliva in a beaker; five minutes later, the volume of accumulated saliva was measured. Data from the literature indicates that normal levels fall between 0.25 and 0.35 mL/min. Determination of stimulated salivary flow (SSF) rate (the procedure was realized in triplicate, recording the mean value) was carried out according to the following method: the patient was sitting in the dental chair as in the previous test and was asked to chew for 60 s, and then swallow the accumulated saliva. The level of oral hygiene and estimation of saliva characteristics responsible for the occurrence of dental caries, for example, can be detected by special indexes such as the Decayed, Missing, and Filled Teeth (DMFT) index.

A database was created using Microsoft Access for Windows. The statistical analysis was performed with the SPSS 23.0 software package for Windows. It was used to assess the central tendency indicators. Statistical analytic methodology (Pearson χ^2 test) was used to evaluate the statistical significance of observed differences.

RESULTS

For paraclinical and clinical assessment, patients were divided into two groups, as follows:

- Group A consisted of 28 patients that followed radiotherapy for oral cancer (cases group);
- Group B, non-cancer cases, consisted of 30 patients (control group).

Table 1. The gender structure of the study groups

Gender	N/(%)	Group A Cases of Radiotherapy	Group B Controls	χ^2_c	Liberty Degrees (LD)	*p* Value
Female	23 (39.66)	9 (32.14)	14 (46.67)			
Male	35 (60.34)	19 (67.86)	16 (53.33)	1.277	1	0.25845
Total	58 (100.0)	28 (48.28)	30 51.72)			

The gender structure of the batches was homogeneous. All the values calculated for $\chi^2 \geq$ up to 3.841 were considered statistically significant for $p < 0.05$.

Table 2. The central tendency indicators on salivary pH.

Group of Study	Mean Value	Std. Dev.	Std. Error	CI 95% −95%	CI 95% +95%	Min. Value	Max. Value	Q25	Median	Q75
Group A: Radiotherapy	4.580	±1.051	0.25	4.059	5.102	3.00	5.50	3.50	5.00	5.50
Group B: Controls	6.259	±0.152	0.04	6.180	6.340	6.00	6.50	6.20	6.25	6.35
Total	5.350	±0.871	0.10	5.149	5.551	3.00	6.50	5.30	5.50	6.00

As was observed in our study, the oral pH in patients with radiotherapy was 4.580 (±1.051), and in the control group the oral pH value = 6.259 (±0.152)

Table 3. The central tendency indicators of resting salivary flow (RSF).

Group of Study	Mean Value	Std. Dev.	Std. Error	CI 95% −95%	CI 95% +95%	Min. Value	Max. Value	Q25	Median	Q75
Group A: Radiotherapy	0.145	±0.051	0.011	0.091	0.131	0.030	0.160	0.105	0.130	0.165
Group B: Controls	0.503	±0.071	0.021	0.461	0.541	0.401	0.601	0.461	0.501	0.571
Total	0.385	±0.271	0.031	0.330	0.440	0.031	0.800	0.123	0.305	0.600

The assessment of the function of the salivary glands was mainly based on the measurement of the saliva flow. Statistical indicators of RSF in mL/min.

Table 4. The central tendency indicators of stimulated salivary flow (SSF).

Group of Study	Mean Value	Std. Dev.	Std. Error	CI 95% −95%	CI 95% + 95%	Min. Value	Max. Value	Q25	Median Value	Q75
Group A: Radiotherapy	0.513	±0.387	0.091	0.321	0.706	0.150	1.130	0.160	0.375	0.890
Group B: Controls	1.475	±0.311	0.078	1.309	1.641	1000	2.000	1.200	1.450	1.750
Total	0.813	±0.393	0.038	0.738	0.889	0150	2.000	0.520	0.700	1.000

The mean value of SSF was significantly lower (at $p < 0.001$) for the cases group with radiotherapy (MRSF = 0.145 mL/min) compared to the control group (MRSF = 0.503 mL/min). Statistical indicators for SSF, in mL/min.

Table 5. The oro-dental morbidity of the study groups.

Disease/Pathological Feature	N/(%)	Group A Cases of Radiotherapy	Group B Controls	χ^2_c	LD	*p* Value
Severe dental caries	33 (56.89)	19 (67.86)	14 (46.67)	2.652	1	0.10341
Periodontal disease	16 (27.59)	9 (32.14)	7 (23.33)	0.563	1	0.45305
Periapical dental pathology	20 (34.48)	12 (42.86)	8 (26.67)	1.68	1	0.19492
Residual root tips	24 (41.38)	13 (46.43)	11 (36.67)	0.569	1	0.45065
Radiographic abnormalities-root resorption	11 (18.97)	7 (25.00)	4 (13.13)	1.283	1	0.25734
Dental/oral cysts	9 (15.52)	6 (21.43)	3 (10.00)	1.443	1	0.22965
Oral candidiasis		3 (10.71)	0 (0.00)		-	-

Some techniques, such as the use of fluoride trays during the clinical phase to properly manage severe caries caused by xerostomia, can prevent tooth loss. Poor buffering capacity and low salivary flow rate have been proposed as markers of dental caries activity. Carious lesions were observed to be tiny and medium (5, 16.67%) with localisation on the occlusal and proximal surfaces in the control group, whereas they were both medium and deep in severity in the cases group with predominant localisation in the cervical area (9, 32.14%). Both groups underwent Class I SI II Black and combined one, as well as the existence of improper dental restorations.

Table 6. Complex oral rehabilitation.

Complex Oral Rehabilitation Feature	N/(%)	Group A Cases of Radiotherapy	Group B Controls	χ^2_c	LD	*p* Value
Fixed prosthesis	14 (24.14)	6 (21.43)	8 (26.67)	0.217	1	0.64133
Endodontical treatments	6 (10.34)	4 (14.29)	2 (6.67)	0.906	1	0.34117
Mobile prosthesis	16 (27.59)	12 (42.86)	4 (13.33)	6.32	1	0.01193
Mixed rehabilitation	9 (15.52)	4 (14.29)	5 (16.67)	0.063	1	0.80181
Mouthguard appliances	8 (13.79)	4 (14.29)	4 (13.33)	0.011	1	0.91647

Myorelaxant drug treatment, at specialist indications, was subsequently accompanied by associated fixed and removable prosthetic devices, related endodontic reconstructions, and restoration of gnathological dental arch parameters within the periodontal and dental support tissues, at the same time as existing malposition and malocclusion, associated periodontal stabilization, and contention.

DISCUSSION

Salivary flow was shown to correspond to a diurnal cycle, with the highest rate in the late afternoon and the lowest during sleep. Although the majority of the flow rates were recorded for entire saliva or saliva from large salivary glands, scientists have suggested that tiny salivary glands also play a significant role. While other studies indicated that there were gender disparities, there was no statistically significant difference in the flow rates between male and female subjects; women's saliva flow rates were found to be lower. Patients with poor hygiene and, generally speaking, a predominant food unbalance had higher values (MSRF = 0.77 mL/min) than the controls. 7 It was indicated 8that chemotherapy radiation induced periodontal inflammation9, which was also suggested in our research. This could be exacerbated, even if the oral hygiene levels were goodIn line with earlier research, we believed that it was essential to manage plaque buildup using relevant indices in irradiated patients in order to stop bacteria from colonising periodontal pockets10, as well as in patients with compromised local defence and long-term salivary alterations. Mucositis was present in all cancer patients to some extent, but some had severe, advanced mucositis of grade three or four, or more accurately, 85% of those getting RT orally (the ratio was even 100% in the case of those with advanced carcinomas). After the last dose, the lesions typically healed in 4–7 weeks.

The prevalence of mucositis in our study was 64.29%. Following the link amongst variables, particularly mucositis and SFR, intensity-modulated radiation treatment (IMRT) was used to treat oral cancer. Our outcomes showed that the patients' general health condition and quality of life significantly declined throughout weeks two and five of the therapy, as measured by the Karnofsky performance status scale (KPS).11

78.41% of the specimen had hyposalivation, and the average radiation dosage was 63.01 Gy (±9.58). Higher radiation exposures were linked to hyposalivation (p = 0.038), which could raise the likelihood of exhibiting hyposalivation by 4.25 times. Regarding this matter, concurrent chemotherapy and RT therapeutic procedures did not appear to raise the risk of hyposalivation in comparison to radiotherapy alone, and the amount of time that had passed since the conclusion of radiotherapy had a protective effect that was measured at 75% (p = 0.025).12

Based on cumulative radiation dose to the gland tissue and the novel approaches to more effectively reduce the dose to the parotid 13, especially the submandibular and minor salivary glands, which are important factors contributing to the moisture content of oral tissues, the literature indicates12 that RT in the head and neck region causes salivary hypofunction and xerostomia.

Conclusion

We can specify that there was a predominance of males in the present study, in the area of the place where the study was conducted, and in the period of time involved. Xerostomia, a RT complication, represents a challenge for a rehabilitation department, as researchers in caries and periodontal control, through the correlative prosthetic difficulties generated as well as the management of associated stress pathology. In patients with labial, jugal, lingual, palatal, or combined oral cancer, in the present study, according to the observations of calculated mean values, there was a decrease in salivary pH after RT (below 6.0): pH value = 4.580 (±1.0) and mean SSF value were significantly lower (at $p < 0.001$) after RT (MRSF = 0.145 mL/min), which caused demineralization of dental hard tissues and increased the risk of post-radiotherapy caries detected by oral screening. Impaired periodontal status after RT was assessed by several specific periodontal indices. It represented a major risk factor for further complications when accompanied by other pathologies, such as root resorption and oral dental cysts, as well as the occurrence of oral candidiasis.

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