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Regular dental visits are associated with earlier stage at diagnosis for oral and pharyngeal cancer

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Abstract

Purpose—Oral and pharyngeal cancer patients diagnosed at an advanced stage experience increased morbidity and mortality relative to those with localized disease. The aim of this study was to assess the impact of dental insurance status and regularity of dental visits on early detection of oral and pharyngeal cancer.

Methods—We examined the relationship of dental insurance and frequency of dental visits with stage at diagnosis among 441 oral and pharyngeal cancer cases from a population-based study of head and neck cancer. Ordinal logistic regression models were used to assess the association with stage, and tumor (T) and nodal (N) classification.

Results—Never or rarely going to the dentist was associated with being diagnosed at higher stage for oral and pharyngeal cancer (cumulative OR = 2.28, 95% CI: 1.02–5.10) and oral cancer (cumulative OR = 9.17, 95% CI: 2.70–31.15) compared to those going to the dentist at least annually. Oral and pharyngeal cancer patients who went to the dentist infrequently (cumulative OR = 1.82, 95% CI: 1.09–3.05) or rarely/never (cumulative OR = 3.24, 95% CI: 1.59–6.57) were diagnosed with a higher T classification compared with those who went at least annually.

Conclusions—Receipt of regular dental examinations at least annually may reduce the public health burden of oral and pharyngeal cancer by facilitating earlier detection of the disease.

Keywords

Dental coverage; oral examination; oral cancer screening; head and neck cancer; early detection

INTRODUCTION

Oral and pharyngeal cancer accounted for an estimated 39,400 new cases and 7,900 deaths in the United States in 2011 [1], more than 90% of which were squamous cell carcinomas [2]. The prognosis for this disease is relatively poor, with about 60% of patients surviving 5 years post-diagnosis. Survival diminishes with increasing cancer stage: the relative 5-year

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CONFLICT OF INTEREST
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survival for localized disease is 82%, compared to 56% for regional and only 33% for distant stage disease [3]. The Healthy People 2010 goal of diagnosing half of oral cancers at a localized stage (I or II), set by the U.S. Department of Health and Human Services (DHHS) [4], remains unmet, with still only about one-third of cases confined to the primary site at the time of diagnosis [3]. Further exacerbating the disease burden is the high morbidity that is frequently experienced by patients, particularly for those diagnosed at an advanced stage (III or IV), with treatment often resulting in disfigurement and/or impairment of basic functions such as talking, swallowing, eating and breathing [5]. The median 1-year cost of treatment for patients with advanced-stage disease is estimated to be 22% higher than those with local disease [6]. Taken altogether, these considerations underscore the importance of early diagnosis in reducing the physical, social and economic impact of oral and pharyngeal cancer.

In the U.S., as in most Western industrialized countries, opportunistic screening of the population for oral cancer is thought to be a more cost-effective alternative to systematic population-based screening programs [7–12]. At present, visual examination and palpation is the only standard mode of oral cancer screening in wide-spread use. Dentists may be particularly well-suited to perform such examinations due to their familiarity with the oral anatomy and regular access to the oral cavity [13]. However, oral cancers are often not conspicuous and thus early detection requires great skill and care, necessitating an informed pool of dentists to conduct thorough examinations [14,15].

While recent attention has focused on the impact of lack of medical insurance or underinsurance on cancer outcomes, an even higher proportion of Americans lack dental coverage [16], which has the potential to adversely impact oral health. In fact, an estimated 39% of Americans aged 18 years or older do not have dental insurance [17], with the greatest deficit found in the senior citizen population (> 65 years). Medicare does not presently offer a comprehensive dental plan, leaving many seniors without coverage and with limited access to dental care [18]. Several studies have reported an association between health insurance status and stage at diagnosis for head and neck cancer patients [19–21]. Here, we hypothesize that oral and pharyngeal cancer patients without dental insurance visit the dentist less frequently, resulting in fewer encounters allowing for opportunistic screenings, which may lead to diagnostic delays. Thus, the aim of this study was to assess the impact of dental insurance status and regularity of dental visits on early detection of oral and pharyngeal squamous cell carcinomas, as measured by stage at diagnosis.

METHODS

Study Population

This case-series study consisted of 441 patients with incident oral (n = 259) or pharyngeal (n = 182) squamous cell carcinoma (ICD-9 141-146, 148, 149, or 161) diagnosed from October 2006 to June 2011. All patients were enrolled as part of a population-based case-control study of head and neck cancer from the greater-Boston area [22,23]. Incident cases of head and neck squamous cell carcinoma (HNSCC) were identified through the multidisciplinary Head and Neck Clinics, Otolaryngology, and Radiation Oncology departments at teaching hospitals located in Boston, Massachusetts, which included Brigham and Women's Hospital, Beth Israel Deaconess Medical Center, Boston Medical Center, Dana-Farber Cancer Institute, Massachusetts Eye and Ear Infirmary, Massachusetts General Hospital, and New England Medical Center. Patients completed a self-administered questionnaire that provided data on sociodemographics, personal characteristics, personal and family cancer history, health behaviors, and dental history. Tumor site and stage was extracted through review of patient medical records. Study approval was obtained from the Institutional Review Boards at Brown University and all participating institutions for sample collection and use of patient data. All patients involved provided written informed consent for participation in this study.

Statistical Analysis

Descriptive statistics were generated for sociodemographic, health behavior, and clinical attributes (primary tumor site and stage) according to dental insurance status at the time of diagnosis and frequency of dental visits as an adult. Dental insurance status was self-reported, categorized as either having or not having dental coverage at the time of the oral and pharyngeal cancer diagnosis, and was available for 415 patients (94.1%). Frequency of dental visits was also self-reported, categorized as *at least annual*, *infrequent* (once every 2–10 years), or *rare/never* (less than once every 10 years), and was available for 426 patients (96.6%). Normality of continuous covariates was evaluated using the Skewness-Kurtosis test [24]. T-tests were used to assess differences by insurance status for normally distributed continuous variables. Differences by frequency of dental visits were assessed by one-way ANOVA for continuous variables following a normal distribution. Differences between categorical variables were assessed by Fisher's exact test. All tests were 2-sided and significance was considered where $P \leq 0.05$.

We used ordinal logistic regression [25], which estimates the risk of being in a higher category for an ordinal response variable, to examine the respective associations between dental insurance status at the time of diagnosis or regularity of dental visits with stage at diagnosis, tumor (T) and nodal (N) classification for oral and pharyngeal cancers, combined and for each site individually. Tumors were staged based on TNM classifications according to the American Joint Committee on Cancer (AJCC) guidelines [26], and were categorized by stage group (I, II, III or IV). For T classification (T1–T4), increasing T represents increasing size and/or local extent of the tumor. For N classification (N0–N3), N0 indicates an absence of regional lymph node metastasis, while N1–N3 represents increasing regional lymph node involvement. All models were adjusted for known oral and pharyngeal cancer risk factors, including age, sex, race, cigarette smoking, alcohol consumption, annual household income, and highest level of education achieved. Age was categorized as *≤ 40 years*, *41–50 years*, *51–60 years*, *61–70 years*, *71–80 years*, and *> 80 years*. Smoking was categorized as *never-smoker*, and by tertile of pack-years (calculated as the average number of cigarette packs smoked per day multiplied by total years of smoking) for ever-smokers (*1st tertile*: 0.1–16.0 pack-years; *2nd tertile*: 16.1–36.9 pack-years; *3rd tertile*: 37.0 – 202.5 pack-years). Alcohol consumption was categorized as *non-drinker*, *≤ 14 drinks per week*, and *> 14 drinks per week* in a typical week during adult life, where one drink was considered to be consumption of 12 oz of beer, 5 oz of wine, or 1.5 oz of liquor. One subject was missing data on race (0.2%) and 62 were missing household income (14.1%); data was complete for age, sex, smoking, alcohol consumption, and education. To compensate for the missing race and household income values, multiple imputation was employed using multivariate normal regression, based on age, sex and education data; multiple imputation results in less biased findings when dealing with missing covariate data [27]. The proportional odds assumption for the ordinal logistic regression models was tested using the Brant test of parallel regression [28], with a violation considered when $P \leq 0.05$.

All statistical analyses were conducted using Stata 11 (College Station, TX).

RESULTS

A description of the demographic, health behavior and tumor characteristics of the study population according to dental insurance status at the time of diagnosis and frequency of dental visits as an adult is provided in Table 1. Compared to those with dental insurance, uninsured patients were significantly older ($P < 0.001$), more likely to be female ($P < 0.001$), more likely to be non-drinkers (P = 0.04), and had a lower annual household income (P < 0.001). Patients who reported visiting the dentist less regularly were more likely to be non-White (P = 0.002), ever-smokers (P < 0.001), smoke more (P < 0.001), consume more than 14 alcoholic drinks per week (P < 0.001), have an annual household income of less than $50,000 per year, and to be less educated (P < 0.001).

There were significant differences between patients with and without dental insurance at the time of diagnosis with regard to their usual insurance status and frequency of dental visits as an adult (Table 2). More than half of those without dental insurance at diagnosis never had dental insurance during their adult lives (52.0%), while the vast majority of insured patients had dental insurance most of the time as an adult (77.5%). Frequency of dental visits was positively associated with dental insurance status (P < 0.001), with insured patients much more likely to report going to the dentist at least annually, while uninsured patients were more likely to report rarely or never going to the dentist.

An abnormal growth or leukoplakia was more likely to be identified among those who went to the dentist more frequently than those who went infrequently (Table 3); this was true overall (p < 0.001) and for oral cancer (p = 0.009), but not pharyngeal cancer (p = 0.20). The frequency of patients reporting a dentist having ever identified an abnormal growth did not significantly differ for younger (< 50 years) versus older (≥ 50 years) patients (data not shown). There was no difference in patients reporting that a dentist ever identified an abnormal growth or leukoplakia by dental insurance status (Table 3).

To examine whether dental insurance or regular dental visits are beneficial with respect to early diagnosis, we assessed the respective associations with stage using ordinal logistic regression (Table 4). After adjusting for age, sex, race, smoking, alcohol consumption, education and household income, we observed a significant association between frequency of dental visits and stage at diagnosis, where patients reporting rarely or never going to the dentist were much more likely to be diagnosed at a higher stage, overall (cumulative OR = 2.28, 95% CI: 1.02–5.10) and for oral cancer patients (cumulative OR = 9.17, 95% CI: 2.70–31.15). No association was observed between dental insurance status and stage at diagnosis, overall or by site.

We further assessed the impact of dental insurance on early diagnosis by examining the association with tumor size (T) and lymph node status (N), again using ordinal logistic regression (Table 4), adjusted for age, gender, race, smoking, alcohol consumption, education and income. Oral and pharyngeal cancer patients reporting infrequent dental visits (once every 2–10 years) and rarely or never going to the dentist had an elevated risk for being diagnosed at a higher T classification (cumulative OR = 1.82, 95% CI: 1.09–3.05; and cumulative OR = 3.24, 95% CI: 1.59–6.57, respectively), with a significant increasing trend across categories with decreasing frequency of visits ($P_{trend} < 0.001$). When assessing oral cancer patients only, those who rarely or never went to the dentist were even more likely to be diagnosed at a higher T classification compared to those going at least annually (cumulative OR = 8.33, 95% CI: 3.00–23.10), again with a significant increasing trend across categories with decreasing frequency of dental visits ($P_{trend} < 0.001$). Infrequent dental visits were associated with increased T classification among pharyngeal cancer patients (cumulative OR = 2.90, 95% CI: 1.31–6.39). No association was observed between frequency of dental visits or dental insurance status and N classification, or with insurance status and T classification, overall or by site.

DISCUSSION

Increased frequency of dental visits was associated with an earlier stage at diagnosis for oral and pharyngeal cancer in this case-series. The association appears to be primarily driven by early detection of cancers arising in the oral cavity, as we saw no consistent association with pharyngeal cancer alone. Although there was no association between dental insurance status at the time of diagnosis and stage, we did find that those with coverage tended to visit the dentist more regularly, suggesting a benefit to having dental insurance with regard to oral cancer.

Our results are corroborated by previous studies examining dental factors influencing early stage at diagnosis. A 1985 study conducted in Canada reported a relationship between regularity of dental care and early stage cancer of the oral cavity [29], although the authors did not account for differences in age, gender, or smoking (only socioeconomic status and alcohol consumption). Two more recent studies reported that having a regular primary dentist was associated with early stage at diagnosis for oral and pharyngeal cancer [30] and cancer of the floor of the mouth [31]. Additionally, a small study of oral and pharyngeal cancer found that patients were more likely to be referred from a dental office and presented with a lower stage than those referred from a medical office [32].

While we did not observe a direct association between dental insurance status and early detection, our findings still may have implications towards oral health promotion and the formulation of a comprehensive dental insurance policy. Patients without dental insurance reported more sporadic visits to the dentist compared to those with insurance. This suggests that an expansion of dental coverage could increase the proportion of the population who see a dentist and the regularity of dental visits, which could in-turn result in earlier stage at diagnosis for oral and pharyngeal cancers, as well as overall improvement of oral health. According to a 2002 report on oral health by the Department of Health and Human Services, only 68.4% of U.S. adults report having a usual dental provider [17]. More people in the U.S. lack dental insurance than medical insurance [17], with a mere 61% of Americans having dental coverage [17]; these proportions further diminish for the elderly and people with lower income. This in-turn can compromise the regularity and continuity of dental care. Further, the estimated per capita annual cost of dental care for the total U.S. population was $332 in 2009 and is projected to reach $496 per capita by 2020 [33], illustrating the increasingly prohibitive cost of dental services as a barrier to care for the uninsured due to the large personal expense.

Despite the observed association between frequency of dental visits and earlier stage at diagnosis, there are indications that there is room for improvement. At first glance it would appear that opportunistic oral cancer examinations are conducted with regularity by dentists. A high percentage of dentists in Massachusetts [34], the state in which our study was conducted, report screening asymptomatic adult patients for oral cancer (> 90%), which is similar to what is reported by dentists in other states throughout the U.S. [35–38]. However, upon closer scrutiny it becomes apparent that this is not the case. Most of these studies did not assess the thoroughness or regularity of the examinations, which are of paramount importance for early detection. While most dentists report providing oral cancer examinations in asymptomatic patients, this may not be performed in a complete and consistent manner, with many dentists lacking in oral cancer knowledge [14,39] and thoroughness of exams [14]. Although the majority of dentists report feeling comfortable with the visual component of oral cancer examinations, they are less likely to feel adequately trained in tactile skills [40], with less than half palpating the cervical nodes with regularity and even fewer palpating the tongue and floor of mouth on a consistent basis [14]. Oral cancer is often subtle, necessitating a high level of training, skill and understanding in its detection, which may come from experience and education. A general dentist will not likely see more than 10 cases of oral cancer in his or her career [41]. This suggests a need for enhanced education of dentists for provision of oral cancer examinations, particularly with respect to palpation. This is highlighted by our observation that increased frequency of dental visits was associated with smaller tumor size (T) at diagnosis, which may be more amenable to visualization, but not nodal status (N), which relies more heavily on palpation for detection. Additionally, oral cancer examinations are geared more towards detection of neoplastic lesions in the oral cavity, which may, in part, explain the lack of association between regular dental examinations and early detection of pharyngeal cancer, although most examinations include inspection of the soft palate. However, given the rising incidence of HPV-associated pharyngeal cancers [42,43], attention should also be paid to the visual inspection of the base of tongue and lingual tonsils during these examinations.

Alternatively, it is conceivable that the observed association between frequency of dental visits and stage at diagnosis could relate to less aggressive disease stemming from an alternate etiology. Our questionnaire did not distinguish patients seeking preventive treatment from those visiting the dentist for treatment of dental health problems. It is plausible that our observations instead relate to slower progressing disease that arises as a result of poor dental health, necessitating increased dental visits. However this scenario is unlikely, as *post hoc* analysis of case-control data (426 cases / 564 controls) reveals no association between frequent dental visits and oral and pharyngeal cancer, overall or with early (stage I or II) or advanced (stage III or IV) stage disease (data not shown).

The major strengths of this study include the use of a large, well-characterized population-based cohort of head and neck cancer with availability of complete detailed information on smoking and drinking, clinical attributes, and dental care, as well as educational and household income allowing us to control for socioeconomic status. There are also several potential limitations to this study. Despite our reasonably large sample size, it is possible that the absence of an observed relationship between stage and dental insurance status was attributable to lack of statistical power, particularly given that dental insurance was associated with increased dental visits, which in-turn was associated with stage. Similarly, the lack of consistent observed association of frequency of dental visits with pharyngeal cancer may also, in part, stem from a lack of statistical power due to the lower frequency of tumors from this site in our study. Despite our inclusion of smoking dose, alcohol consumption, highest level of educational attainment and income in our models, we cannot fully rule out the possibility of residual confounding by smoking, drinking or socioeconomic status. We also did not collect specific information on the level of dental coverage among the insured, so it is conceivable that the inclusion of underinsured patients among the insured could bias our results towards the null. Additionally, we did not directly assess the portion of patients referred by dentists by frequency of dental visits but rather estimated this with a surrogate question of whether a dentist ever told the patient that they have an unusual growth or leukoplakia. However, this would likely bias the results towards the null since not all unusual growths are indicative of malignancy, thus diluting the effect.

In summary, increased regularity of dental examinations is associated with earlier stage at diagnosis for oral and pharyngeal cancer. Addressing the issue of infrequent dental care through expansion of dental coverage and enhancement of public education efforts could have a major impact on public health, given the higher degree of mortality, morbidity, and economic costs that are associated with advanced stage disease. Moreover, efforts aimed at improving education and awareness by dental practitioners may make further contributions to increasing early detection and achieving the oral cancer goals imposed by Healthy People 2010.

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Table 1

Description of oral and pharyngeal squamous cell carcinoma cases by dental insurance status at diagnosis.

	Dental Insurance Status at Diagnosis			Frequency of Dental Visits			
	Insured (n=263)	Uninsured (n=152)	P-value	At Least Annually (n=307)	Infrequently (every 2–10 yrs) (n=76)	Rarely or never (n=43)	P-value
Age, mean years (median, sd)	56.2 (56, 10.7)	63.3 (64, 11.2)	<0.001[a]	58.8 (59, 10.9)	58.5 (57,11.9)	61.3 (63, 13.8)	0.36[c]
Gender							
Female	53 (20.2%)	55 (36.2%)	<0.001[b]	84 (27.4%)	19 (25.0%)	11 (25.6%)	0.94[b]
Male	210 (79.9%)	97 (63.8%)		223 (72.6%)	57 (75.0%)	32 (74.4%)	
Race							
White	243 (92.8%)	141 (92.8%)	> 0.99[b]	15 (4.9%)	6 (7.9%)	9 (20.9%)	0.002[b]
Non-White	19 (7.3%)	11 (7.2%)		291 (95.1%)	70 (92.1%)	34 (79.1%)	
Cigarette smoking							
Never-smoker	92 (35.0%)	43 (28.3%)	0.25[b]	116 (37.8%)	18 (23.7%)	4 (9.3%)	<0.001[b]
1st tertile (0.1-16.0 pack-years)	61 (23.2%)	34 (22.4%)		72 (23.5%)	14 (18.4%)	11 (25.6%)	
2nd tertile (16.1-36.9 pack-years)	60 (22.8%)	34 (22.4%)		70 (22.8%)	20 (26.3%)	6 (14.0%)	
3rd tertile (37.0–202.5 pack-years)	50 (19.0%)	41 (27.0%)		49 (16.0%)	24 (31.6%)	22 (51.2%)	
Alcohol consumption							
Non-drinker	19 (7.2%)	23 (15.1%)	0.04[b]	30 (9.8%)	7 (9.2%)	5 (11.6%)	<0.001[b]
< 14 drinks per week	147 (55.9%)	75 (49.3%)		185 (60.3%)	34 (44.7%)	10 (23.3%)	
> 14 drinks per week	97 (36.9%)	54 (35.5%)		92 (30.0%)	35 (46.1%)	28 (65.1%)	
Household income (annual)							
< $20,000	17 (7.3%)	29 (23.0%)	<0.001[b]	14 (5.3%)	21 (31.8%)	13 (34.2%)	<0.001[b]
$20,000-$49,999	38 (16.2%)	30 (23.8%)		38 (14.4%)	17 (25.8%)	16 (42.1%)	
	179 (76.5%)	67 (53.2%)		212 (80.3%)	28 (42.4%)	9 (23.7%)	
Highest level of education							
< High school	15 (5.7%)	16 (10.5%)	0.10[b]	9 (2.9%)	8 (10.5%)	14 (32.6%)	<0.001[b]
High school	63 (24/0%)	48 (31.6%)		64 (20.9%)	29 (38.2%)	21 (48.8%)	
Some college/associates/technical school	45 (17.1%)	20 (13.2%)		54 (17.6%)	12 (15.8%)	4 (9.3%)	
College (4-year)	72 (27.4%)	38 (25.0%)		90 (29.3%)	19 (25.0%)	6 (9.3%)	

	Dental Insurance Status at Diagnosis			Frequency of Dental Visits			
	Insured (n=263)	Uninsured (n=152)	P-value	At Least Annually (n=307)	Infrequently (every 2–10 yrs) (n=76)	Rarely or never (n=43)	P-value
Graduate or professional degree	68 (25.9%)	30 (19.7%)		90 (29.3%)	8 (10.5%)	0 (0.0%)	
Tumor site							
Oral cavity	152 (57.8%)	95 (62.5%)	0.35[b]	190 (61.9%)	39 (51.3%)	25 (58.1%)	0.24[b]
Pharynx	111 (42.2%)	57 (37.5%)		117 (38.1%)	37 (48.7%)	18 (41.9%)	
Stage at Diagnosis (AJCC stage group)							
AJCC Stage at Diagnosis							
I	35 (13.3%)	25 (16.5%)	0.84[b]	51 (16.6%)	9 (11.8%)	2 (4.7%)	0.25[b]
II	31 (11.8%)	18 (11.8%)		34 (11.1%)	9 (11.8%)	7 (16.3%)	
III	38 (14.5%)	22 (14.5%)		46 (15.0%)	14 (18.4%)	4 (9.3%)	
IV	159 (60.5%)	87 (57.2%)		176 (57.3%)	44 (57.9%)	30 (69.8%)	

[a] 2-sample t-test

[b] Fisher's exact test

[c] One-way ANOVA Abbreviations: sd = standard deviation; AJCC = American Joint Committee on Cancer

Table 2

Frequency of dental visits by insurance status.

	Dental Insurance Status at Diagnosis		
	Insured	Uninsured	P-value[a]
Frequency of Dental Insurance as an Adult			
Never	---	77 (52.0%)	< 0.001
Rarely	16 (6.1%)	28 (18.9%)	
Sometimes	43 (16.4%)	23 (15.5%)	
Most of the time	203 (77.5%)	20 (13.5%)	
Frequency of Dental Visits			
Rarely or never	15 (5.7%)	28 (18.4%)	< 0.001
Infrequently (every 2–10 years)	37 (14.1%)	36 (23.7%)	
At least annually	210 (80.2%)	88 (57.9%)	

[a]Fisher's exact test

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Table 3

History of identification of a growth by a dentist by dental insurance status, overall and by stage at diagnosis.

	History of an Unusual Growth Being Identified by a Dentist								
	Oral & Pharyngeal			Oral Cavity			Pharynx		
	No	**Yes**	**P-value[a]**	**No**	**Yes**	**P-value[a]**	**No**	**Yes**	**P-value[a]**
All Stages									
Dental Insurance Status at Diagnosis									
Uninsured	130 (86.7%)	20 (13.3%)	0.33	78 (83.0%)	16 (17.0%)	0.59	52 (92.9%)	4 (7.1%)	0.45
Insured	234 (90.0%)	26 (10.0%)		130 (85.5%)	22 (14.5%)		104 (96.3%)	4 (3.7%)	
Frequency of Dental Visits									
At least annually	258 (84.6%)	47 (15.4%)	< 0.001	150 (79.4%)	39 (20.6%)	0.009	108 (93.1%)	8 (6.9%)	0.20
Infrequently (every 2—10 years)	72 (97.3%)	2 (2.7%)		37 (94.9%)	2 (5.1%)		35 (100%)	0 (0.0%)	
Rarely or never	42 (97.7%)	1 (2.3%)		24 (96.0%)	1 (4.0%)		18 (100%)	0 (0.0%)	
Local Stage (I or II)									
Dental Insurance Status at Diagnosis									
Uninsured	30 (71.4%)	12 (28.6%)	0.66	22 (68.8%)	10 (31.3%)	0.81	8 (80.0%)	2 (20.0%)	0.56
Insured	50 (75.8%)	15 (24.2%)		38 (71.7%)	15 (28.3%)		12 (92.3%)	1 (7.7%)	
Frequency of Dental Visits									
At least annually	56 (66.7%)	28 (33.3%)	0.02	46 (64.8%)	25 (35.2%)	0.21	10 (76.9%)	3 (23.1%)	0.38
Infrequently (every 2–10 years)	16 (88.9%)	2 (11.1%)		12 (85.7%)	2 (14.3%)		4 (100%)	0 (0.0%)	
Rarely or never	9 (100%)	0 (0.0%)		3 (100%)	0 (0.0%)		6 (100%)	0 (0.0%)	
Advanced Stage (III or IV)									
Dental Insurance Status at Diagnosis									
Uninsured	100 (92.6%)	8 (7.4%)	0.45	56 (90.3%)	6 (9.7%)	0.57	44 (95.7%)	2 (4.4%)	0.66
Insured	184 (94.9%)	10 (5.2%)		92 (92.9%)	7 (7.1%)		92 (96.8%)	3 (3.2%)	
Frequency of Dental Visits									
At least annually	202 (91.4%)	19 (8.6%)	0.03	104 (88.1%)	14 (11.9%)	0.12	98 (95.2%)	5 (4.9%)	0.73
Infrequently (every 2–10 years)	56 (100%)	0 (0.0%)		25 (100%)	0 (0.0%)		31 (100%)	0 (0.0%)	
Rarely or never	33 (97.1%)	1 (2.9%)		21 (95.5%)	1 (4.6%)		12 (100%)	0 (0.0%)	

[a] Fisher's exact test

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Table 4

Association between dental insurance status at diagnosis and frequency of dental visits with stage and T and N classifications.

	Oral & Pharyngeal		Oral		Pharyngeal	
	n	Cumulative OR[a] (95% CI)	n	Cumulative OR[a] (95% CI)	n	Cumulative OR[a] (95% CI)
Stage Group (I–IV)						
Insurance Status at Diagnosis						
Insured	263	1.00 *(reference)*	152	1.00 *(reference)*	111	1.00 *(reference)*
Uninsured	152	1.18 (0.76–1.85)	95	1.18 (0.66–2.09)	57	0.97 (0.43–2.19)
Frequency of Dental Visits						
At least annually	307	1.00 *(reference)*	190	1.00 *(reference)*	117	1.00 *(reference)*
Infrequently (every 2–10 years)	76	1.08 (0.63–1.85)	39	1.15 (0.54–2.46)	37	1.02 (0.39–2.63)
Rarely or never	43	**2.28 (1.02–5.10)**	25	**9.17 (2.70–31.15)**	18	0.40 (0.10–1.54)
		P_{trend}=0.09		**P_{trend} = 0.002**		P_{trend} = 0.32
T Classification (T1–T4)						
Insurance Status at Diagnosis						
Insured	258	1.00 *(reference)*	148	1.00 *(reference)*	110	1.00 *(reference)*
Uninsured	150	1.12 (0.74–1.69)	93	1.17 (0.68–2.01)	57	0.85 (0.42–1.69)
Frequency of Dental Visits						
At least annually	302	1.00 *(reference)*	186	1.00 *(reference)*	116	1.00 *(reference)*
Infrequently (every 2–10 years)	74	**1.82 (1.09–3.05)**	37	1.46 (0.69–3.10)	37	**2.90 (1.31–6.39)**
Rarely or never	43	**3.24 (1.59–6.57)**	25	**8.33 (3.00–23.10)**	18	0.81 (0.27–2.46)
		P_{trend} < 0.001		**P_{trend} < 0.001**		P_{trend} = 0.44
N Classification (N0–N3)						
Insurance Status at Diagnosis						
Insured	259	1.00 *(reference)*	148	1.00 *(reference)*	111	1.00 *(reference)*
Uninsured	151	0.96 (0.63–1.46)	94	0.94 (0.53–1.66)	57	0.87 (0.43–1.73)
Frequency of Dental Visits						
At least annually	303	1.00 *(reference)*	186	1.00 *(reference)*	117	1.00 *(reference)*

	Oral & Pharyngeal		Oral		Pharyngeal	
	n	**Cumulative OR[a] (95% CI)**	n	**Cumulative OR[a] (95% CI)**	n	**Cumulative OR[a] (95% CI)**
Infrequently (every 2–10 years)	76	0.90 (0.54–1.50)	39	0.86 (0.41–1.80)	37	0.90 (0.40–2.01)
Rarely or never	42	0.99 (0.48–2.05)	24	2.06 (0.77–5.56)	18	0.53 (0.15–1.89)
		$P_{trend} = 0.84$		$P_{trend} = 0.31$		$P_{trend} = 0.40$

[a]Adjusted for age, sex, race, smoking, alcohol consumption, education and annual household income

[b]Cumulative OR was calculated using ordinal logistic regression and represents the association with a 1 –unit increase in stage group (I–IV), T or N, respectively