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Feeding tube utilization in patients with salivary gland malignancies

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Abstract

Objectives—To evaluate feeding tube utilization in patients with salivary gland malignancies (SGM).

Study Design—Case series with planned data collection.

Setting—The University of Texas MD Anderson Cancer Center, Houston, TX, USA.

Subjects and Methods—Patients (n=287) were sampled from an epidemiologic SGM registry during a 12-year period. Feeding tube history was retrospectively reviewed. Patients with outside locoregional therapy or palliative treatment were excluded. Enteral feeding and length of dependence were analyzed as a function treatment modality and site of SGM.

Results—Seventy-nine of 287 patients (28%) required temporary nasogastric tube feeding (median duration: 13 days, IQR 6–21). Among those 79, 30 (10% of total cohort) required conversion to percutaneous gastrostomy (G-tube). Median G-tube duration was 4.8 months (IQR 3.7–13.1). G-tube placement was only necessary in patients receiving multimodality therapy ($p<0.001$), and among those, 50% with SGM arising from pharyngeal/laryngeal sites required G-tube compared to 8-to-19% of SGM arising from all other sites ($p<0.01$). At a median follow-up of 2.4 years, 9 (3%) of all SGM patients were G-tube dependent, but 14% (3/22) of patients with

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laryngeal/pharyngeal sites treated with multimodality therapy remained chronically G-tube dependent.

Conclusion—While almost 30% of SGM survivors require a temporary nasogastric tube, G-tube utilization is uncommon, in roughly 10% of SGM overall. G-tube utilization appears exclusive to patients treated with multimodality therapy, and chronic gastrostomy remains high (14%) in patients with minor gland cancers arising in the pharynx/larynx suggesting impetus for dysphagia prophylaxis in these higher risk subsets similar to patients treated for squamous cancers.

Keywords

salivary gland malignancy; feeding tube; gastrostomy tube

Introduction

Salivary gland malignancies (SGM) represent a rare and heterogenous group of tumors comprising approximately 3–6% of head and neck cancers in the United States.^{1,2} Predominant histopathologies include mucoepidermoid carcinoma, adenoid cystic carcinoma, adenocarcinoma, and acinic cell carcinoma amongst others. These tumors most commonly arise in the major glands (parotid, submandibular, and sublingual) but can occur in mucosal surfaces such as the sinonasal tract and oropharynx. While primary intervention is traditionally surgery, modern advances in diagnostic and therapeutic technologies have increased the role of radiotherapy and chemotherapy. Adjuvant radiation after primary surgical resection and concurrent chemoradiotherapy are associated with greater locoregional and distant control of disease with adverse pathological features.^{3–5}

Five-year survival rates of SGM reported in recent decades range from 51–94% depending on tumor burden and stage.^{3,4,6–8} Favorable survival probabilities merit attention to toxicity profiles and quality of life after SGM. Swallowing-related issues remain prominent in general head and neck cancer survivorship with gastrostomy utilization upwards of 50% in patients treated with radiotherapy for mucosal primary tumors of the head and neck region.⁹ Treatment-related side effects such as dysphagia, odynophagia, xerostomia, and mucositis predispose patients to malnutrition, weight loss, poor wound healing, and prolonged recovery. Overall, the need for enteral feeding serves as a surrogate marker for acute treatment-related toxicity at times when patients exhibit impaired oral intake, weight loss, dysphagia, and risk for aspiration.

Long-term gastrostomy dependence is thought to reflect chronic swallowing dysfunction, and rates are dependent on site, stage, and treatment parameters. G-tube dependence is commonly reported as a measure of functional outcome for patients with carcinomas of the head and neck.^{10–12} Historically, studies analyzing nutritional outcomes typically combine multiple subgroups of head and neck cancer.¹² Prior site-specific investigations of G-tube utilization from our group have identified factors affecting feeding tube timing and dependence, such as type of radiotherapy and concomitant boost fractionation schedules.^{9,13} To date, no studies have focused on feeding tube usage in patients with salivary gland cancers, and the heterogeneity of SGM presents a challenge to recognizing factors affecting enteral support. Greater understanding of functional outcomes specific to SGM will help

identify SGM subgroups at high-risk for G-tube placement and address patient expectations in this cohort. Therefore, this study serves to characterize feeding tube utilization and dependence among patients with SGM.

Methods

Study Design and Eligibility

Patients with newly diagnosed SGM and no prior history of cancer (with the exception of non-melanoma skin cancer) were prospectively recruited to an epidemiologic cohort at the University of Texas MD Anderson Cancer Center between 2001 and 2013. The study cohort was approved by the MD Anderson Cancer Center Institutional Review Board, and each subject provided informed consent before recruited into this study. A total of 324 SGM patients were recruited to the cohort. A 12-year retrospective review was undertaken to investigate feeding tube utilization in patients with previously untreated SGM sampled from the epidemiologic registry. Patients with lymphoproliferative malignancies were not included. Thirty-seven patients with outside locoregional therapy or palliative treatment were excluded. The remaining 287 patients from the SGM cohort who underwent primary locoregional therapy for curative intent at our institution were included in this study.

Data collection

Data variables collected included demographics, pathology, treatment parameters, feeding tube characteristics, and clinical status at last follow-up visit. Type of radiation, dosage, and neck field, if any, were recorded as well as any chemotherapy agent and schedule. Surgical fields felt to reflect elevated risk of postoperative dysphagia were coded as any combination of oral cavity, pharynx, and larynx based on structures resected.

Locations of SGM were classified into five major subsites: oral, major gland, pharynx & larynx, sinonasal, and other. Oral cavity carcinomas included those of the buccal mucosa, floor of mouth, lip, mandibular and maxillary gingiva, retromolar trigone, hard palate, and oral tongue. Major gland carcinomas were tumors of the parotid, sublingual, and submandibular glands. Cancers of the pharynx and larynx arose from the base of tongue, soft palate, piriform sinus, and subglottis. Sinonasal tract cancers involved the ethmoid, maxilla, nose, nasopharynx, and nasal septum. Remaining tumors arising in the neck, thyroid, ear, lacrimal gland, parathyroids, and scapula were classified as other. Single modality treatment was defined as patients who underwent surgery or radiation alone. A combination of surgery, radiation, and/or chemotherapy was considered multimodality treatment.

Speech pathology referrals were coded. Referrals to a speech pathologist for swallow assessment before treatment depended on primary site of cancer and surgeon's impression on dysphagia risk. Patients who underwent surgical resection of structures in the oral cavity or oropharynx also typically received postoperative inpatient swallow evaluation by speech pathology. These patients received swallowing exercises related to tongue base retraction, pharyngeal constriction, and laryngeal closure.

For surgical patients in the perioperative setting, feeding tubes were placed at the discretion of the surgeon based on perceived risk of dysphagia due to the extent of surgical resection or

if recommended after postoperative swallow evaluation by the speech pathologist. Patients generally received a gastrostomy feeding tube if they demonstrated failure to convert to PO intake within 6 weeks of surgery or by the time adjuvant therapy was initiated. For nonsurgical patients, feeding tubes were not placed prophylactically.

Feeding tube data included type, duration, and timing of placement. Feeding tubes utilized were nasogastric or Dobhoff tubes (NG tube) and percutaneous gastrostomy tube (G-tube). Chronic G-tube dependence was defined as having the feeding tube at last follow-up visit. Patients who underwent removal of their G-tube were considered to have temporary G-tube dependence. Sources of chronic dependence were ascertained from patient history and coded as self-reported dysphagia, clinically documented aspiration, xerostomia, and dysgeusia.

Statistical considerations

Primary clinical endpoints were incidence and duration of feeding tube usage. Associations between feeding tube outcomes and study variables were analyzed for statistical significance using Pearson's chi-square and Fischer's exact tests. Multinomial ordered logistic regression analysis was performed to identify risk factors for feeding tube utilization. Feeding tube group (no tube, temporary nasogastric, temporary gastrostomy, chronic gastrostomy) was regressed on candidate predictors first in univariate models. The multivariate model was fit using stepwise backward elimination. The final model retained covariates that were independently associated with feeding tube utilization ($p < 0.05$). A p value < 0.05 was considered statistically significant. Statistical analyses were performed using STATA data analysis software, version 14.0 (Stata-Corp, College Station, TX, USA).

Results

Patient characteristics

Of 324 patients with salivary gland malignancies (SGM) recruited to the parent prospective molecular epidemiologic study, 287 patients (54% female) met criteria for this study. Median age of the patients was 55 years old (IQR 45–65). The majority of cancers were adenoid cystic (37%) and mucoepidermoid carcinoma (22%), followed by acinic cell carcinoma (10%) and adenocarcinoma (9%). The most common location of these SGMS were major glands (41%) followed by oral cavity (29%), pharynx and larynx (13%) and sinonasal tract (13%). Additional demographics are detailed in Table 1A.

Treatment characteristics and follow-up

Two hundred seventy-one (94%) patients underwent surgical intervention and 165 (57%) patients received adjuvant therapy with either radiotherapy (47%) or chemoradiation (10%). The remaining patients received primary nonsurgical therapy including single modality radiation (1%) or chemoradiation (5%). Overall, a multimodality approach constituted 62% of treatment regimens. Table 1B provides further treatment information.

The majority of surgeries did not involve swallow-critical structures of the oral cavity, pharynx, or larynx (52%). Surgeries of the oral cavity comprised of 39% cases while 8% of cases involved both oral cavity and pharyngeal or laryngeal structures. For surgical

reconstruction, 18% of patients received a free flap and 6% received a local flap. For radiation therapy, the primary modality was intensity-modulated radiotherapy (IMRT) (82% of radiotherapy cohort). Only 34% of all patients received radiation to the neck.

Median follow-up time was 2.4 years (range 41 days–12.4 years). Almost 70% of the total SGM cohort had no evidence of disease at last clinic visit. Death attributable to disease and to other causes occurred in 12% and 7% patients, respectively.

Feeding tube utilization

NG tube placement was required for 79 of 287 (28%) patients during treatment of SGM with a median duration of 13 days (IQR, 6–21 days). Characteristics of feeding tube placement are summarized in Table 2. Of those 79 patients, 30 (10% of total SGM cohort) patients required conversion to percutaneous gastrostomy. Median G-tube duration was 4.8 months (IQR, 3.7–13.1 months). Twenty-one of the 30 patients had temporary G-tube placement with median duration of 4.1 months (IQR 3.1–6.2 months). Gastrostomy dependence over time is plotted in Figure 1. While 9 patients (3% of total SGM cohort) were chronically gastrostomy dependent, 14% (3 of 22) of patients with pharyngeal and laryngeal SGM sites treated with multimodality therapy remained chronically G-tube dependent.

Factors associated with feeding tube utilization

Table 3 demonstrates feeding tube characteristics in association with study variables. Feeding tube utilization significantly differed by site of SGM ($p<0.001$). Stratifying by tumor site, 28 of 36 (79%) patients with SGM arising from the pharynx and larynx required a NG tube and 12 (31%) patients in this group underwent G-tube. The subgroup with the second highest feeding tube rate was those with sinonasal tract tumors as 11 (30% of 37) patients needed an NG tube and 6 (17%) patients required a G-tube. In all other sites, the proportion of patients requiring NG and G-tubes ranged from 13–28% and 6–7%, respectively.

Treatment modality was also significantly associated with feeding tube utilization. Stratifying by treatment type, 35% (63 of 179) of patients treated with a multimodality regimen and 15% of patients with single modality therapy required NG tube ($p<0.01$). G-tube was only necessary in patients receiving multimodality therapy ($p<0.01$). Among patients requiring multimodality therapy, 50% of patients with SGM arising from pharyngeal and laryngeal sites required G-tube placement compared to 8-to-19% of SGM arising from all other sites ($p<0.001$). Figure 2 illustrates the distribution of feeding tube characteristics by site and treatment modality.

Surgical and radiation characteristics were also significant predictors of feeding tube utilization. Oral cavity, pharyngeal, and/or laryngeal resection was significantly associated with both NG-tube ($p<0.01$) and G-tube placement ($p=0.02$). For patients who underwent reconstruction, 27% of patients who received a free flap required G-tube placement compared to 6% of those with a local flap; furthermore, 6 (12%) patients with free-flaps became chronically G-tube dependent compared to 2 (1%) patients without reconstruction ($p<0.01$). Additionally, 7 (41%) of patients who received bilateral radiation to the neck had G-tube placement with 3 (18%) requiring chronic G-tube utilization.

Multivariable analysis demonstrated primary tumors of the oral cavity, pharynx, and larynx, multimodality treatment, and expected surgical parameters independently predicted feeding tube utilization ($p < 0.01$). Table 4 details the multivariable model results.

Discussion

Multimodality management of selected salivary gland malignancies confers locoregional and distant disease control benefits, but the associated treatment-related toxicities such as acute mucositis, xerostomia, and chronic swallowing dysfunction can impair recovery and quality of life (QOL) in cancer survivorship. Feeding tube utilization for nutritional support is well-characterized in certain head and neck cancers. However, studies detailing feeding tube utilization in patients with salivary gland malignancies have not been published. Our investigation presents the first large-sample analysis of feeding tube utilization in patients with SGM. Feeding tube utilization among all SGM patients was low. We found that 28% of the cohort needed nutritional support with nasogastric tube and 10% eventually required conversion to a G-tube, but high risk groups emerged in subgroup analyses identifying those SGM patients for whom dysphagia prophylaxis is likely warranted. Classifiers, including minor gland cancer sites arising in the larynx or pharynx and multimodality treatment regimens, were associated with robust effect sizes in multivariate statistical analysis (Table 4), asserting their predictive value.

As expected, multimodality treatment for SGM (definitive chemoradiotherapy or surgery followed by adjuvant radiation and/or chemotherapy) was an independent risk factor for G-tube placement and chronic dependence. In contrast, single modality treatment, which was predominantly surgery alone, did not carry the same risk. Radiation to the bilateral neck, while rare, was associated with increased feeding tube and G-tube usage. These results reiterate the detrimental effects of postoperative radiation to the neck on swallowing function that have been reported in other non-SGM cohorts.^{14–17} Langendijk et al. reported bilateral neck irradiation as an independent prognosticator of swallow dysfunction,¹⁸ and organ-at-risk specific analyses relate average radiation doses of 50–70 Gy to pharyngeal constrictor and laryngeal regions to dysphagia.^{19–22} In addition, these investigators and others, including a large multi-institutional review of G-tube usage after nonsurgical therapy for oropharyngeal cancer, found concurrent chemotherapy is an independent risk factor for long-term G-tube dependence.^{10,23} Our findings corroborate these prior observations, in that multimodality treatment with radiation (i.e., surgery with adjuvant radiation or definitive chemoradiation) and neck irradiation radiation fields predispose SGM patients to enteral feeding with greater potential for long-term dependence.^{24,25}

Feeding tube utilization was, by far, most common in salivary gland malignancies arising in pharyngeal and laryngeal sites. This trend was particularly pronounced among patients with pharyngeal or laryngeal salivary malignancies requiring multimodality treatment, among whom 50% required a G-tube and 14% became chronically feeding tube dependent in long-term follow-up. Rates of chronic gastrostomy in this subgroup of SGM parallel those reported in predominantly squamous cell carcinoma series such as Caudell et al. who reported 14% 2-year G-tube dependence after chemoradiation for head and neck cancer with

base of tongue, hypopharyngeal, and laryngeal cancers at higher risk for persistent dysphagia.²⁶

Surgical factors had a substantial impact on feeding tube utilization in SGM. When results were stratified by surgical fields, cases with resections within the oral cavity, pharynx, and/or larynx had significantly higher rates of NG tube (41–75%) and G-tube usage (14–25%) than those involving other surgical fields (8% and 5%, respectively). Cases with oral cavity resection fields also included patients with sinonasal tumors, who had the second highest feeding tube usage rate, as they underwent maxillectomy and/or palatectomy. Small sample size may have limited correlating these surgical parameters with chronic G-tube dependence. Surgery involving the bolus passageway requires substantial physical, mechanical, and sensory adaptation by the patient. The degree of swallowing impairment is further influenced by volume and location of surgical resection in the oral cavity and oropharynx as others have previously studied in great detail, but these surgical factors were not available in this study.²⁷ Dysphagia following free-flap reconstruction in the oral cavity and oropharynx is common and well-characterized clinical condition. A prospective case series by McConnel et al. demonstrated less efficient swallow function with greater pharyngeal residue and longer dwell times in patients who underwent free flap reconstruction compared to primary closure cases.²⁸ Our results agree with McConnel et al. and earlier investigations that describe significant incompetency during oral and pharyngeal phases of swallowing after extensive resections necessitating intraoral and pharyngeal free flap surgery.^{27,29,30} Nearly 40% of patients in our SGM cohort who had extensive surgical resection necessitating free flap reconstruction required G-tube placement with approximately half of them becoming chronically dependent on G-tube feedings. Free flap reconstruction was an independent risk factor for G-tube utilization in multivariate models adjusted for adjuvant therapy. Low event rates of chronic G-tube dependence precluded multivariate analysis of this endpoint. Notably, however, none of the patients with flap reconstruction alone became chronically G-tube dependent; all patients who became G-tube dependent after flap reconstruction had also received adjuvant radiotherapy, reiterating multimodality treatment as an independent risk for chronic dependence.

By determining subgroups of patients who have higher risk for requiring enteral feeding, clinical decision-making models can be enhanced to help educate patients and anticipate barriers to treatment adherence or recovery. Prior studies on enteral nutritional support in head and neck cancer have predominantly focused on patients treated with definitive radiotherapy for squamous cell carcinomas of the head and neck. Some programs perform prophylactic g-tube placement to prevent weight loss and adjuvant treatment breaks, but prolonged periods without oral intake are also linked with long-term G-tube dependence, dysphagia, and adverse remodeling of swallowing muscles that exacerbate the treatment effects.^{31–33} Our institution adopts a reactive or “wait-and-see” approach by closely following patient’s ability to maintain adequate oral intake and weight before recommending enteral feeding routes. The feasibility of this approach has been demonstrated in large published series.^{9,13} The intent of this practice is to minimize swallow deconditioning from prolonged enteral dependence and avoid risks and costs of the procedure when possible as advocated by previous studies.^{9,13,34,35} In our earlier published series by Bhayani et al., 30–40% of patients undergoing chemoradiotherapy for oropharyngeal and hypopharyngeal

carcinomas avoided placement of G-tubes with a lower likelihood of gastrostomy dependence in patients also participating in preventive swallow exercise therapy.^{9,13} Our present analysis argues that high risk groups of SGM patients such as those with multimodality treatment, bilateral neck irradiation, SGM arising in the pharyngeal and laryngeal sites, and those requiring intra-oral free flap reconstruction might benefit from similar proactive swallowing therapy service models in effort to lower rates of chronic gastrostomy dependence.

Overall, our results demonstrate favorable outcomes with a reactive feeding tube placement approach for patients with SGM as evidenced by low rates of both reactive NG tube feeding (28%) and gastrostomy tube utilization (10%). As patients with pharyngeal and laryngeal SGM were at the highest risk for feeding tube utilization and dependence, standardized observation and medical scrutiny is warranted similar to surveillance models that have been popularized for SCC of the head and neck. Concomitant with counseling about the probability of requiring a feeding tube, these patients may benefit from a prophylactic swallow therapy program instituted before and after treatment initiation to assist with their ability to continue oral intake safely. Previous investigations by our group have demonstrated that a reactive tube placement model coupled with maintenance of oral intake and swallowing exercises can help prevent placement or shorten gastrostomy duration and maintain more normal diets after treatment.^{9,36} Therefore, a multidisciplinary approach in addressing dysphagia in patients with SGM undergoing adjuvant radiotherapy or definitive chemoradiation might provide improved outcomes in swallowing rehabilitation and need for long-term enteral support.

A significant limitation of this study is its retrospective, observational design that restricts the ability to definitively identify predictors of feeding tube placement and causal inferences. We acknowledge also the potential for internal bias with regard inherent in a retrospective single institution analysis such as this, particularly with regard to subjectivity in practice patterns such as decisions on feeding tube candidacy. However, this study represents the first detailed analysis of feeding tube utilization in SGM that may be instrumental to future studies investigating clinical outcomes and quality of life implications. A relatively large sample size and prospectively ascertained clinical details enabled analysis of SGM-specific factors associated with G-tube dependence. Future studies prospective in design would provide further insight into G-tube dependence and timing for patients with SGM.

Conclusion

These results demonstrate low incidence of G-tube placement (10%) among all SGM patients in an institution with a reactive tube placement model. G-tube utilization appears exclusive to patients treated with multimodality therapy, and chronic gastrostomy remains high (14%) in patients with minor gland cancers arising in the pharynx and larynx who require multimodality therapy, suggesting impetus for dysphagia prophylaxis in these higher risk patient groups.

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Figure 1.
Kaplan-Meier plots of duration of feeding tube for patients with salivary gland malignancies who underwent (A) nasogastric (NG) tube and (B) gastrostomy tube placement.

Figure 2.

Distribution of feeding tube usage among patients with salivary gland malignancies who underwent multimodality (A) or single modality (B) treatment regimen. Gastrostomy tube usage was significantly associated with multimodality treatment and primary site at oropharynx & larynx ($p < 0.01$).

Table 1A

Characteristics of patients with salivary gland malignancies.

Characteristic	Value (%)
No. of patients	287
Median age (IQR)	55 (45–65)
Female	155 (54)
Tumor Pathology	
Adenoid cystic carcinoma	107 (37)
Mucoepidermoid carcinoma	62 (22)
Acinic cell carcinoma	28 (10)
Adenocarcinoma	25 (9)
Salivary duct carcinoma	15 (5)
Polymorphous adenocarcinoma	15 (5)
Carcinoma ex-pleomorphic adenoma	12 (4)
Other	24 (9)
Tumor Site	
Major gland	118 (41)
Oral cavity	82 (29)
Sinonasal tract	37 (13)
Pharynx/larynx	36 (13)
Other	14 (5)
T classification	
0	2 (0)
1	116 (41)
2	50 (17)
3	36 (13)
4	63 (22)
NA	20 (7)
N classification	
0	221 (77)
1	11 (4)
2 or 3	35 (12)
NA	20 (7)

IQR – interquartile range

Table 1B

Treatment characteristics of patients with salivary gland malignancies.

Characteristic	Value (%)
Treatment Modality	
S	107 (37)
SX	135 (47)
SXC	29 (10)
X	1 (0)
XC	15 (5)
Surgical field	
Non-oropharyngeal	133 (46)
Oral cavity	112 (39)
Oral cavity and pharyngeal	22 (8)
Pharyngeal and/or laryngeal	4 (1)
No surgery	16 (6)
Surgical reconstruction	
Local flap	17 (6)
Free flap	52 (18)
No reconstruction	202 (70)
No surgery	16 (6)
Radiation modality	
IMRT	147 (51)
Proton	16 (6)
3D conformal	1 (0)
Unknown	16 (6)
No RT	107 (37)
Mean radiation dosage (SD)	61 Gy±5.4
Neck radiation	
Unilateral	79 (28)
Bilateral	17 (6)
No neck field	72 (25)
Unknown	12 (4)
No RT	107 (37)
Chemotherapy	
Definitive	15 (5)
Adjuvant	29 (10)
No chemotherapy	243 (85)
Speech pathology rehabilitation	93 (32)

S – surgery; X – radiation; C - chemotherapy

Table 2

Feeding tube characteristics in patients with salivary gland malignancies

Characteristic	Value (%)
No. of patients	287
Median follow-up time (years)	2.4
NG tube placement	79 (28)
Duration of NG tube (days)	
Median (IQR)	13 (6–21)
G-tube placement	30 (10)
G-tube dependence	
Temporary	21 (7)
Chronic	9 (3)
Median duration of G-tube (IQR)	4.8 months (3.7–13.1)
Reason for G-tube dependence	
Dysphagia or aspiration	8 (3)
Xerostomia, oral aversion, dysgeusia	2 (1)

Major Subsite of Salivary Gland Tumor

Table 3

Feeding tube characteristics based on salivary gland tumor treatment parameters

Characteristic	No. patients (n=287)	NG tube (%)	p value	G-tube (%)	p value	Chronic G-tube (%)	p value
Treatment type			0.005*		<0.001*		0.018*
Single modality (S or X only)	108	16 (15)		0 (0)		0 (0)	
Multimodality	179	63 (35)		30 (17)		9 (5)	
SX	135	49 (36)		21 (16)		8 (6)	
SXC	29	10 (34)		5 (17)		1 (3)	
XC	15	4 (27)		4 (27)		0 (0)	
Tumor site			<0.001*		<0.001*		0.320
Oral cavity	82	23 (28)		5 (6)		1 (1)	
Major gland	118	15 (13)		6 (5)		4 (3)	
Pharynx & larynx	36	28 (79)		12 (31)		3 (8)	
Sinonasal tract	37	11 (30)		6 (17)		1 (3)	
Other	14	2 (14)		1 (7)		0 (0)	
Tumors treated with multimodality			<0.001*		<0.001*		0.416
Oral cavity	42	18 (43)		5 (11)		1 (2)	
Major gland	76	14 (18)		6 (8)		4 (5)	
Pharynx & larynx	22	19 (86)		12 (50)		3 (14)	
Sinonasal tract	33	11 (33)		6 (19)		1 (3)	
Other	6	1 (17)		1 (7)		0 (0)	
Surgical field			0.001*		0.023*		0.425
Non-oro-pharyngeal or laryngeal	149	12 (8)		8 (5)		2 (1)	
Oral cavity	112	46 (41)		16 (14)		5 (4)	
Oral cavity and pharyngeal	22	18 (82)		5 (22)		2 (9)	
Pharyngeal and/or laryngeal	4	3 (75)		1 (25)		0 (0)	
Surgical reconstruction			<0.001*		<0.001*		<0.001*
Local flap	17	5 (29)		1 (6)		1 (6)	
Free flap	52	37 (71)		14 (27)		6 (12)	
Radiation to neck field			0.025*		<0.001*		<0.004
Unilateral	79	22 (28)		10 (13)		3 (4)	

Characteristic	No. patients (n=287)	NG tube (%)	<i>p</i> value	G-tube (%)	<i>p</i> value	Chronic G-tube (%)	<i>p</i> value
Bilateral	17	14 (82)		7 (41)		3 (18)	

Table 4

Multivariate analysis of variables associated with feeding tube utilization in patients with salivary gland malignancies (SGM)

Variable	Odds Ratio (CI)	<i>p</i>
Multimodality treatment	4.3 (2.0–9.1)	<0.001
Oral cavity/pharynx/larynx primary site	6.2 (2.7–14.0)	<0.001
Surgical field		
Oral cavity	5.4 (2.6–11.1)	<0.001
Pharynx & larynx	6.6 (2.2–19.7)	0.001
Free flap reconstruction	2.2 (1.6–3.1)	<0.001

CI – 95% confidence interval; SGM