Feeding tube use in patients with head and neck cancer

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ABSTRACT: *Background.* Use of a prophylactic feeding tube before concurrent chemotherapy and radiotherapy (CRT) for patients with head and neck cancer is often debated.

Methods. A retrospective, exploratory study of 109 veterans with stage III/IV head and neck cancer who completed standard CRT was conducted. Relationships among 3 feeding tube status groups: prophylactic feeding tube (PFT), reactive feeding tube (RFT), and no feeding tube (no-FT) were compared for clinical outcomes.

Results. Patients with a PFT had significantly less weight loss during CRT, fewer nutrition-related emergency department visits or hospitalizations, and higher proportions of chemotherapy cycles completed compared to those with an RFT or no-FT. At 12 months post-CRT, there was no relationship between the use of a PFT and 100% feeding tube dependency.

Conclusion. Use of a PFT in this veteran population with stage III/IV head and neck cancer produced better outcomes when compared to both an RFT or no feeding tube without higher rates of long-term dysphagia.
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KEY WORDS: enteral feeding, gastrostomy, head and neck neoplasms, radiotherapy, chemotherapy

INTRODUCTION

Current treatment of advanced head and neck cancer requires multimodality therapy. Surgery, radiotherapy, and concurrent chemotherapy and radiotherapy (CRT) have become the standard of care.[1] CRT has improved the locoregional control of advanced stage disease but with increased toxicity that often impacts nutritional status.[2,3] According to the National Comprehensive Cancer Network, 40% to 90% of patients who receive CRT for head and neck cancer experience severe mucositis[4] as compared to 20% to 30% of patients who receive radiotherapy alone.[5] High rates of mucositis make oral intake difficult and painful and has been associated with weight loss, poor self-care habits, reduced treatment doses, functional decline, and eventual dehydration.[6–9] Mucositis and dehydration are predominant factors associated with delays in head and neck cancer treatment and hospitalizations.[10,11]

Early nutrition intervention may include nutrition counseling with oral supplementation in patients who are able to maintain oral intake. However, patients with head and neck cancer who receive aggressive cancer therapy may not be able to meet nutritional needs orally and therefore require the use of enteral feeding.[12] Enteral feeding tube use for patients who receive radiotherapy or CRT for head and neck cancer ranges from 13% to 85%.[13] Prophylactic feeding tubes (PFTs) are placed before treatment and begin in anticipation of significant oral toxicity, whereas reactive feeding tubes (RFTs) are placed later during treatment because of actual oral toxicity.[12,14]

Placement of a PFT during cancer treatment can result in less weight loss, fewer hospital or emergency department admissions, improved quality of life, and fewer treatment interruptions.[15–17] Disadvantages of placement of a PFT include cost, risk of feeding tube site infections, and increased long-term dysphagia, which decrease quality of life.[18–20] The purpose of this study was to compare clinical outcomes including weight change, emergent care, and the ability to complete chemotherapy in 3 feeding tube status groups (PFT, RFT, and no feeding tube [no-FT]) in 1 veteran affairs medical center where a multidisciplinary team monitors patients closely during CRT and places feeding tubes on a case-by-case basis. We hypothesized that patients with a PFT would experience less weight loss and fewer hospital admissions than patients without a PFT.

PATIENTS AND METHODS

This retrospective, exploratory study used electronic medical record data of patients with stage III or IV head and neck cancer who received standard CRT (cisplatin-

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TABLE 1. Patient, tumor, and treatment characteristics of 109 patients treated with concurrent chemotherapy and radiotherapy.

Characteristic	Total no. of patients	No-FT ($n = 50$)	PFT ($n = 25$)	RFT ($n = 34$)	p value
Age, y					
Mean	60.1	60.9	58.2	60.4	.30
Median	60.0	60.0	59.0	60.0	
Range	36–81	50–77	36–71	45–81	
Sex, no. (%)					
Male	107 (98)	50 (100)	24 (96)	33 (97)	.29*
Female	2 (2)	0 (0)	1 (4)	1 (3)	
Race no. (%)					
White	96 (88)	46 (92)	19 (76)	31 (91)	
Black	9 (8)	2 (4)	6 (24)	1 (3)	.01*
Hispanic	3 (3)	2 (4)	0	1 (3)	
Unknown	1 (1)	0 (0)	0	1 (3)	
Tumor stage, no. (%)					
III	30 (27)	11 (22)	8 (32)	11 (32)	.49
IV	79 (73)	39 (78)	17 (68)	23 (68)	
Tumor site, no. (%)					
Oropharynx	53 (49)	27 (54)	9 (36)	17 (50)	
Larynx	31 (28)	12 (24)	8 (32)	11 (32)	.68*
Oral cavity	16 (15)	6 (12)	6 (24)	4 (12)	
Other	9 (8)	5 (10)	2 (8)	2 (6)	
Radiation technique, no. (%)					
IMRT	71 (65)	33 (66)	13 (52)	25 (73)	.23
Conformal	38 (35)	17 (34)	12 (48)	9 (27)	
Radiation dose, cGy					
Mean dose	7110	7120	7094	7106	.94
Median dose	7000	7000	7000	7000	
Tobacco use, no. (%)					
Yes	54 (49)	24 (48)	10 (40)	20 (59)	.35
No	55 (51)	26 (52)	15 (60)	14 (41)	
ECOG performance status, no. (%)					
0	39 (36)	16 (32)	12 (48)	11 (32)	
1	42 (38)	22 (44)	7 (28)	13 (38)	.50*
2	3 (3)	1 (2)	1 (4)	1 (3)	
3	1 (1)	0 (0)	0 (0)	1 (3)	
Unknown	24 (22)	11 (22)	5 (20)	8 (24)	

Abbreviations: No-FT, no feeding tube; PFT, prophylactic feeding tube; RFT, reactive feeding tube; IMRT, intensity-modulated radiation therapy; ECOG, Eastern Cooperative Oncology Group.
* Fisher's exact test results.

based chemotherapy every 3 weeks concurrently with radiation therapy to an average dose of 6600–7400 cGy) at a veteran's hospital. Relationships between feeding tube status and anthropometrics, hospital admissions, emergency department visits, proportion of planned chemotherapy cycles completed, and oral diet consumption post-CRT were explored. Feeding tube status groups included: patients with no feeding tube (no-FT), patients with a feeding tube placed before CRT (PFT), and patients who received a feeding tube after CRT was started (RFT).

Medical records of patients presented at the head and neck tumor board conference between January 1, 2004, and January 1, 2011, were evaluated by the principal investigator for inclusion into the study. The study protocol was approved by the Institutional Review Board at the James A. Haley VA Hospital and University of Medicine and Dentistry of New Jersey, Newark, NJ.

Statistical analyses were conducted using SPSS, version 20.0 (Chicago, IL). A priori alpha was set at 0.05. One-way independent analysis of variance with post-hoc analysis was used to compare weight change for each time period, emergency department visits, hospital admissions, and proportion of chemotherapy cycles completed by each feeding tube group. Chi-square or Fisher's exact test was used to compare oral diet consumption and feeding tube dependency at completion of and up to 12 months post-CRT.

RESULTS

A total of 247 patients were presented at the tumor board conference during this study period. One hundred thirty-five patients (54.7%) had confirmed stage III or IV head and neck cancer and received the standard CRT and were included in the study. Three patients (1.2%) were excluded from the study because of previous CRT or had a feeding tube in place for reasons other than preparation for CRT. The final total number of medical records used was 109.

Demographic, tumor, and treatment characteristics for all patients are described in Table 1. The most frequent site of cancer occurred in the oropharynx (49.0%; $n = 53$) followed by the larynx (28%; $n = 31$). The majority of patients had stage IV disease (79%; $n = 73$).

Anthropometrics

A series of anthropometric measurements and calculations including body mass index (BMI) during the first

TABLE 2. Percentage of weight change for each time period by feeding tube status.

Anthropometric	No-FT	PFT	RFT	*p* value*
Pretreatment (% weight change from diagnosis to d 1 CRT)	−1.2	−4.3	−2.6	.031
Treatment (% weight change from first to last day of CRT)	−10.5	−4.3	−10.1	< .001†
3 mo (% weight change from last day of CRT to 3 mo post-CRT)	−4.0	+0.8	+0.6	.001‡
6 mo (% weight change from 3–6 mo post-CRT)	−1.9	+0.2	−0.8	.670
12 months (% weight change from 6–12 mo post-CRT)	+2.1	+3.9	+2.6	.772
Total weight change (% weight change from diagnosis to 12 mo post-CRT)	−15.2	−2.4	−10.4	< .001§

Abbreviations: No-FT, no feeding tube; PFT, prophylactic feeding tube; RFT, reactive feeding tube; CRT, concurrent chemotherapy and radiotherapy.
* *p* value for overall effect feeding tube status had on percent of weight change at each time period when controlling for pretreatment percent of weight change.
† Treatment percent of weight change: RFT vs no-FT ($p = 1.0$); PFT vs no-FT ($p = .001$); PFT vs RFT ($p = .002$).
‡ Three months post-CRT percent weight change: RFT vs no-FT ($p = .003$); PFT vs no-FT ($p = .008$); PFT vs RFT ($p = 1.0$).
§ Total percent of weight change: RFT vs no-FT ($p = .043$); PFT vs no-FT ($p < .001$); PFT vs RFT ($p = .012$).

week of CRT and body weight in pounds at 6 separate time periods (diagnosis, first and last week of CRT, and 3, 6, and 12 months after CRT completion) were recorded (Table 2).There were significant differences among the feeding tube status groups and pretreatment percent weight change ($p = .021$) and BMI ($p = .002$). Patients with a PFT had a significantly lower BMI (mean = 22.2 as compared to those with no feeding tube (mean = 27.0) or those with an RFT (mean = 25.9). The clinical decision to place a PFT is often based on pretreatment percent weight loss; therefore, this factor rather than BMI was used as a covariate.

Table 2 describes the relationships between weight changes for each time period by feeding tube group. Controlling for pretreatment percent weight loss, a significant relationship ($p < .001$) was found tube status and weight change from diagnosis to 12 months post-CRT. Post-hoc analysis found that patients with a PFT lost significantly ($p < .001$) less weight (mean = −2.4%) than those in the no-FT group (mean = −15.2%) and significantly less ($p = .012$) than those in the RFT group (mean = −10.4%).

Emergency department visits and hospital admissions

Emergency department visits and hospital admissions between day 1 of CRT and 12 months after CRT were reviewed for the 109 medical records. Any emergency department visits or hospital admissions for dehydration, dysphagia, mucositis, odynophagia, or feeding tube-related problem was considered nutrition related (Table 3). There were 146 emergency department visits experienced by 67.9% of the total sample ($n = 74$ patients); 120 emergency department visits were nutrition related (82.2% of all emergency department visits). There were 115 hospital admissions among 65.1% of the total sample ($n = 71$ patients); 86 were nutrition related (74.8% of all hospital admissions). Table 3 describes the significant relationships found between feeding tube status and nutrition-related emergency department visits and hospital admissions.

Chemotherapy completion rate

The mean number of planned chemotherapy cycles for the sample was 3.0. The mean number of completed chemotherapy cycles was 2.5 (SD = 0.7; median = 3.0; range = 1.0–3.0); the proportion of chemotherapy cycles completed for the total sample was 82.1% (SD = 21.5; median = 100.0; range 33.3% to 100.0%). The proportion of chemotherapy cycles completed was significantly related to feeding tube status ($p < .001$). Patients with a PFT completed a significantly higher proportion of chemotherapy cycles (mean = 96.0%) compared to the no-FT group (mean = 81.7%; $p = .002$) and RFT group (mean = 72.5%; $p < .001$). There was no significant difference between patients with an RFT compared to those with no feeding tube ($p = .131$).

Oral diet consumption and feeding tube dependency

At the end of CRT, 54.1% of the patients ($n = 59$) had a feeding tube in place and all of these patients utilized their feeding tubes for either total or supplemental nutrition support. There were no significant ($p = .492$) differences found between the mean days of feeding tube use. The mean number of days a PFT was used was 319.3 days (SD = 181.0; median = 272.5; range = 61–627 days) and the mean number of days an RFT was used was 276.8 days (SD = 253.6; median = 206.5; range = 14–1250 days). There were no significant differences in route of nutrition between a PFT and RFT at each time period of the study. By 12 months post-CRT, there were no patients in the PFT group who were unable to take nutrition orally, whereas there were 3 patients (11%) unable to swallow orally in the RFT group (Table 4).

DISCUSSION

Minimizing weight loss during CRT improves treatment tolerance, treatment completion, rate of emergent care required, quality of life, and prognosis.[10] Interventions that help minimize weight loss during CRT include management of oral complications, pain management, management of nausea, nutrition counseling, and enteral nutrition.[6,21–23] Consistent with prior research[21,22,24] of advanced stage patients with head and neck cancer treated with aggressive CRT, our results indicate that patients with a PFT had less weight loss than patients without a PFT during CRT. Chen et al[22] similarly found patients who received a PFT experienced an 8% weight loss from baseline weight, which was significantly less ($p < .001$) than the 14% weight loss that patients without a PFT experienced during CRT.

TABLE 3. Nutrition-related emergency department visits and hospital admissions by feeding tube status group ($n = 109$).

Event	No. of patients	Median visits per patient	Mean visits per patient	SD	No. of nutrition-related visits	p value*
Nutrition-related emergency department visits						
No-FT	50	1.0	1.02	1.17	Dehydration = 38 Oral complaints = 13† Feeding tube-related = 0	< .001‡
PFT	25	0.0	0.28	0.61	Dehydration = 6 Oral complaints = 0 Feeding tube-related = 1	
RFT	34	1.5	1.82	1.80	Dehydration = 52 Oral complaints = 3 Feeding tube-related = 7	
Nutrition-related hospital admissions						
No-FT	50	0.0	0.62	0.85	Dehydration = 21 Oral complaints = 10 Feeding tube-related = 0	< .001§
PFT	25	0.0	0.28	0.68	Dehydration =6 Oral complaints = 1	
RFT	34	1.0	1.41	1.1	Feeding tube-related = 0 Dehydration = 31 Oral complaints = 16 Feeding tube-related = 1	

Abbreviations: No-FT, no feeding tube; PFT, prophylactic feeding tube; RFT, reactive feeding tube.
* Nutrition-related emergency department visits and hospital admissions were significantly ($p < .001$) related to feeding tube status.
† Oral complaints include any visit for dysphagia, odynophagia, or mucositis.
‡ Post-hoc analysis results for nutrition-related emergency department visits: PFT vs no-FT ($p = .002$); PFT vs RFT ($p < .001$); RFT vs no-FT ($p = .066$).
§ Post-hoc analysis results for nutrition-related hospital admissions: PFT vs no-FT ($p = .156$); PFT vs RFT ($p < .001$); RFT vs no-FT ($p = .003$).

Although there was no significant difference in weight loss found between an RFT and no feeding tube during treatment, the use of an RFT or PFT seems to be beneficial during the early months after CRT because those with a PFT and an RFT experienced significantly less weight loss than those with no feeding tube. Chen et al[22] found that patients with a PFT continued to have less weight loss at 3 months (5% loss in PFT; 8% loss in control) and 6 months post-CRT (4% in PFT; 7% in control) as compared to baseline weight, yet the results were not significant. A prospective, randomized trial conducted by Silander et al[17] also reported that if weight loss occurred

TABLE 4. Routes of nutrition from end of chemotherapy and radiotherapy to 12 months post-chemotherapy and radiotherapy for patients with enteral nutrition.

	No. of patients (%) by route of nutrition			
Time period and feeding tube status	All oral no-FT	Oral plus FT	All FT no oral	p value
Last day of CRT				
PFT ($n = 25$)	0 (0)	4 (16)	21 (84)	.443*
RFT ($n = 34$)	0 (0)	3 (9)	31 (91)	
3 mo post-CRT				
PFT ($n = 24$)	2 (8)	9 (38)	13 (54)	.265
RFT ($n = 32$)	8 (25)	9 (28)	15 (47)	
6 mo post-CRT				
PFT ($n = 23$)	6 (26)	10 (44)	7 (30)	.276
RFT ($n = 32$)	15 (47)	11 (34)	6 (19)	
12 mo post-CRT				
PFT ($n = 18$)	11 (61)	7 (39)	0 (0)	.215*
RFT ($n = 28$)	9 (68)	6 (21)	3 (11)	

Abbreviations: no-FT, no feeding tube; FT, feeding tube; CRT, chemotherapy and radiation therapy; PFT, prophylactic feeding tube; RFT, reactive feeding tube.
Routes of nutrition = All oral no feeding tube: includes patients who were taking 100% of nutrition by the oral route. Oral plus feeding tube: includes patients who were taking nutrition both orally and by feeding tube. All feeding tube no oral: includes patients who were 100% dependent on a feeding tube for nutrition.
* Fisher's exact test.

in advanced stage patients with head and neck cancer after treatment, those patients with a PFT experienced significantly less weight loss at 6 months posttreatment compared to the control group (nonprophylactic feeding tube group). Silander et al[17] found that the incidence of malnutrition (defined as >10% unintended weight loss over the 6 previous months) was higher in the non-PFT group compared to the PFT group for the entire first year posttreatment. The period between 3 to 12 months post-CRT is one of transition as patients are encouraged to wean off the feeding tube and increase oral intake[23] to help prevent a decline in swallowing function that may occur with disuse.[25] Once the patients can maintain their weight using an oral diet for a period of time (usually 1 month), feeding tubes are removed.[26] Therefore, there may not be statistically significant weight changes observed during this transition period but the use of enteral nutrition (PFT or RFT) is often clinically necessary to support patients during this transition period to prevent further weight loss that may result in emergent care. We found that patients with a PFT experienced 6 times less total percentage weight change from diagnosis to 12 months post-CRT than the no-FT group and at least 4 times less than the RFT group. The RFT group lost nearly 5% less total weight compared to the no-FT group and this was also found to be significant.

Patients with a PFT experienced significantly fewer emergency department visits and nutrition-related hospital admissions during the study period as compared with patients with an RFT or no feeding tube. Feeding routes, such as the PFT that bypass the mouth and throat, help facilitate adequate calories, protein, and hydration, and may prevent excessive weight loss, metabolic abnormalities, and subsequent emergency department visits or hospitalizations.[27–29] Lin et al[29] reported that patients with head and neck cancer who received CRT and had weight loss near 10% had significant metabolic alterations that required medical attention. Chen et al[22] also found that patients without a PFT had a 69% significantly higher rate of interventions for dehydration ($p = .03$) compared with those with a PFT, which is consistent with the current study results (79% higher emergency department visits in patients without a PFT compared with those with a PFT).[22] Beaver et al[24] also found that when feeding tubes were placed during or after completion of radiotherapy, compared to prophylactic placement, the patients were more likely to be hospitalized during treatment. This is consistent with our study findings; patients with a PFT compared to an RFT had fewer hospital admissions. When the 3 feeding tube groups were compared, there was no significant difference in total hospital admissions between patients with a PFT and those with no feeding tube. However, there were significantly less nutrition-related hospital admissions experienced by the PFT group when compared to the RFT group, and the RFT group experienced significantly more nutrition-related hospital admissions than the no-FT group. Interestingly, our results show that patients with an RFT had a significantly higher number of emergency department visits and hospital admissions compared with patients with a PFT or no feeding tube. We speculate that the higher rate of weight loss during treatment may result in the need for more emergent care for patients who receive an RFT.

The results of the current study indicate that patients with a PFT completed a higher proportion of planned chemotherapy cycles as compared with patients without a PFT. Interventions that improve treatment completion are important to oncology practitioners and patients with head and neck cancer as improved treatment completion rates have been related to better survival.[30] Greater weight loss has been shown to significantly decrease proportions of chemotherapy cycles completed.[31] Hill et al[31] evaluated associations between weight loss and treatment outcomes in 73 patients undergoing CRT for gastrointestinal cancers and found that those who did not complete a full chemotherapy course had significantly more weight loss than those who completed the chemotherapy ($p = .046$). Although the relationship between weight loss and proportions of chemotherapy cycles completed was not specifically explored in the current study, there was significantly less weight loss during CRT and a significantly higher proportion of chemotherapy cycles completed in patients with a PFT compared with patients without a PFT.

The relationship between feeding tube use and the ability to resume an oral diet after completion of CRT is multifactorial.[32–42] Factors including radiation dose and location, smoking history, history of neck dissections, existing pretreatment dysphagia, swallowing therapy interventions, and quality of life factors should be considered before arriving at conclusions about the relationship between the use of a feeding tube during CRT and the ability to resume an oral diet. Similar to other studies in patients with head and neck cancer who received CRT,[3,33,43]our findings revealed that the majority of patients (93.5%) resume oral intake by 12 months post-CRT when feeding tubes are utilized. Additionally, we found no statistically significant differences in the days of enteral nutrition used between those with a PFT compared to an RFT. Silander et al[17] found that those with a PFT used enteral feeding significantly longer than those without a PFT. The authors suggest that the higher number of enteral feeding days with a PFT was due to earlier nutrition received by the PFT group and not related to higher rates of dysphagia because of the finding that those with a PFT scored better on the dysphagia scale compared to the non-PFT group.

Strengths of this study include the length of time included for data analysis (up to 12 months post-CRT); the well-defined inclusion and exclusion criteria allowed for consideration of confounding factors, such as pre-CRT dysphagia or surgery; and analysis of 3 separate feeding tube groups to compare an RFT to a PFT. The primary limitation of this study was its retrospective nature. Some data were not evaluated, which may address the need for enteral nutrition during CRT, such as radiation field size or social support.[4] The study was limited to the US veteran population and may not be generalized to other populations. The significant difference in pretreatment weight change and BMI between the PFT and non-PFT groups may indicate bias of providers who may have encouraged patients with pretreatment weight loss to receive a PFT. Care provided at this veteran's medical facility uses comprehensive interdisciplinary care; however, frequency and timing of nutrition and speech

language pathology interventions were not assessed and may have impacted the significant results of this study.

Veterans with stage III/IV head and neck cancer treated with CRT in this study experienced less weight loss, fewer emergency department visits and hospital admissions, and completed chemotherapy at higher rates when a PFT was used compared to an RFT or no feeding tube. Patients with an RFT benefited from less weight change from the end of CRT to 6 months post-CRT compared to patients with no feeding tube, but outcomes were worse in the RFT group for emergent care visits and proportion of chemotherapy cycles completed compared with those with no feeding tube or a PFT. The majority of patients were able to resume an oral diet by 12 months without feeding tube dependency post-CRT regardless of feeding tube group.

Although the results of this study support the use of a PFT in patients with stage III and IV head and neck cancer treated with CRT, it is still undetermined which patients should proactively receive a PFT. Additional research is needed to develop protocols to assist providers with PFT referrals as well as the long-term effects these interventions have on survival, cost of emergent care, impact of nutritional support on cancer treatment outcomes, and quality of life compared to the cost of the feeding tube placement.

REFERENCES

1. Sanabria A, Domenge C, D'Cruz A, Kowalski LP. Organ preservation protocols in developing countries. *Curr Opin Otolaryngol Head Neck Surg* 2010;18:83–88.
2. Mendenhall WM, Riggs CE, Vaysberg M, Amdur RJ, Werning JW. Altered fractionation and adjuvant chemotherapy for head and neck squamous cell carcinoma. *Head Neck* 2010;32:939–945.
3. Akst LM, Chan J, Elson P, Saxton J, Strome M, Adelstein D. Functional outcomes following chemoradiotherapy for head and neck cancer. *Otolaryngol Head Neck Surg* 2004;131:950–957.
4. National Comprehensive Cancer Network Clinical Practice Guidelines in Oncology, volume 2011: Head and Neck Cancers. Available at: http://www.nccn.org/professionals/physician_gls/f_guidelines.asp#site. Accessed November 3, 2012.
5. Trotti A, Bellm LA, Epstein JB, et al. Mucositis incidence, severity and associated outcomes in patients with head and neck cancer receiving radiotherapy with or without chemotherapy: a systematic literature review. *Radiother Oncol* 2003;66:253–262.
6. Murphy BA, Gilbert J, Ridner SH. Systemic and global toxicities of head and neck treatment. *Expert Rev Anticancer Ther* 2007;7:1043–1053.
7. Sonis ST, Elting LS, Keefe D, et al. Perspectives on cancer therapy-induced mucosal injury: pathogenesis, measurement, epidemiology, and consequences for patients. *Cancer* 2004;100(9 Suppl):1995–2025.
8. Wong PC, Dodd MJ, Miaskowski C, et al. Mucositis pain induced by radiation therapy: prevalence, severity, and use of self-care behaviors. *J Pain Symptom Manage* 2006;32:27–37.
9. Epstein JB, Beaumont JL, Gwede CK, et al. Longitudinal evaluation of the oral mucositis weekly questionnaire-head and neck cancer, a patient-reported outcomes questionnaire. *Cancer* 2007;109:1914–1922.
10. Jager–Wittenaar H, Dijkstra PU, Vissink A, van der Laan BF, van Oort RP, Roodenburg JL. Critical weight loss in head and neck cancer--prevalence and risk factors at diagnosis: an explorative study. *Support Care Cancer* 2007;15:1045–1050.
11. Meirovitz A, Kuten M, Billan S, et al. Cytokines levels, severity of acute mucositis and the need of PEG tube installation during chemoradiation for head and neck cancer—a prospective pilot study. *Radiat Oncol* 2010;5:16.
12. Mangar S, Slevin N, Mais K, Sykes A. Evaluating predictive factors for determining enteral nutrition in patients receiving radical radiotherapy for head and neck cancer: a retrospective review. *Radiother Oncol* 2006;78:152–158.
13. Cheng SS, Terrell JE, Bradford CR, et al. Variables associated with feeding tube placement in head and neck cancer. *Arch Otolaryngol Head Neck Surg* 2006;132:655–661.
14. Garsed K, Armstrong R, Scott BB. Delayed healing of percutaneous endoscopic gastrostomy site during chemotherapy. *Gut* 2007;56:1028–1029.
15. Osborne JB, Collin LA, Posluns EC, Stokes EJ, Vandenbussche KA. The experience of head and neck cancer patients with a percutaneous endoscopic gastrostomy tube at a Canadian cancer center. *Nutr Clin Pract* 2012;27:661–668.
16. Gomes CA Jr, Lustosa SA, Matos D, Andriolo RB, Waisberg DR, Waisberg J. Percutaneous endoscopic gastrostomy versus nasogastric tube feeding for adults with swallowing disturbances. *Cochrane Database Syst Rev* 2010;11:CD008096.
17. Silander E, Nyman J, Bove M, Johansson L, Larsson S, Hammerlid E. Impact of prophylactic percutaneous endoscopic gastrostomy on malnutrition and quality of life in patients with head and neck cancer: a randomized study. *Head Neck* 2012;34:1–9.
18. Corry J. Feeding tubes and dysphagia: cause or effect in head and neck cancer patients. *J Med Imaging Radiat Oncol* 2009;53:431–432.
19. Corry J, Poon W, McPhee N, et al. Prospective study of percutaneous endoscopic gastrostomy tubes versus nasogastric tubes for enteral feeding in patients with head and neck cancer undergoing (chemo)radiation. *Head Neck* 2009;31:867–876.
20. El-Deiry MW, Futran ND, McDowell JA, Weymuller EA Jr, Yueh B. Influences and predictors of long-term quality of life in head and neck cancer survivors. *Arch Otolaryngol Head Neck Surg* 2009;135:380–384.
21. Beer KT, Krause KB, Zuercher T, Stanga Z. Early percutaneous endoscopic gastrostomy insertion maintains nutritional state in patients with aerodigestive tract cancer. *Nutr Cancer* 2005;52:29–34.
22. Chen AM, Li BQ, Lau DH, et al. Evaluating the role of prophylactic gastrostomy tube placement prior to definitive chemoradiotherapy for head and neck cancer. *Int J Radiat Oncol Biol Phys* 2010;78:1026–1032.
23. Larsson M, Hedelin B, Johansson I, Athlin E. Eating problems and weight loss for patients with head and neck cancer: a chart review from diagnosis until one year after treatment. *Cancer Nurs* 2005;28:425–435.
24. Beaver ME, Matheny KE, Roberts DB, Myers JN. Predictors of weight loss during radiation therapy. *Otolaryngol Head Neck Surg* 2001;125:645–648.
25. Rosenthal DI, Lewin JS, Eisbruch A. Prevention and treatment of dysphagia and aspiration after chemoradiation for head and neck cancer. *J Clin Oncol* 2006;24:2636–2643.
26. Irish Nutrition and Dietetic Institute.Guidance document for prophylactic gastrostomy feeding tubes for head and neck cancer patients. 2008. Available at: http://www.indi.ie/docs/582_HOIG_Guidance_Document_on_PEG_Placement_in_HNCa.pdf. Accessed November 3, 2012.
27. Cady J. Nutritional support during radiotherapy for head and neck cancer: the role of prophylactic feeding tube placement. *Clin J Oncol Nurs* 2007;11:875–880.
28. DeLegge MH. Consensus statements regarding optimal management of home enteral nutrition (HEN) access. *JPEN J Parenter Enteral Nutr* 2006;30(1 Suppl):S39–S40.
29. Lin A, Jabbari S, Worden FP, et al. Metabolic abnormalities associated with weight loss during chemoirradiation of head-and-neck cancer. *Int J Radiat Oncol Biol Phys* 2005;63:1413–1418.
30. Ang KK, Harris J, Garden AS, et al. Concomitant boost radiation plus concurrent cisplatin for advanced head and neck carcinomas: radiation therapy oncology group phase II trial 99-14. *J Clin Oncol* 2005;23:3008–3015.
31. Hill A, Kiss N, Hodgson B, Crowe TC, Walsh AD. Associations between nutritional status, weight loss, radiotherapy treatment toxicity and treatment outcomes in gastrointestinal cancer patients. *Clin Nutr* 2011;30:92–98.
32. Ahlberg A, al-Abany M, Alevronta E, et al. Esophageal stricture after radiotherapy in patients with head and neck cancer: experience of a single institution over 2 treatment periods. *Head Neck* 2010;32:452–461.
33. Al-Othman MO, Amdur RJ, Morris CG, Hinerman RW, Mendenhall WM. Does feeding tube placement predict for long-term swallowing disability after radiotherapy for head and neck cancer? *Head Neck* 2003;25:741–747.
34. Caglar HB, Tishler RB, Othus M, et al. Dose to larynx predicts for swallowing complications after intensity-modulated radiotherapy. *Int J Radiat Oncol Biol Phys* 2008;72:1110–1118.
35. Caudell JJ, Schaner PE, Desmond RA, Meredith RF, Spencer SA, Bonner JA. Dosimetric factors associated with long-term dysphagia after definitive radiotherapy for squamous cell carcinoma of the head and neck. *Int J Radiat Oncol Biol Phys* 2010;76:403–409.
36. Chapuy CI, Annino DJ, Snavely A, et al. Swallowing function following postchemoradiotherapy neck dissection: review of findings and analysis of contributing factors. *Otolaryngol Head Neck Surg* 2011;145:428–434.
37. Dornfeld K, Simmons JR, Karnell L, et al. Radiation doses to structures within and adjacent to the larynx are correlated with long-term diet- and speech-related quality of life. *Int J Radiat Oncol Biol Phys* 2007;68:750–757.
38. Goguen LA, Posner MR, Norris CM, et al. Dysphagia after sequential chemoradiation therapy for advanced head and neck cancer. *Otolaryngol Head Neck Surg* 2006;134:916–922.
39. Lango MN, Egleston B, Ende K, et al. Impact of neck dissection on long-term feeding tube dependence in patients with head and neck cancer treated with primary radiation or chemoradiation. *Head Neck* 2010;32:341–347.

40. Naik AD, Abraham NS, Roche VM, Concato J. Predicting which patients can resume oral nutrition after percutaneous endoscopic gastrostomy tube placement. *Aliment Pharmacol Ther* 2005;21:1155–1161.
41. Patterson J, Wilson JA. The clinical value of dysphagia preassessment in the management of head and neck cancer patients. *Curr Opin Otolaryngol Head Neck Surg* 2011;19:177–181.
42. Roe JW, Ashforth KM. Prophylactic swallowing exercises for patients receiving radiotherapy for head and neck cancer. *Curr Opin Otolaryngol Head Neck Surg* 2011;19:144–149.
43. Wiggenraad RG, Flierman L, Goossens A, et al. Prophylactic gastrostomy placement and early tube feeding may limit loss of weight during chemoradiotherapy for advanced head and neck cancer, a preliminary study. *Clin Otolaryngol* 2007;32:384–390.