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Advantages of Percutaneous Endoscopic Gastrostomy Tube Placement in Patients with Head and Neck Cancer who Receive Radiation as Part of Their Treatment

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ADVANTAGES OF PERCUTANEOUS ENDOSCOPIC GASTROSTOMY TUBE PLACEMENT IN PATIENTS WITH HEAD AND NECK CANCER WHO RECEIVED RADIATION AS PART OF THEIR TREATMENT

by

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THESIS

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DEDICATION

This project is dedicated to my husband, Nathan, for his unwavering support and faith in me, his pride in my accomplishments, and his steadfastness that allowed me to pursue my dreams. To my children, Olivia and Zerrin, who reminded me to find the joy in all I do, and were always the first to celebrate my accomplishments.

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ABSTRACT

The use of percutaneous endoscopic gastrostomy tubes as an intervention strategy in head and neck cancer was investigated in this retrospective chart review. Twenty-five veterans met the inclusion criteria and were categorized into two groups – use of prophylactic percutaneous endoscopic gastrostomy and absence of percutaneous endoscopic gastrostomy tube placement. Medical charts were reviewed and data extracted included weight, swallow function, swallow exercise compliance, and physical and social quality of life for 2 years post-treatment. Month-to-month data were compared across the two groups with respect to weight, swallow function, swallow exercise compliance, and physical and social quality of life scores. While both groups had similar weight loss during radiation, the percutaneous endoscopic gastrostomy group had faster recovery to baseline. The percutaneous endoscopic gastrostomy group had greater swallow deficits and better exercise compliance than the absence of percutaneous endoscopic gastrostomy group. More research is needed to guide clinical decision making

for the use of percutaneous endoscopic gastrostomy tubes to offset the effects of radiation on patients with head and neck cancer.

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Chapter 1

Introduction

Head and neck cancer (HNCa), and the medical treatments provided, can significantly alter the anatomy and physiology of the head and neck region. Patients with HNCa often undergo intensive treatment including chemotherapy and radiation, and sometimes surgery, to one of the most integral systems of human anatomy that "strikes at the most basic human functions – the ability to communicate, eat, and interact socially" (Gotay & Moore, 1992). HNCa and its treatmeants can result in a high incidence of dysphagia, malnutrition, and a lower quality of life (García-Peris et al., 2007). Although not uniformly employed, feeding tubes, such as percutaneous endoscopic gastrostomy (PEG) tubes, and nasogastric tubes (NG) have been utilized to ensure that individuals with dysphagia get adequate nutrition throughout the treatment and recovery phase. Lack of nutrition can impede recovery, thus negatively impacting ones quality of life.

Intensity-modulated radiation therapy (IMRT) is a commonly used treatment for HNCa. The effects on swallow function are two-fold, and include both early stage and late stage effects. The early effects of radiation on swallow function may include xerostomia, dysguesia, ulcerations, bleeding, pain, and mucositis (Johnson & Jacobson, 2015). Patients may develop hypopharyngeal strictures that may require dilation or surgery (Caudell et al., 2009). Xerostomia and dysguesia withstanding, the majority of these side effects are short-term and resolve within a few months after radiation ends.

The long-term effects of IMRT in the oropharyngeal cavity include osteoradionecrosis (bone death), trismus, fibrosis, muscle wasting, and xerostomia (Caudell et al., 2009; Pauloski, Rademaker, Logemann, Discekici-Harris, & Mittal, 2015; Russi et al., 2012).

The fibrotic effects of radiation can last for years after treatment ends and can have permanent effects on oropharyngeal range of motion including hyolaryngeal trajectory, and movement of the tongue and lips. Hyolaryngeal elevation is a critical component of swallow function as it serves to protect the airway and lungs from aspiration. In addtion to its impact on swallow safety, its impairment may lead to reduced upper esophageal sphincter (UES) opening, which impacts the ability of food to efficiently pass into the esophagus.

The cumulative impact of the various side effects from radiation can have dismal consequences on swallowing and nutrition. Xerostomia can increase the build up of bacteria and plaque, and accelerate decay in the oral cavity. Fibrosis reduces swallow efficiency by reducing driving pressure, and increasing residue, which serve to increase the risk of penetration and aspiration. In the presence of xerostomia and fibrosis, microaspiration of bacteria-laden food or liquid can increase the risk of aspiration pneumonia, a prevalent event in this population that may have severe negative consequences on their health and recovery.

Radiation results in damage to the oropharyngeal structures. This can result in pain occuring at the site of the delicate oropharyngeal tissue and damage to taste receptors. Thus in addition to the effects of xerostomia and fibrosis as noted above, a patient may also experience a distortion of loss of taste (dysguesia) and pain (odynophagia) with chewing and swallowing. These combined effects of radiation can result in severe swallow deficits in patients with HNCa. In light of reduced taste and swallow function, if not addressed, weight loss is often inevitable. Additonally, if chemotherapy is used adjunctively the patients may experience nausea and loss of appetite, which further compounds and complicates their ability to maintain a healthy weight. As noted above, these side effects may be alleviated with the use of feeding tubes. However, currently there is no global standard of care for the use of feeding tubes as an adjunctive therapy for patients being treated for HNCa. Instead, the decision to utilize a feeding tube may be left to individual physicians with input from patients and families. While patients are often advised that the placement of a feeding tube can help to alleviate some of the complications that may arise from the malnutrition that occurs as a result of the side effects of the HNCa and its treatment, many opt not to receive this care.

The negative effects of treatment for HNCa extend to quality of life and have been documented in the literature. HNCa and its treatment can affect both disease-specific health-related quality of life (e.g. salivary and swallow functions), and the more general domains of health-related quality of life, such as physical, mental, and social health, (Langendijk et al., 2008). Several studies report that patients who experience dysphagia from treatment for HNCa also experience increased rates of anxiety and depression (Hassan & Weymuller, 1993; Stringer, 1999; Zigmond & Snaith, 1983). Cultures worldwide center social interactions around mealtimes, and the treatment sequelea that arises secondary to the treatment of HNCa often impairs an individuals ability to fully participate in these important family and community events. This may lead to social isolation, depression, and feelings of loneliness, and further impact the consequences of the cancer diagnosis and the subsequent treatment side effects.

The aim of this paper is to explore the impact of prophylactic PEG placement and swallow exercises on swallow function, weight and quality of life in patients who receive radioation as part of their treatment of HNCa.

Chapter 2

Literature Review

Head and Neck Cancer

The National Cancer Institute (2017a) defines HNCa as, "squamous cells that line the moist, mucosal surfaces inside the head and neck." This can be further divided by location: oral cavity, pharynx, larynx, paranasal sinuses and nasal cavity, and salivary glands. There are a number of risk factors for HNCa, which include tobacco and alcohol use, poor oral hygiene, occupational exposures to toxic chemicals, and radiation exposure (National Cancer Institute, 2017). Although non-specific, the most common early symptoms of HNCa include a "lump" in the throat, complaints of a chronic sore throat, difficulty swallowing, and a change in vocal quality (hoarseness). Specific to the oral cavity, patients may report red or white patchiness, swelling of the jaw, or unusual bleeding of the gums (National Cancer Institute, 2017). Symptoms specific to the pharyngeal cavity may include problems breathing or speaking, odynophagia, frequent headaches, tinnitus, and/or difficulty hearing (National Cancer Institute, 2017). In the larynx, the primary symptom is odynophagia.

Radiation

Current standard of care for the treatment of HNCa typically includes all conventionally fractionated radio-therapy that delivers total doses of 66-70 Gy over a course of 6-8 weeks (Numico et al., 2006; Nuyts et al., 2009; Russi et al., 2012). Altered fractionation schedules, as well as concomitant chemotherapy, may significantly improve tumor response to treatment. Unfortunately, altered fractionated radio-therapy with concomitant chemotherapy has been shown to increase toxicity rates and to have a potentially detrimental effect on patient prognosis unless adequate supportive care is provided.

Effects of radiation on swallow function. Patients with HNCa who receive radiation as part of their treatment often report a myriad of dysphagia symptoms secondary to their treatment sequalea such as: fibrosis, xerostomia, dysguesia, and odynophagia (Rosenthal, Lewin, & Eisbruch, 2006).

The main late stage effect of radiation on swallow function stems from the resulting fibrosis (Russi et al., 2012). Fibrosis of the oropharyngeal structures can cause atrophy of the tongue, vocal cord palsy, velopharyngeal incompetence, and poor pharyngeal constriction (Lazarus et al., 2007; Wu, Ko, Hsiao, & Hsu, 2000). The physiological implication of these effects include reduced tongue base contraction to the posterior pharyngeal wall, reduced hyolaryngeal elevation, reduced closure of the laryngeal vestibule, prolonged oral transit times, and incoordination of overall swallow function. These physiological impairments all lead to reduced propulsive forces and increased residue, which may result in penetration and/or aspiration after the swallow (Jensen, Lambertsen, & Grau, 2007).

Although radiation is often part of the treatment protocol, there are confounding variables or concurrent treatments that may increase the effect of radiation on swallow function. Confounding variables that increase the impact of radiation on swallow function include smoking status during and after treatment, advanced age, the radiation dose administered, multiple treatment techniques, weight loss, and site and size of the primary tumor location may increase the impact of radiation-therapy on swallow function (Langendijk et al., 2009; Taylor, Mendenhall, & Lavey, 1992). When radiation is combined with surgery there is an increase of negative effects which include decreased oropharyngeal swallow efficiency, and a shorter duration of cricopharyngeal opening (Pauloski & Logemann, 2000). When radiation is combined with chemotherapy the effects of the chemotherapy medication add a layer of acute dysphagia and malnutrition secondary to the side effects of nausea, vomiting, risk of infection, and fatigue (Russi et al., 2012).

Effects of radiation on weight and nutrition. Patients with HNCa who receive radiation as part of their treatment often experience acute weight loss during and after treatment (Ottosson, Zackrisson, Kjellén, Nilsson, & Laurell, 2013). The prevalence of malnutrition in HNCa ranges from 20 – 67% according to van Bokhorst-de van der Schueren et al. (1997). One possible explanation is the treatment sequelea of radiation, which causes xerostomia, dysguesia, dysphagia, and leads to reduced oral intake. This acute weight loss may also be caused by the location of the tumor itself, especially if the tumor is occupying a large amount of space in the pharynx. The tumor can cause an obstruction, and the bolus may be unable to pass through the pharyngeal cavity. Additionally, weight loss may be the negative effects of radiation on metabolism, which may reduce a person's appetite, and strength (Chasen & Bhargava, 2009). Acute and critical weight loss has been reported to reduce the rates of disease-specific survival, patient reports of functional performance, and quality of life (Langius et al., 2013).

Use of swallow exercises during radiation. A variety of strategies exist for treating dysphagia after radiation for HNCa. These include postural adjustments, diet modifications, range-of-motion exercises, and the strengthening of the pharyngeal and suprahyoid musculature (Peng et al., 2015). Recent strategies have focused on early intervention (starting a swallow preservation protocol before the start of radiation) to improve both the acute and long-term effects of radiation on the affected musculature (Rosenthal et al., 2006). A typical swallowing preservation protocol is taught to the individual before the onset of treatment and includes swallowing, jaw, and tongue exercises. These exercises vary depending on the location of the tumor, the area that will be irradiated, and the anticipated post radiation deficits. According to Murphy & Gilbert (2009), exercises are to be preformed three times a day for 10 repetitions, and are recommended until the patient reaches the goal of 1-year post treatment status.

Some of the exercises used with this clinical population include jaw exercises in which the jaw is opened and stretched both laterally and horizontally. Tongue exercises consist of forced contraction of the tongue against the anterior hard palate, as well as forced contraction anteriorly, and side to side. These first types of exercises assist in maintaining the suppleness and mobility of the muscles in order to combat the fibrosis that occurs post radiation (Kotz et al., 2012). The second group of exercises are restorative in nature and include the Shaker, Mendelsohn maneuver, the Masako, and effortful swallow. These exercises specifically target the physiological structures necessary for swallowing, and assist the patient in maintaining and regaining swallow function post radiation (Kotz et al., 2012).

As with any strength training rehabilitation program, compliance with the exercise regimen is critical. Duarte, Chhetri, Liu, Erman, & Wang, (2013) reported that 54% of patients who were compliant with the swallow preservation protocol were back to a regular diet 1-month post discontinuation of the protocol. This is compared to participants who were judged non-compliant, of which only 21% were back to a regular diet 1-month post discontinuation of the swallow protocol. They also found a higher incidence of pharyngeal stenosis in the non-compliant group (Duarte et al., 2013). A study done by Peng et al. (2015) found worse functional swallow outcomes in the non-compliant patient group versus the compliant patient group.

Prophylactic use of Enteral Feeding for HNCa in the GI Community

Enteral feeding tubes are commonly placed in a variety of clinical situations in which patients are failing to get adequate nutrition through traditional oral methods. One common type of an enteral feeding tube that is used are naso feeding tubes, which are tubes that are inserted through the nose and travel through the esophagus to the stomach (nasogastric tube), and in some cases to the small intestine (nasojejunal tube) (Feeding Tube Awareness Foundation, 2016a). The other type of enteral feeding tube that is commonly used is a percutaneous endoscopic feeding tube. These tubes are more common in patients who require more long term feeding tube placement, as they are inserted through the skin on the abdomen directly into the stomach (gastrostomy tube) or to the small intestine (jejunostomy tube) (Feeding Tube Awareness Foundation, 2016b). This clinical intervention may be used with a variety of patient populations and include patients with neurological disorders such as ALS, gastrointestinal disorders such as gastroparesis, and HNCas which make the oral and pharyngeal phase of swallowing difficult and painful.

PEG tubes are primarily used in the HNCa population in anticipation of several clinical concerns that commonly arise in this population. As discussed previously, the effects of high dose radiation, and chemoradiation include acute and chronic mucositis. When this is combined with the effects of surgery, xerostomia, and tumor-related anorexia patients are at a high risk for acute complications and nutritional deterioration. Severe dehydration and malnutrition may lead to unplanned treatment breaks or hospitalizations that have a detrimental impact on treatment efficacy and may lead to recurrence of the tumor, or an incomplete response of the tumor to treatment.

Research has shown that patients with HNCa who are receiving multimodal treatments (ie accelerated radiation therapy, or chemoradiation), may benefit from the placement of prophylactic PEG tubes. Studies by Lee et al. (1998); Madhoun, Blankenship, Blankenship, Krempl, & Tierney (2011); Scolapio, Spangler, Romano, McLaughlin, & Salassa (2001) all found that the use of prophylactic gastronomy tubes significantly reduce weight loss, the frequency and rate of hospitalization for dehydration and complications of mucositis, and further reduce the incidence of treatment interruptions. A study by Senft, Fietkau, Iro, Sailer, & Sauer (1993) showed that quality of life, body weight, prealbumin levels, and tricep skin fold measurements remained constant in patients with prophylactic gastronomy tubes and declined significantly for patients who only took their nutrition orally.

Overall Validity of Quality of Life Measures in HNCa

In the past decade quality of life (QOL) measures and how they can be used as clinical tools have gained more and more attention in the literature. Research using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core-30 (EORTC-30), and the Quality of Life Questionnaire HNCa Module (QLQH&NC) showed dry mouth and sticky saliva to be two of the greatest factors impacting patients (Abendstein et al., 2005; Chaukar et al., 2009; de Graeff et al., 2000). A study done by Osthus, Aarstad, Olofsson, & Aarstad (2011) found that the results of the EORTC-30 and the QLQHN&C were all positively correlated with survival. Their study also found that the sum scores of the health-related QOL questionnaire was a strong predictor of survival and was independent of self-reported levels of neuroticism, avoidance focused coping, coping by suppression of competing activity, alcohol consumption, smoking, heart and lung disease, as well as gender, age, and the time between diagnosis and subsequent inclusion in the study. Furthermore, a study conducted by Sherman & Simonton (2010) that looked at the significant developments in QOL research between 2000-2010, found that the use of standardized QOL measures and criteria have been established to define effects that are clinically significant as opposed to statistically significant. Overall, much of the research literature done in QOL measures has shown that the measures can serve as prognostic indicators for our patients, and they can even help guide us in our choices of treatment planning and modalities.

Chapter 3

Methods

Participants

The Institutional Review Boards (IRB) at both the Raymond G. Murphy Veteran Affairs Medical Center (VAMC), and at the University of New Mexico approved this research project. This study was conducted retrospectively using the medical records database available at the Albuquerque VAMC from the years 2015 - 2017. The inclusion criteria for the search included a minimum of three completed University of Washington Quality of Life Questionnaires (UW-QOL), a diagnosis of squamous cell carcinoma of the head and neck that necessitated intervention from a speech-language pathologist, the use of radiation as a treatment strategy, and the use or absence of a prophylactic feeding tube. Initially, 35 patients were identified as having a minimum of three UW-QOL forms. However, due to the exclusion criteria, which included the placement of an emergent PEG mid-way through treatment, or if patient records were marked as *SENSITIVE*, 10 patients were dropped from the study. Of the 25 patients identified that matched these criteria 14 fell into the PEG group. Some participants had not yet reached their 2 year mark at the end of the study time, and therefore, do not have data for all time periods. See Table 1 for a detailed description of participants per time point in the time series data.

Table 1

N Values Per Time Point

Time Point	Available Patients for PEG Group	Available Patients for NoPEG Group
Start of Radiation	14	11
End of Radiation	14	11
3 Months Post Radiation	14	11
6 Months Post Radiation	13	10
12 Months Post Radiation	11	7
24 Months Post Radiation	8	1

Of the 25 patients, 23 of them were male, and they had a mean age of 64.84, which is representative of the population treated at VAMC's nationwide. Cancer diagnosis included Oropharynx (48%), Larynx (40%), Oral (4%), and Hypopharynx (8%). Patients received between 60-70Gy of radiation, delivered over an average of 31 days. 72% of all patients received chemotherapy. The preferred chemotherapy was Cisplatin, however, if patients suffered renal complications during treatment or had pre-existing renal injuries they were treated with Cetuximab. Eight of the 25 patients continued to smoke during the course of treatment. Nine of the 25 patients had p16 positive cancer cells in conjunction with the diagnosis of squamous cell carcinoma. Table 2 provides a comprehensive view of patient demographics in this study.

Table 2

Patient Demographics

Patient ID	Sex	Age at Diagnosis	Cancer Location	Cancer Stage	Treatment Modality	PEG Status	PEG Duration
P01	Male	68	Oropharynx	IVA	Chemoradiation	PEG	14 mos
P02	Female	61	Larynx	III	Chemoradiation	PEG	3 mos
P03	Male	65	Oropharynx	III	Chemoradiation	PEG	8 mos
P04	Male	65	Oropharynx	0	Chemoradiation	PEG	5 mos
P07	Male	63	Oropharynx	III	Chemoradiation	PEG	5 mos
P08	Male	68	Oropharynx	IVA	Chemoradiation	No PEG	
P09	Male	89	Larynx	I	Radiation	No PEG	
P10	Male	64	Oropharynx	III	Chemoradiation	No PEG	
P11	Male	44	Oropharynx	III	Chemoradiation	PEG	Permanent
P12	Female	64	Larynx	IVB	Chemoradiation	PEG	3 mos
P14	Male	61	Oropharynx	III	Chemoradiation	PEG	3 mos
P15	Male	54	Oropharynx	III	Chemoradiation	PEG	3 mos
P17	Male	66	Oral	IVA	Radiation	No PEG	
P21	Male	67	Oropharynx	IVA	Chemoradiation	PEG	3 mos
P22	Male	52	Oropharynx	III	Chemoradiation	PEG	3 mos

P24	Male	63	Larynx	IVA	Chemoradiation	PEG	3 mos
P26	Male	57	Hypopharynx	IVA	Chemoradiation	No PEG	
P27	Male	65	Larynx	I	Radiation	No PEG	
P28	Male	65	Larynx	IVA	Chemoradiation	PEG	8 mos
P29	Male	78	Larynx	I	Radiation	No PEG	
P30	Male	66	Larynx	II	Radiation	No PEG	
P32	Male	72	Larynx	I	Radiation	No PEG	
P33	Male	68	Larynx	II	Radiation	No PEG	
P34	Male	61	Hypopharynx	IVA	Chemoradiation	No PEG	
P35	Male	75	Oropharynx	IVA	Chemoradiation	PEG	5 mos

Data Collection

All data were collected by reviewing patient medical records, and completed UW-QOL questionnaires available at the VAMC. Patients were selected on the basis of the completion of a minimum of three completed UW-QOL (with a minimum of one completed immediately before or after the completion of treatment). Once this criterion was met medical records were reviewed and the following data points were extracted: weight, UW-QOL scores, swallow exercise compliance, and swallow function.

Weight. Patient weight was pulled from the patient medical records at the following time points: 1 year prior to diagnosis, at the time of diagnosis, at the beginning of radiation, at the end of radiation, 3 months post radiation, 6 months post radiation, 12 months post radiation, and 24 months post radiation. Due to the consistent collection of weight across clinics in the VAMC all data points for each patient were collected (two patients did not have baseline weights available, and were excluded from the baseline weight data analysis). The weight at 1 year prior to diagnosis was defined as the baseline weight, and the lowest recorded weight after the start of radiation was defined as the nadir weight. All weight was normalized by setting the baseline weight for each person equal to 100% and making each weight measurement thereafter a percentage of their baseline for each time point.

University of Washington Quality of Life Questionnaires. The UW-QOL is a validated and reliable questionnaire that was constructed for use in the HNCa population (Hassan & Weymuller, 1993). There are four advantages to using the UW-QOL questionnaire: (1) it is brief and self-administered, (2) it is multi-factorial, (3) it provides questions specific to HNCa, (4) it allows no input from the health care provider (Hassan & Weymuller, 1993). The questionnaire has the patient rate 12 different domains (pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder, taste, saliva, mood, and anxiety), and they are ranked on a scale of 0 (worst) to 100 (best). Once the patient has completed the questionnaire the scores are broken up into three main effects; a physical function score, a social-emotional score, and a composite quality of life score. The physical function score is calculated by averaging the scores from the domains of appearance, swallowing, chewing, speech, taste, and saliva. The social function score is calculated by averaging the scores from the domains of pain, activity, recreation, shoulder, mood, and anxiety. The composite score is the average of all of the domains.

Additionally, patients are asked to identify their top three concerns from the past seven days from a list of 12 possible concerns. These include pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder, taste, saliva, mood, and anxiety.

UW-QOL scores were pulled for the following time points for all patients as available: before the start of radiation, at the end of radiation, 3 months post radiation, 6 months post radiation, 12 months post radiation, and 24 months post radiation. For UW-QOL scores to be included in this investigation, forms had to be completed within one month of the decided time point. If no UW-QOL scores were available for a specific time point the data cell was left empty. See Table 3 for a detailed look at available UW-QOL per patient.

Table 3

Available UW-QOL per Patient

Patient ID	Time 1	Time 2	Time 3	Time 4	Time 5	Time 6
P01	X	X	X	X	X	X
P02	X	X	X	X	X	X
P03	X	X	X		X	X
P04	X	X			X	
P07		X	X	X	X	X
P08	X	X	X	X	X	
P09	X	X	X		X	

P10		X	X	X	X	X
P11	X	X		X	X	X
P12	X	X	X	X	X	X
P14	X	X	X	X	X	X
P15	X	X		X	X	X
P17	X	X		X	X	
P21		X	X	X	X	X
P22	X	X	X	X	X	X
P24	X	X	X	X		
P26		X	X	X	X	
P27	X	X			X	
P28		X	X	X		
P29		X	X	X		
P30	X	X	X	X		
P32	X	X	X			
P33	X	X	X			
P34	X	X		X		
P35	X	X	X			

Swallow function. Swallow function was determined from information gathered through patient report, clinical swallow examinations, and modified barium swallow studies. All qualitative data that were collected were then turned into two different scores: a swallow function composite score, and a swallow exercise compliance score. The swallow function score was based on the National Cancer Institute's Common Terminology Criteria for Adverse Events v5.0 (CTCAE v5.0), which rates dysphagia severity (Table 4).

This CTCAE dysphagia scale was modified as noted in Table 5 to include diet modification, and signs and symptoms of penetration/aspiration, in order to compose a more sensitive scale that fit the qualitative, retrospective nature of this study.

Table 4

National Cancer Institute Common Terminology Criteria for Adverse Events v5.0

CTCAE Term	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Dysphagia	Symptomatic, able to eat regular diet	Symptomatic, and altered eating/ swallowing	Severely altered eating/ swallowing; tube feeding, TPN, or hospitalization indicated	Life threatening consequences; urgent intervention indicated	Death

Table 5

Swallow Function Rating Scale

Component	Score of 0	Score of 1	Score of 2	Score of 3	Score of 4
CTCAE Term	Asymptomatic, no diet modifications	Symptomatic, able to eat regular diet	Symptomatic, and altered eating/ swallowing	Severely altered eating/ swallowing; tube feeding, or hospitalization indicated	Life threatening consequences; urgent intervention indicated
IDDSI Score	7	7	6 or lower	4 or lower	PEG tube dependent for all nutrition
Nutrition Intake Method	PO only	PO only	No more than minimal intake from a PEG	Supplemental PEG feedings, limited PO intake	100% of nutrition from PEG feedings
Signs and Symptoms of Penetration/ Aspiration	Age appropriate swallow function	No more than 1 sign/ symptom of penetration/ aspiration	2 or more signs/ symptoms of penetration/ aspiration	2 or more signs/ symptoms and the inclusion compensatory strategies	

Each patient's medical record was reviewed at the following time points for swallow function: pre-radiation, end of radiation, 3 months post radiation, 6 months post radiation, 12 months post radiation, and at 24 months post radiation. The qualitative data recorded at the time of the appointment was cross-referenced for the above criteria, and a score ranging from 0-4 was assigned for swallow function at each time point. If there was no appointment scheduled within one month of the scheduled time point, no data was recorded for that time point and the data cell was left blank.

Swallow exercise compliance was established through patient report of compliance, the patient's ability to demonstrate the exercises accurately, and clinical documentation of patient's progress in the treatment. It was typical for the attending speech-language pathologist to document at the end of each note if the patient was still receiving the swallow exercise protocol, and indicate their level of compliance with the terms: MET, NOT MET, or IN PROGRESS. As with the swallow function scores each patient's medical record was reviewed at the following time points: pre-radiation, end of radiation, 3 months post radiation, 6 months post radiation, 12 months post radiation, and at 24 months post radiation. If there was no appointment scheduled within one month of the scheduled time point, no data was recorded for that time point and the data cell was left blank. The scale shown in Table 6 was used to determine the patient's level of compliance to the exercises.

Table 6

Swallow Exercise Compliance Ratings

Score	Definition
0	Patient has not received exercise training, or the compliance is unknown
1	Patient has received swallow exercise protocol and training but is non-compliant
2	Patient has received swallow exercise protocol and training; is only intermittently or inconsistently compliant (minimal compliance)
3	Patient has received swallow exercise protocol and training; is fairly consistent in compliance, with minimal modifications due to treatment sequelea
4	Patient has received swallow exercise protocol and training; very consistent and compliant despite treatment sequelea

Data Analysis

Data points were entered into an excel spreadsheet and transported into a statistics package (Statistical Analysis Software 9.2) for analysis. Descriptive statistics were used to describe patient characteristics for the various groups evaluated (eg., PEG vs. NoPEG, low vs. high exercise compliance. T-tests were used to compare the continuous descriptive variables: baseline weight, age at time of diagnosis, amount of radiation greys received, and gender. The Satterthwaite method for unequal variances was employed to correct the degrees of freedom for the imbalance in standard deviations to allow for more accurate analysis. Fisher exact test was employed to compare group data for the binary and categorical variables: gender, cancer location, cancer staging (NCCN, v.2.2017), presence of p16 marker, pretreatment surgery, addition of chemotherapy, smoking during treatment, and alcohol use during treatment.

Repeated measures analysis of variance was employed to evaluate the time series data. The data were grouped by several variables including: presence or absence of PEG, compliance with swallow exercises, stage of cancer, and location of cancer. Outcomes evaluated included the quality of life physical function and social function scores, level of swallow exercise compliance, status of swallow function, and weight. Statistical significance was judged by group effect, and across time points. Across all analyses a p-value of less than .05 was considered significant.

Chapter Four

Results

Comparisons Between PEG and NoPEG Groups

All participants were sorted into two groups: one group that did not receive a PEG, and a group that received their PEG prophylactically at the beginning of treatment. As demonstrated in Table 7 across the two groups, baseline weight and age did not vary statistically [weight: $t(19)=1.17$, $p=0.26$; age: $t(20)=1.99$, $p=0.06$] respectively. Baseline weights were not available for two participants in the PEG group. Baseline weight in the NoPEG group ranged from 152 to 238 with a mean weight of 202.9, and from 121 to 254 with a mean weight of 184.9 in the PEG group. Two of the participants in the PEG group were female, who are normally associated with lower weights and impacted the mean and standard deviations of this group. Age in the NoPEG group ranged from 57 to 89 with a mean age of 68.5, and in the PEG group from 57 to 89 with a mean age of 61.9. Across the two groups the amount of radiation greys received did not vary statistically [$t(14)=-1.92$, $p=.07$]. Radiation greys for the NoPEG group ranged from 60Gy – 70Gy with a mean dosage of 65.09. Radiation greys for the PEG group ranged from 66Gy – 70Gy with a mean dosage of 67.35.

Table 7

Continuous Variable Outcomes for Peg vs. NoPEG groups

	No PEG		PEG		
Variable	*n*	Mean (SD)	*n*	Mean (SD)	*p values*
Weight	11	202.9 (28.65)	12	184.9 (44.24)	.26
Age	11	68.5 (8.7)	14	61.9 (7.6)	.06
Grey	11	65.1 (3.5)	14	67.4 (1.9)	.07

The two groups were compared categorically using Fisher's exact test across the following variables: sex, cancer location, staging, presence of HPV markers, surgery prior to radiation, adjunctive chemotherapy, and continued alcohol and nicotine intake as seen in Table 8. Of these variables, sex (p=.49) presence of HPV (p=.68), surgery prior to treatment (p=1.0), and continued alcohol and nicotine intake did not vary statistically (p=.29; p=1.0, respectively). Across the two groups the following variables did vary statistically: cancer location (p=.02), cancer staging (NCCN v.2.2017) (p=.01), and adjunctive chemotherapy (p>.01).

Table 8

PEG Vs. NoPEG Group Characteristics

Variable	PEG *(n=14)*	NoPEG *(n=11)*
Sex		
Male	12	11
Cancer Location		
Oral	0	1
Oropharynx	10	2
Hypopharynx	0	2
Larynx	4	6
Cancer Stage (NCCN, V2.2017)		
0	1	0
I	0	4
II	0	2
III	7	1
IVa	5	4
IVb	1	0
HPV marker	6	3
Preradiation surgery	5	4
Adjunctive chemotherapy	14	4
Alcohol Use	1	3
Nicotine Use	5	3

Outcomes of PEG and NoPEG Groups

Repeated measures analysis of variance (ANOVA) was employed to analyze the time series outcome measures of this study. There was no interaction effect between the two groups for weight. There was no main effect of weight between the two groups, [$F (1, 21) = .16, p = .7$]. There was a month-to-month interaction for weight, [$F (6, 109) = 4.81, p > .05$)]. Both groups lost approximately 5% of body weight from baseline to the onset of radiation. During the two-month course of radiation treatment the NoPEG group lost 4% more of their weight, which resulted in a 9% overall weight loss at the end of treatment. The PEG group lost 10% of their weight over the course of radiation treatment, leading to a 15% overall weight loss at the end of treatment. At three months post treatment the PEG group was already recovering nutritionally and, had returned to 97% of their baseline weight within a year. The NoPEG group continued to lose weight until the three-month post treatment mark. This weight stabilized for the NoPEG group until about one year post treatment, and did not recover to near baseline weight until two years post treatment. Figure 1 displays the normalized weights across time for the two groups.

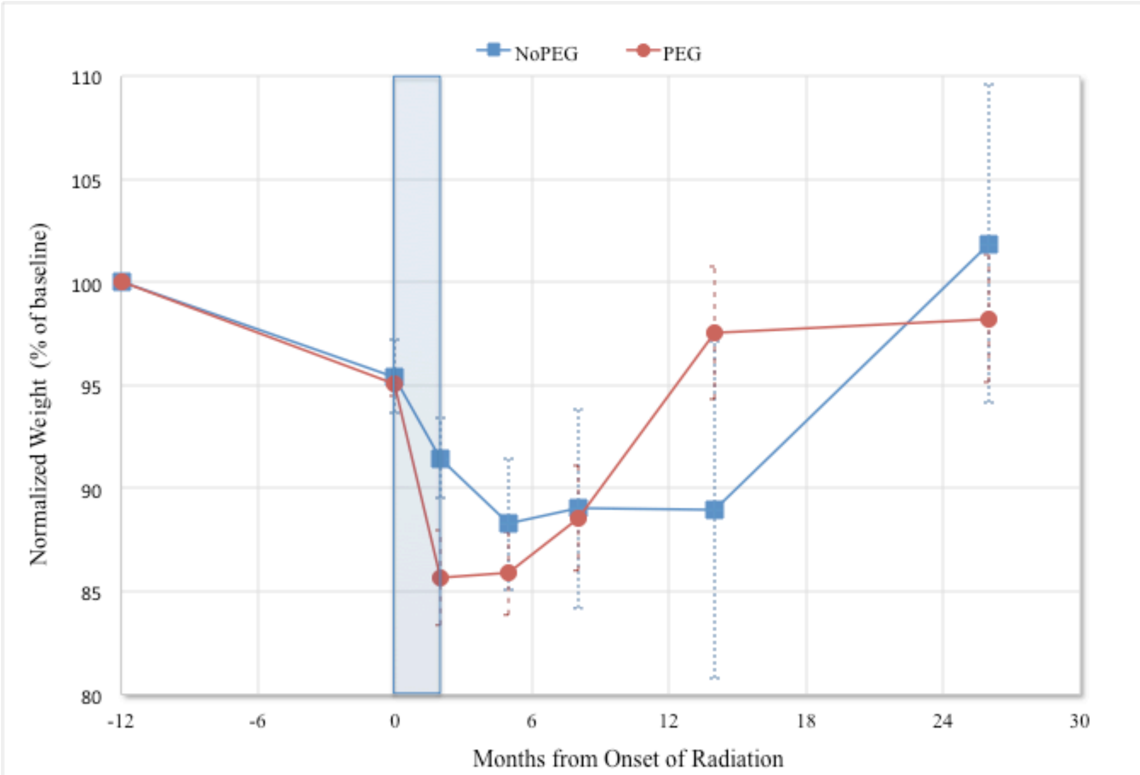

Figure 1. Average normalized weight (± SE) for PEG vs. NoPEG group across time. The shaded bar indicates the period of time that patients received radiation.

Figure 2 displays the average swallow exercise compliance for the PEG versus NoPEG groups. There was no interaction effect (p=0.91) between the two groups for swallow exercise compliance. For swallow exercise compliance there was a main effect between the two groups, [F (1, 23) = 11.93, p < .05] and no month-to-month effect [F (4, 70) = .14, p = .97]. While neither group had perfect compliance (score of 4), on average the PEG group had greater swallow exercise compliance (mean =2.14, SD=0.87), whereas the no PEG group had an average swallow exercise compliance score of 1.52 (SD=1.07).

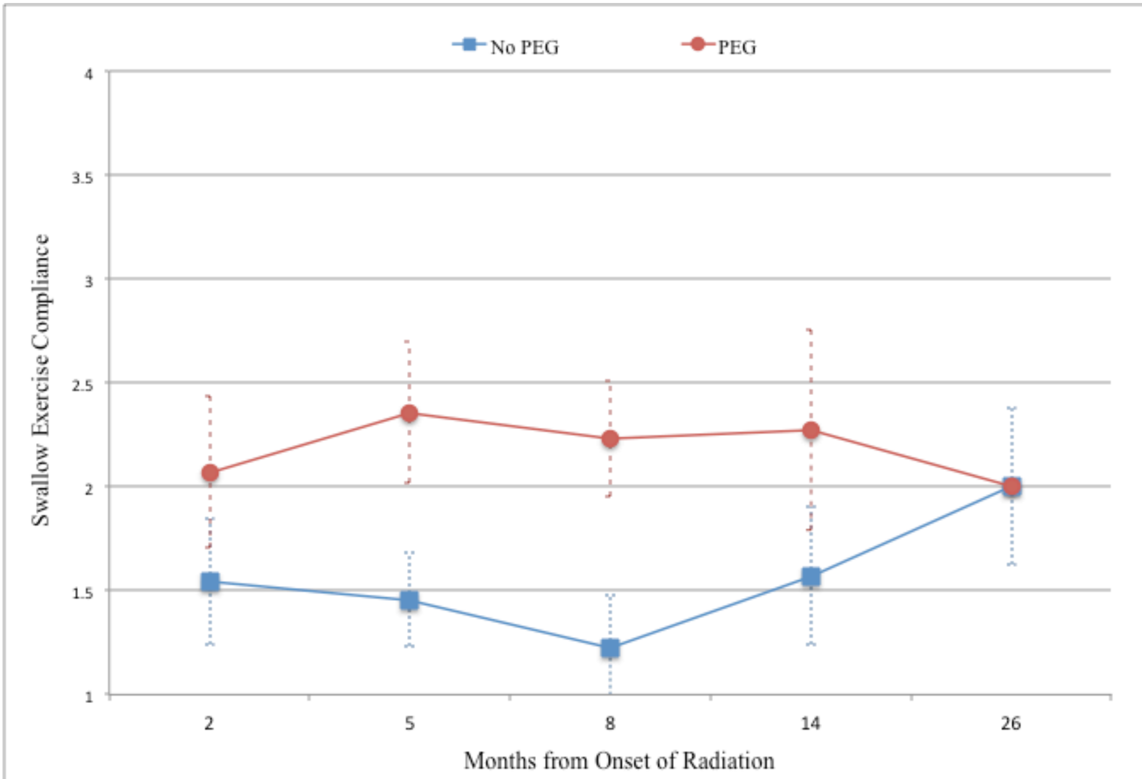

Figure 2. PEG vs. NoPEG swallow exercise compliance across time (± SE).

For the overall swallow function score there was no interaction effect (p=0.97) between the two groups for swallow function. Two patients from the NoPEG group were omitted from this analysis, as their cancer location and staging combined with their treatment course did not warrant the introduction of swallow exercises. A main effect between the two groups was found [F (1, 23) = 17.53, p < .05]. There was also a month-to-month interaction [F (5, 91) = 5.83, p < .05]. The NoPEG group consistently had better swallow function than the PEG group. The NoPEG group returned to an unimpaired swallow function by the two-year mark, while the PEG group still required minimal diet modifications, and had continued impairment to their overall swallow function.

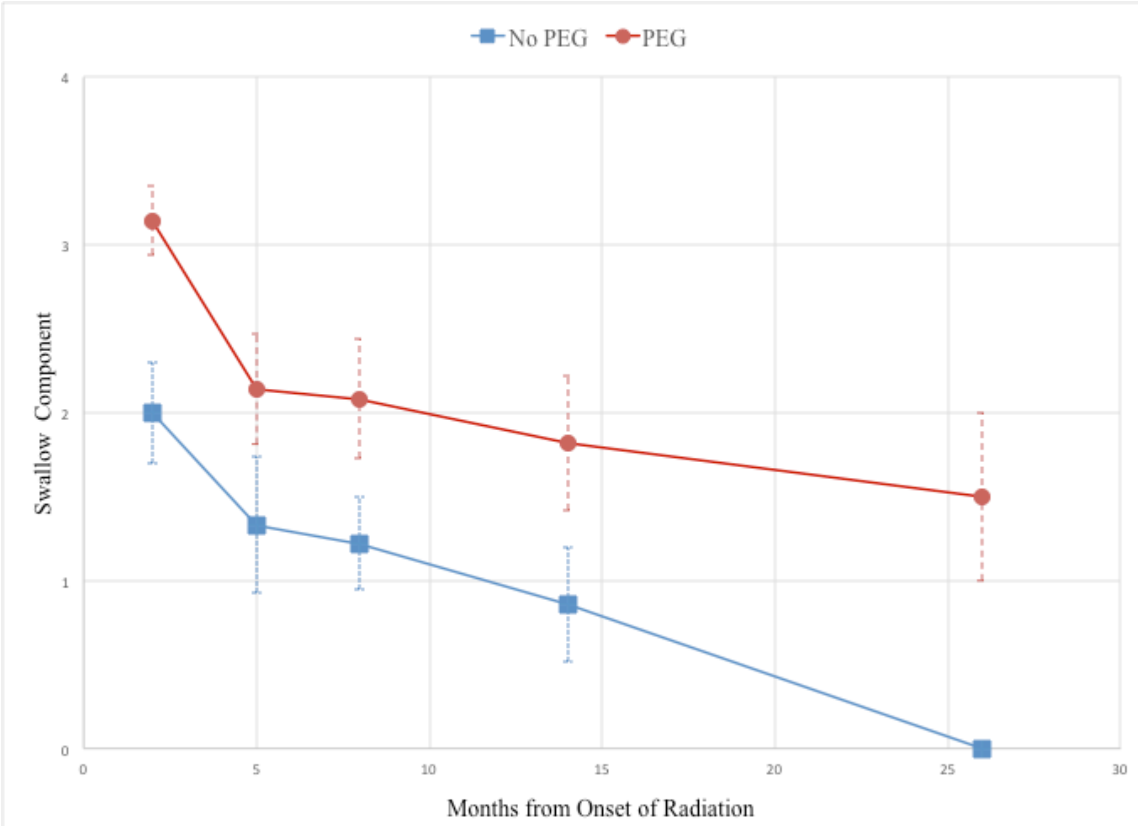

Figure 3. PEG vs. NoPEG swallow function scores across time (± SE).

Quality of life scores for physical functioning and social functioning were measured as a percent of max scores and averaged across the groups. For quality of life physical functioning scores, Figure 4, there was no main effect, [F (1, 23) = 3.82, p = .06]. There was a month-to-month interaction between groups [F (5, 74) = 5.34, p > .05]. By the end of treatment both the PEG and the NoPEG group had a score of 58% for physical function. While the trajectory of the scores mirror each other over time, the NoPEG groups physical function scores are consistently 12 percentage points higher. For quality of life social functioning scores, Figure 5, there was no main effect, [F (1, 23) = 1.49, p = .23]. There was a month-to-month interaction between groups [F (5, 74) = 2.58, p = .03]. Both the PEG and NoPEG group's social function scores improve during treatment and continue to improve after treatment at about the same rate. The PEG group has higher social function scores throughout with the biggest difference being at 3 months post treatment (9% higher).

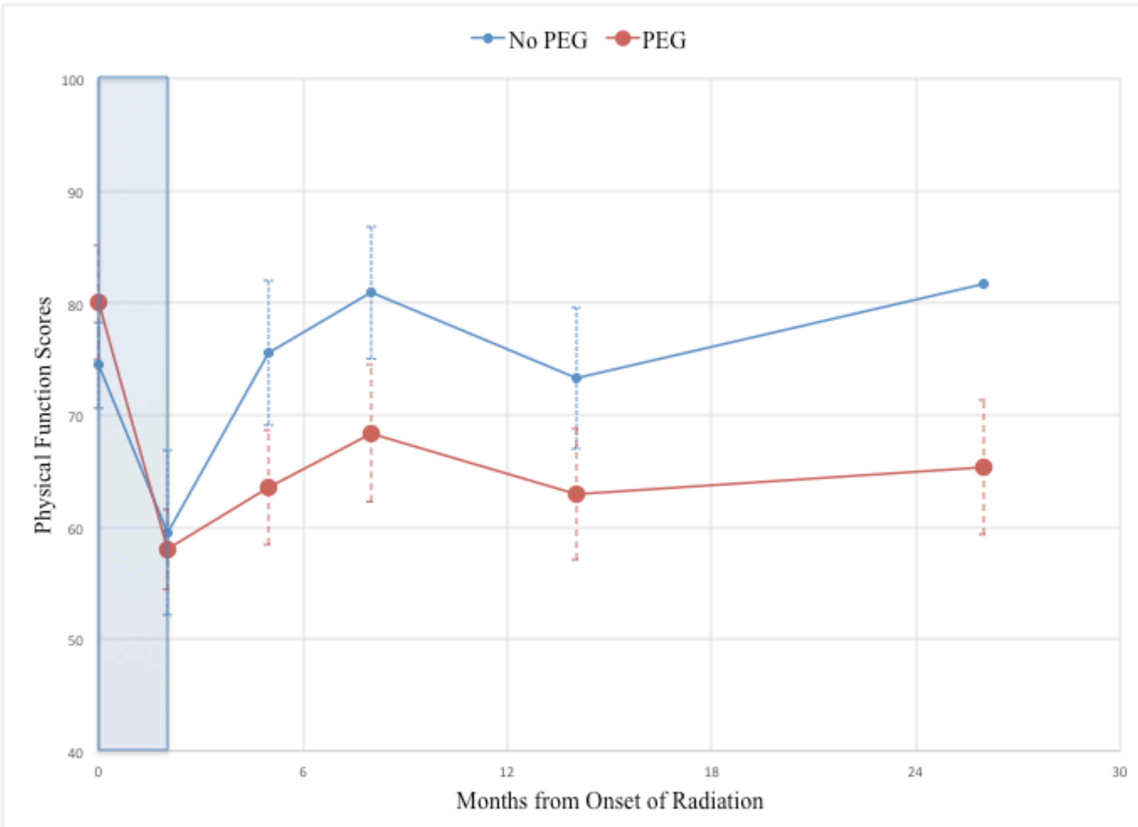

Figure 4. PEG vs. NoPEG quality of life physical function scores over time (± SE). All scores were derived from the UW-QOL questionnaire. The shaded bar indicates the period of time that patients received radiation.

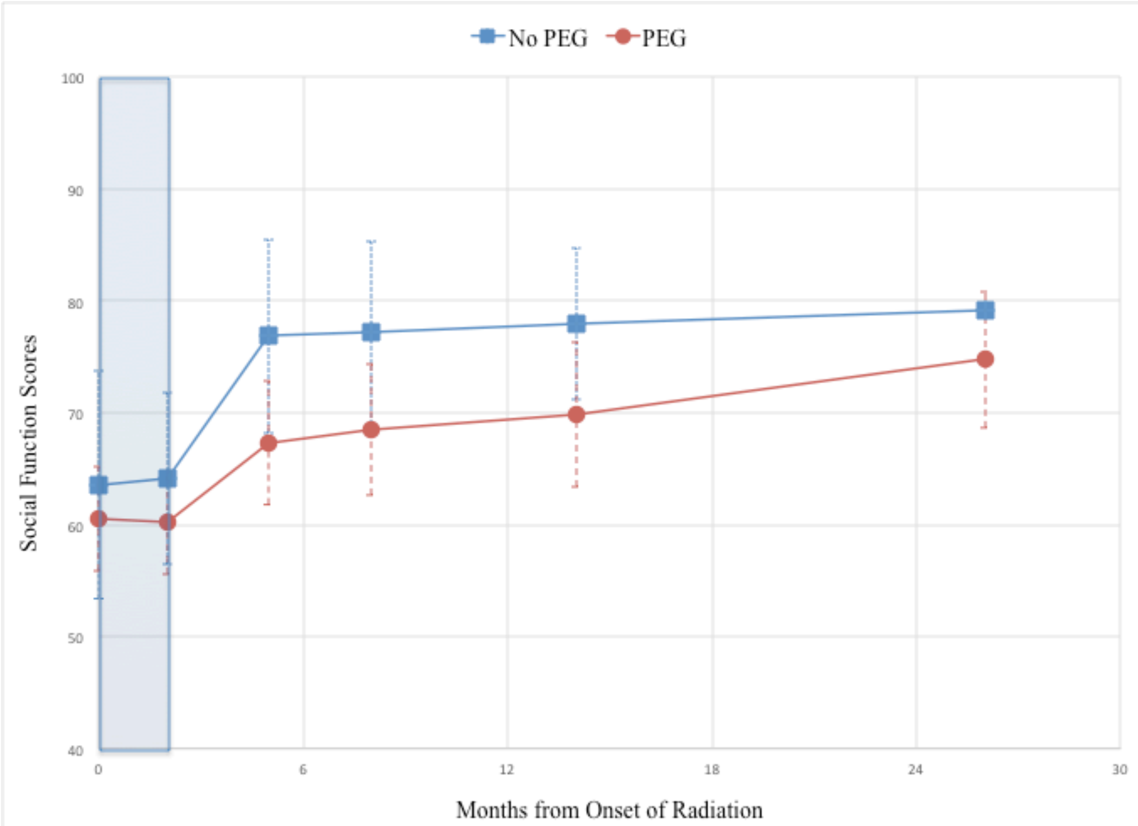

Figure 5. PEG vs. NoPEG quality of life social function scores across time (± SE). All scores were derived from the UW-QOL questionnaire. The shaded bar indicates the period of time that patients received radiation.

Chapter Five

Discussion

The purpose of this thesis was to investigate the advantages of prophylactic PEG tube placement in patients with HNCa who received radiation as part of their treatment. It explored the effects of PEG tubes on (a) weight changes, (b) swallow exercise compliance, (c) swallow function, and (d) quality of life, from the onset of radiation until 2 years post treatment.

Weight

For the purposes of this investigation baseline weight was found in the patient chart one year prior to the time of diagnosis. This baseline weight was calculated to be equal to 100%, and each weight time point was a percentage of that baseline. This was done to better compare the two groups without bias to size.

In this investigation both the PEG group and the NoPEG group experienced a loss in weight before the start of treatment. On average, both groups lost about 5% of their baseline weight before the start of radiation. Across all 25 individuals included in the study 11 (44%) lost 5% or more of their baseline weight before the start of radiation. This is comparable to Kubrak et al. (2010) who established a baseline weight at 6 months prior to the start of treatment and found that 29% of their patients experienced a 5% reduction in weight by the onset of medical treatment.

In this study the NoPEG group lost on average 4% of their weight during treatment, and another 3% at the 3-month post treatment mark. These findings are comparable to Kubrak et al. (2013) which followed nutritional status for orally fed patients from the start of treatment to 2.5 months post treatment. Kubrak et al. (2013) found that orally fed patients lost on average 3.5% of weight by the end of treatment, and another 1.9% at 2.5 months post-treatment. In a study done by Munshi et al. (2003) that looked at the relationship between radiation therapy and weight loss across 140 patients it was found that 74% of their patients experienced a weight loss of 10% or more during the treatment phase. In this current investigation across the two groups 44% of patients lost 10% or more of their weight during treatment. While both studies identified weight loss, the study done by Munshi et al. (2003) had a sample size of 140, while this study had a sample size of 25; and Munshi et al. (2003) used patient reported weight loss in the month prior to diagnosis, while the current study's baseline weight was taken 1 year prior to the onset of treatment as reported by the medical team at the Albuquerque VAMC. These differences in the definition of baseline weight may account for the discrepancy found in the baseline weight loss between the two studies.

Another longitudinal study by van den Berg et al. (2014) that followed patients for up to five years, found that the patient's mean weight at the morbidity clinic had recovered to their pretreatment baseline weight. This is consistent with this investigation, which found that on average all patients had returned to between 98%-101% of their baseline weight. While the van den Berg study did record patients who received PEG tubes, they did not parse out the possible contributing factors for their findings, so it is difficult to know what role, if any, the presence of a PEG tube may have played in this. It does show however that patients can return to baseline weight regardless of their nutritional intake status, and/or diet modifications.

Findings from our study show that while there was no difference across time for weight gain between groups, which is in line with findings from Langmore, Krisciunas, Miloro, Evans, & Cheng (2012), the PEG group began recovering their weight a year before the NoPEG group. It appears that for the PEG group the placement of a PEG enabled them to begin recovering their weight deficit more rapidly than the NoPEG group. One hypothesis to this quicker weight recovery in the PEG group is the presence of an alternative nutrition source, which is nutritionally advantageous for someone who is experiencing the side effects of cancer and its treatment. Adequate nutritional intake is paramount in the healing process as the body works to recover from the disease process and the effects of radiation. Many patients "develop tumor-associated malnutrition characterized by an insufficient supply of macro- and micronutrients" (Ströhle, Zänker, & Hahn, 2010).

Swallow Exercise Compliance

In this current study swallow exercise compliance was judged across the two groups, with the PEG group demonstrating higher swallow exercise compliance than the NoPEG group. Notably the PEG group had more advanced disease, a larger number of oropharyngeal cancers (as opposed to laryngeal), and greater pre-treatment swallow deficits. This combination of factors may account for the difference in compliance. That is, individuals in the PEG group may have been more motivated to comply with their exercise protocol in hopes of maintaining or improving their already impaired swallow function. In the absence of pre-treatment dysphagia, as was the case for patients in the NOPEG group who had lower cancer staging, patients may be less motivated to comply with their exercise protocol.

To date there are no studies that explore the impact of PEG tubes on swallow exercise compliance. However, studies have been done exploring the adherence to a swallow exercise program in patients with HNCas regardless of PEG tube status. During radiation treatment, across both groups, swallow exercise compliance was 56%. This is in line with the literature that reports 55% - 64% adherence rate during treatment (Cnossen et al., 2014; Shinn et al., 2013). Another study by Cnossen et al. (2017) reported that 38% of participants who received a swallow exercise protocol continued with their swallow exercises 3 months post treatment. Similarly, in this current investigation 40% of participants had continued with their swallow exercise protocol at some level.

Adherence to swallow exercise compliance can be evaluated by level of compliance. In this study adherence was broken down into 4 levels, with 4 being high compliance and 1 being no compliance (Table 4). Cnossen et al. (2014) broke down adherence into low, moderate, and high compliance which was reported at 42%, 30%, and 27%, respectively. While the Shinn et al. (2013) study broke down compliance into non-adherence (55%), partial adherence (32%), and high adherence (13%). This is comparable to the current investigation in which 42% of patients exhibited low compliance, 42% exhibited moderate compliance, and 14% exhibited high compliance.

Swallow Function

The CTCAE v5.0 was employed as the foundation for determining level of dysphagia severity in this retrospective chart review of veterans. This was a combination of treatment sequalea complaints, evidence of penetration/aspiration, and level of PEG tube dependency to assign a dysphagia severity score on a scale of 0-4, where 0 represented an absence of swallow deficits (Table3). In this study 16% of patients with PEG tubes had Grade 3 dysphagia scores or higher at 3 months post-treatment, compared to NoPEG patients (4%). At 6 months post-treatment this reduced to 12%, and 0% of patients in the NoPEG group were judged to be Grade 3 or higher. This decline in swallow deficit compares to Chen et al. (2010), which found 46%, and 34% of patients with prophylactic PEGs to have Grade 3 dysphagia at the 3, and 6 month post-treatment mark respectively. This compares to 27%, and 5% of patients without prophylactic PEGs who had Grade 3 dysphagia at the 3, and 6-month mark respectively. While there were improvements in swallow function over time when comparing the % of participants in this study and the Chen et al. (2010) study, the Chen study reported higher numbers of participants with Grade 3 dysphagia. The inclusion criteria in the Chen et al. (2010) investigating required that all patients had stage III/IV HNCa and adjuvant chemotherapy, while our study had staging ranging from 0-IVB, and not all participants received adjuvant chemotherapy. It has been documented in the literature that adjuvant chemotherapy correlates with higher dysphagia severity (Langendijk et al., 2008; Russi et al., 2012; Taylor et al., 1992). Further, in our study all patients received IMRT as opposed to the Chen et al. (2010) study in which only 51% of patients received IMRT. IMRT has been shown to limit the effects of radiation to the structures (Eisbruch et al., 2004; Pauloski et al., 2015).

Caudell et al. (2009) did not find the placement of PEG tubes to be a significant variable for dysphagia, but rather, the location of the tumor, the use of adjuvant chemotherapy, scheduled dosing of radiation therapy, and increased age had the most significant impact. In this current investigation the PEG group did have higher dysphagia severity overall. However, due to the retrospective nature of this study it cannot be ascertained if the greater dysphagia severity was a function of cancer staging, location, use of chemotherapy, and age, or some other factor impacting dysphagia. Caudell et al.

(2010), found that radiation greys of above 41 to the oropharyngeal and laryngeal structures, had significant effects on PEG tube dependence and aspiration in patients with HNCa. This is in agreement with our study, which found that patients with PEG tubes had significantly higher dysphagia severity ($p > .05$). To date there is a paucity of research that uses prophylactic PEG placement as an outcome measure or variable for dysphagia in HNCa.

Quality of Life

In this investigation the QOL was evaluated from the time of diagnosis to two years post radiation treatment. Across all time points, participants in the PEG group reported lower quality of life scores than those in the NoPEG group. This trend is supported throughout the literature regardless of the instrument used to record quality of life. (Khandelwal, Neeli, Gadiyar, & Khandelwal, 2017; Morton, Crowder, Mawdsley, Ong, & Izzard, 2009; Rogers, Thomson, O'Toole, & Lowe, 2007; Terrell et al., 2004). These lower scores have been linked to the fact that the presence of the PEG serves as a constant reminder that they had cancer, and the presence of the PEG impacts QOL even after the cancer has been eradicated (Terrell et al. 2004). This theory combined with the fact that patients who receive PEG tubes have more advanced disease may account for this trend.

El-Deiry, Futran, McDowell, Weymuller Jr., & Yueh (2009) looked at clinical predictors of long-term quality of life in HNCa patients two years post treatment. They utilized the UW-QOL to assess the quality of life and found that patients who had received a PEG tube had on average composite scores that were 11.5 points lower than patients who had never received PEG tubes. This was comparable to our study, which found that patients who had received a PEG tube had on average a composite score that was 9.27 points lower at the two-year mark, than patients who had never received a PEG tube. A deficit of 7 points is considered clinically significant for this questionnaire (El-Deiry et al., 2009). Overall, across all studies, and in spite of the tool used to measure quality of life, patients who received a PEG tube at any point during the course of treatment were more likely to report lower quality of life scores as far as two years post treatment.

This study looked at the both the physical function and social function scores separately and found that although the NoPEG group reported greater quality of life, the month-to-month profile was similar across the two groups. While both groups regained, and showed improvement from baseline in their social function scores, this was not the case for the physical function scores. The PEG group remained, on average, 15 points below baseline reports for physical functioning even at the two-year post treatment mark. This may be due to the fact that on average the PEG group was more likely to receive adjuvant chemotherapy, which confounds the effects of treatment. Another hypothesis is that patients in the PEG group are coming to terms with the reality that their swallow function will never return to "normal," and they must adjust to this "new normal."

Limitations

There are some inherent limitations with this, and any, retrospective chart review. As with any retrospective review groups cannot be randomized, and there is no control for group assignment. This correlates directly to this study in which the PEG vs. NoPEG groups were not well matched for cancer staging, location, or adjuvant chemotherapy, which are all important factors that may influence/bias the findings of this investigation.

Further, the patients in this retrospective chart review were exclusively veterans from the Raymond G. Murphy VAMC. Veteran populations are predominantly male, and they often live with comorbidities such as Post-Traumatic Stress Disorder, that may influence the findings of this study.

Internal validity. Due to the retrospective and longitudinal nature of this study's design there is some vulnerability to the internal validity of this investigation. Most notably there were ambiguous temporal precedences, because the direction of the relationship between PEG status and the outcome variables was not clear due to the inherent bias in patients who received PEG tubes prophylactically. Bias in differential selection effects was present due to the fact that the subjects were not randomly assigned to their respective groups. Some threat to internal validity from history effects exists. With any longitudinal, time series study, there is the possibility that factors outside of therapy influenced the outcomes of this study. Vulnerability to attrition effects in this study also exist, due to the small sample size, and not all participants had progressed to the two-year post-treatment mark. In fact, there was only one participant left in the NoPEG group, and seven participants in the PEG group at the two-year mark.

External validity. As previously mentioned this study looked exclusively at the veteran population, therefor, results of this study should be generalized to the general public with caution. Of note, though, is that many of the findings of this investigation were corroborated by the literature, which was not focused primarily on the veteran population. There were also multiple-treatment interference effects as patients were often treated with a variety of techniques including: radiation, surgery, and chemotherapy.

Some patients also had to switch chemotherapy medications partway through treatment due to complications that arose.

Future Directions

To date, there is a paucity of research exploring the effects of PEG status on patients with HNCa. To this end no universal standard of care has been established regarding the timing and use of PEG tubes in this most vulnerable of clinical populations. Further researchers, especially prospective, randomized, control studies are needed to guide clinical decision-making in this area. As quality of life gains more traction in the literature, the quality of life of caregivers should also be investigated in this area. Oftentimes caregivers act as the patients nurse, changing PEG tubes, and setting reminders for exercises and appointments; support system, attending appointments and offering compassion; and care coordinators, organizing appointments, and relaying information between differing health care providers. And most importantly, they heavily influence the patient's decision-making about their care. If we truly wish to improve the quality of life, and service delivery to our patients we must ensure that their caregivers are adequately supported as well.

Conclusion

There is currently a lack of evidence in the literature regarding the appropriateness of prophylactic PEG placement for patients with HNCa who receive radiation as part of their treatment protocol. While the findings of this study, and the literature, find that there are risks associated with the placement of PEG tubes, there are also benefits that cannot be overlooked. Disruption to treatment can have serious detrimental effects on cancer eradication, and may result in incomplete response of the tumor to treatment, and cancer recurrence (National Cancer Institute, 2016). Nutrition status oftentimes plays a key role in the patient's ability to tolerate treatment, and supporting nutrition in this population is vitally important.

It should be noted that swallow function is tied to long-term quality of life in patients, and therefor it's importance should not be overlooked. More research needs to be done in order to better determine when the benefits of support from a PEG tube outweigh the risks. There is a need for evidence in this area so that clinicians and physicians can make well-informed decisions when guiding patients in the decision making process. Further, a higher level of importance should be placed on swallow exercise compliance with patients who elect to have a prophylactic PEG placed. It is imperative that they understand the importance and reasoning behind the swallow exercises, and the ramifications of non-compliance. Frazier freewater protocols should also be considered for patients in this population who are NPO or partially PEG dependent, in order to mitigate non-compliance with swallow exercise. As previously stated, swallow function is a "use it or lose it" task, and even some swallowing is better than no swallowing at all. Periods of complete oral disuse should be avoided to prevent muscular atrophy and long-term deficits.

Clinical Implications

This retrospective investigation compared individuals with head and neck cancer whom went underwent radiation and either received a PEG prior to radiation or completed radiation without prophylactic PEG placement. The two groups of individuals were followed to note changes in weight, quality of life, and swallow function at various points in time from the onset of radiation to a maximum of 2 years post radiation.

Participants were not randomly assigned to the groups, while it appears that patients with more advanced stage disease, pre-treatment dysphagia, and oropharyngeal cancers who received concomitant chemotherapy were more likely to be in the group that received prophylactic PEG placement. Although the PEG group had greater illness severity and deficits, both groups showed similar weight loss profiles in the early stages of treatment. It is possible that the PEG group may have had greater weight loss if they did not have a PEG. However, this cannot be determined from this investigation. While both groups recovered their weight by the 2-year mark, the PEG group did achieve the goal faster. This supports the use of prophylactic PEG placement in patients with advanced staging of oral or pharyngeal cancers.

It has been expressed that the PEG may actually prevent the recovery of swallow function. However, our data did not support that notion. In fact, the PEG group was more likely to comply with the swallow exercises, and all but one participant had the PEG removed before the termination of the study. Therefor, based on this limited investigation, PEG placement should not be considered as a detriment to future swallow function in patients with advanced disease.

Although quality of life scores were lower in the PEG group, from this investigation there is no way to determine if this finding is from the presence of the PEG or the advanced cancer staging. However, keeping in mind that the presence of a PEG tube may decrease quality of life, psychological supports should be considered for patients who choose to obtain a prophylactic PEG. Identification of at-risk patients can be achieved prior to PEG placement by inquiring about the patient's feelings regarding PEG placement (e.g., (a) it would be terrible to have one, (b) would accept one if the medical team feels it is useful, or (c) it is better to have it as a safety net). The impact of the PEG on quality of life may be reduced if patients are involved in the decision regarding PEG placement.

Meaningful outcomes need to be further assessed and measured. Studies are needed that systematically assess the impact of each variable on the patients ability to return to their baseline swallow function and quality of life in order to gain clear insight into the true impact of prophylactic PEG tubes, and adequately judge their respective benefits. Clinically relevant effects of prophylactic PEG tube placement and the associated risk to swallow physiology and quality of life can neither be confirmed nor excluded using the evidence provided in this study. Clinically meaningful outcomes for swallow physiology may require increased continuity in outcome measures, and the way that these are evaluated.

APPENDIXES

APPENDIX A

University of Washington Quality of Life Questionnaire

University of Washington Quality of Life v4 for Head & Neck Cancer.

Each of the 12 questions is scaled from 0 (worst) to 100 (best) based on the past 7 days. Two main composite scores include: 'Physical function' (chewing, swallowing, speech, taste, saliva and appearance) and 'Social-emotional function' (anxiety, mood, pain, activity, recreation and shoulder function). Each composite score is computed as the simple average of the 6 compiled items. Additionally, the pt is asked to identify specific areas most important to them. There are also three global questions (A,B&C), to determine broader sentiments; scores are again scaled from 0 to 100.

1. Pain:
    "I have no pain" (100)
    "There is mild pain not needing medication" (75)
    "I have moderate pain - require regular medication." (50)
    "I have severe pain controlled only by prescription medicine (e.g. morphine)." (25)
    "I have severe pain, not controlled by medication." (0)
2. Appearance:
    "There is no change in my appearance." (100)
    "The change in my appearance is minor." (75)
    "My appearance bothers me but I remain active." (50)
    "I feel significantly disfigured and limit my activities due to my appearance. (25)
    "I cannot be with people due to my appearance." (0)
3. Activity:
    "I am as active as I have ever been." (100)
    "There are times when I can't keep up my old pace, but not often." (75)
    "I am often tired and have slowed down my activities although I still get out" (50)
    "I don't go out because I don't have the strength." (25)
    "I am usually in bed or chair and don't leave home." (0)
4. Recreation:
    "There are no limitations to recreation at home or away from home." (100)
    "There are a few things I can't do but I still get out and enjoy life." (75)
    "There are many times when I wish I could get out more, but I'm not up to it." (50)
    "There are severe limitations to what I can do, mostly I stay at home and watch TV." (25)
    "I can't do anything enjoyable." (0)
5. Swallowing:
    "I can swallow as well as ever." (100)
    "I cannot swallow certain solid foods." (70)
    "I can only swallow liquid food." (30)
    "I cannot swallow because it 'goes down the wrong way' and chokes me." (0)

6. Chewing:
"I can chew as well as ever." (100)
“I can eat soft solids but cannot chew some foods.” (50)
“I cannot even chew soft solids.” (0)
7. Speech:
"My speech is the same as always" (100)
“I have difficulty saying some words but I can be understood over the phone.” (70)
“Only my family and friends can understand me.” (30)
“I cannot be understood.” (0)
8. Shoulder:
“I have no problem with my shoulder” (100)
"My shoulder is stiff but it has not affected my activity or strength" (70)
“Pain or weakness in my shoulder has caused me to change my work/hobbies.” (30)
“I cannot work or do my hobbies due to problems with my shoulder.” (0)
9. Taste:
"I can taste food normally." (100)
“I can taste most foods normally.” (70)
“I can taste some foods.” (30)
“I cannot taste any food.” (0)
10. Saliva:
"My saliva is of normal consistency" (100)
“I have less saliva than normal, but it is enough.” (70)
“I have too little saliva.” (30)
“I have no saliva.” (0)
11. Mood:
“My mood is excellent and unaffected by my cancer.” (100)
“My mood is generally good and only occasionally affected by my cancer.” (75)
“I am neither in a good mood nor depressed about my cancer.” (50)
"I am somewhat depressed about my cancer" (25)
“I am extremely depressed about my cancer.” (0)
12. Anxiety:
“I am not anxious about my cancer.” (100)
“I am a little anxious about my cancer.” (70)
“I am anxious about my cancer.” (30)
"I very am anxious about my cancer." (0)

A) Compared to the month before you developed cancer, how would you rate your health-related quality of life?

"Much better." (100)
"Somewhat better." (75)
"About the same." (50)
"Somewhat worse." (25)
"Much worse." (0)

B) In general, would you say your health-related quality of life during the past 7 days has been:

"Outstanding." (100)
"Very good." (80)
"Good." (60)
"Fair." (40)
"Poor" (20)
"Very poor." (0)

C) Overall quality of life includes not only physical and mental health, but also many other factors, such as family, friends, spirituality, or personal leisure activities that are important to your enjoyment of life. Considering everything in your life that contributes to your personal well-being, rate your overall quality of life during the past 7 days.

"Outstanding." (100)
"Very good." (80)
"Good." (60)
"Fair." (40)
"Poor" (20)
"Very poor." (0)

INTERPRETATION:

Physical function score: (0% worst ---> 100% best)
Social-emotional function score: (0% worst ---> 100% best)
Most important: Pain, Swallowing, Taste, Appearance, Chewing, Saliva, Activity, Speech, Mood, Recreation, Shoulder, Anxiety.

Physical Function:
(2) ____
(5) ____
(6) ____
(7) ____
(9) ____
(10) ____

Total: ______

Social Emotional:
(1) ____
(3) ____
(4) ____
(8) ____
(11) ____
(12) ____

Total: ______

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