Swallowing Outcomes in Oropharyngeal Squamous Cell Carcinoma Patients

by

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Abstract

Background: Dysphagia, or impairment of swallowing function, is a consequence of oropharyngeal squamous cell carcinoma (OPSCC) treatments and often results in a devastating reduction in quality of life (QoL). The impacts of treatments on swallowing function makes this a critical area of study.

Purpose: The research objective was to report swallowing outcomes in OPSCC patients using the Modified Barium Swallow Impairment Profile (MBSImP) PI scores and MD Anderson Dysphagia Inventory (MDADI) composite scores at four appointments: pre-treatment, one month post-, six months post-, and 12 months post-treatment. The secondary research objective was to study the relationship between these two types of measures at each appointment.

Methods: This was a retrospective study design where data from January 2013 to December 2017 were collected from a tertiary health center for four appointments relative to cancer treatment. To address the primary objective, MBSImP PI scores and MDADI composite scores were reported for each appointment and stratified by treatment modality. To address the secondary objective, four Spearman tests were run between MBSImP PI and MDADI composite scores at each appointment.

Results: 123 participants were included (81.9% male). Data were analyzed cross-sectionally, per appointment type. MBSImP PI scores worsened one month post-treatment and remained impaired at six and 12 months. At 12 months following treatment, organ preservation patients appeared to have the best clinician-driven swallowing outcomes, while patients who received both surgery and adjuvant (C)RT had the worst. For MDADI composite scores, patient reports worsened one month post-treatment and subsequently improved at six and 12 months. Patients who received surgery alone reported scores at 12 months that surpassed pre-treatment reports. Organ preservation

patients reported MDADI composite scores that appeared to remain stable throughout the first year following treatment. Patients who received both surgery and (C)RT reported the greatest swallowing impairment and remained at a level of function at 12 months. MBSImP PI and MDADI composite scores were weakly negatively correlated (in agreement) at the pre- and 12 month post-treatment appointments.

Conclusions: Swallowing outcomes in OPSCC patients have distinct yet predictable trends for both clinician-driven and patient-reported swallowing outcomes during the first year following cancer treatment. However, unlike previous findings, these two types of measures were in agreement at the pre-treatment and 12 month post-treatment appointment within the first year, highlighting the importance of considering data within this time period.

Keywords: deglutition disorders, oropharyngeal dysphagia, oropharyngeal neoplasms, patient reported outcomes, pharyngeal neoplasms, rehabilitation, swallowing disorders

Preface

This thesis is an original work by Sarah Kabalan. The research project, of which this thesis is a part, received research ethics approval from the Health Research Ethics Board of Alberta Cancer Committee (HREBA-CC), "Longitudinal Swallowing Outcomes in Oropharyngeal Cancer Patients", Ethics ID: HREBA.CC-20-0076, April 15, 2020.

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I would also like to thank my husband, AbdAllah, alongside my family and friends who I consider family. I would not have made it this far without so much love and support. Thank you.

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Swallowing Outcomes in Oropharyngeal Squamous Cell Carcinoma Patients

Squamous cell carcinoma (SCC) accounts for 90% of all malignant neoplasms (Kendall et al., 2014). The incidence of SCC originating in the oropharynx, or oropharyngeal squamous cell carcinoma (OPSCC), has increased, primarily as a result of human papillomavirus (HPV) (Sturgis & Cinciripini, 2007). Along with an increase in incidence, the demographics of OPSCC survivors have shifted to include younger patients who have the potential to live decades after cancer treatment (Forte et al., 2012). One well documented consequence of OPSCC treatment is swallowing difficulty, or dysphagia (Hutcheson et al., 2014; Kirsh et al., 2019; Roets et al., 2018). Dysphagia can impact both the health (e.g., malnutrition, dehydration, pneumonia) (García-Peris et al., 2007) and psychosocial well-being of patients (e.g., prolonged meal time, embarrassment, self-isolation) (Semple et al., 2008). The impacts of OPSCC treatment on swallowing in combination with a steady increase in patients diagnosed with these cancers make understanding swallowing outcomes a critical area of study (Pan et al., 2018).

Treatment of OPSCC

Treatment of OPSCC can include a variety of modalities, all of which can negatively impact swallowing function. Treatments may include surgery, radiotherapy (RT) with or without chemoradiation therapy (CRT), or a combination of both surgery and (C)RT (Bessell et al., 2011). Surgery involves resection of the tumour and margins surrounding the affected area. Treatments that use (C)RT exclusively, also referred to as organ preservation treatments, may be selected to prevent surgical exposure (Starmer et al., 2014). Finally, a combination of surgery and (C)RT (in this case referring to surgery first, followed by adjuvant therapy) can be used in advanced cancer cases where RT or CRT may be required following surgery to reduce the chance of recurrence (Pauloski & Logemann, 2000). Treatment selection may be based on factors such as disease stage,

patient history, and institutional preferences. Irrespective of treatment modality, tissues and structures that are critical for swallowing are negatively impacted (Pauloski & Logemann, 2000), putting patients at risk for subsequent physical, functional, and psychosocial impairments (Teasell et al., 1999).

Swallowing Impairment: Dysphagia in OPSCC Patients

Patients can experience dysphagia both before OPSCC treatment as well as following treatment. Dysphagia prior to treatment can be a consequence of the tumour affecting an organ of swallowing (Chen et al., 2001). Following treatment, patients also can experience difficulties with swallowing (Gillespie et al., 2005), irrespective of the treatment modality they received. For example, patients treated with surgery alone may have structures critical for swallowing resected, such as the soft palate or the base of tongue (Pauloski & Logemann, 2000). In addition to muscle tissue, resection also may involve nerves, leading to sensory-motor impairments and/or incoordination of swallow function (Baijens et al., 2021). Similarly, patients who receive organ preservation treatments may experience both short-term and latent dysphagia as a result of chemoradiation toxicity (Wall et al., 2013). Impairment of swallowing function in organ preservation patients can result from edema, mucositis, altered or thickened saliva, and pain; latent or persistent swallowing impairments may occur due to tissue fibrosis (scarring) and chronic oxidative stress (Wall et al., 2013). In the case of patients who receive both surgery and (C)RT, patients may suffer from dysphagia symptoms related to both treatment modalities, and are at an increased risk of negative long-term swallowing outcomes (Achim et al., 2018).

In general, dysphagia in OPSCC patients is typically characterized by reduced tongue-base retraction and post-swallow pooling in the valleculae and/or pyriform sinuses, which increases the risk for aspiration (for example, as a result of residue entering the airway) (Simon et al., 2020).

Dysphagia in this patient subgroup is not limited to these two observations and can include impairments anywhere in the swallowing process. OPSCC patients living with dysphagia may develop increased coughing, nasal regurgitation (Simon et al., 2020), malnutrition, dehydration, aspiration (García-Peris et al., 2007), and are at an increased risk of life-threatening pneumonia (Hutcheson et al., 2014). Patients also may report negative impacts of dysphagia on their QoL, such as taking longer to eat, changes in their ability to taste or smell food, and embarrassment associated with drooling (Semple et al., 2008). Speech-language pathologists (SLPs) use a variety of tools to evaluate swallowing physiology and the impact dysphagia has on OPSCC patients.

Assessment of Disordered Swallows

Both clinician-driven and patient-reported outcomes are valuable, but different, ways to assess disordered swallows. For clinician-driven swallowing outcomes, the videofluoroscopic modified barium swallow (MBS) is regarded by many to be the gold standard in the evaluation of swallowing physiology and swallow safety (Teasell et al., 1999). The MBS study is conducted by observing a patient ingest various consistencies of food (e.g., thin, nectar thick, honey thick, pudding, etc.) mixed with barium, a contrast that allows for the visualization of the bolus on X-ray (Sandidge, 2009). The literature is replete with different methods for assessing and reporting on findings from MBS studies. In response to the need for a validated and reliable tool to summarize MBS observations, the Modified Barium Swallow Profile (MBSImP™ ©) was developed by Martin-Harris et al. in 2008. The MBSImP is characterized by high inter- and intra-rater reliability following standardized training for clinicians with a minimum of three years of experience (Sandidge, 2009). The MBSImP consists of 17 items that address different physiological swallowing components. Clinicians assign a score to each component based on their observations of the MBS, from 0 to 2, 0 to 3, or 0 to 4, depending on the component being assessed. Patients

are assigned an overall *Oral Impairment* score that assesses oral impairment, a *Pharyngeal Impairment* score that assesses pharyngeal clearance and airway protection, and an *Esophageal Impairment* score (Martin-Harris et al., 2008). High scores indicate impairment when using this tool.

To evaluate patient perception of swallowing function, the M.D. Anderson Dysphagia Inventory (MDADI), is one of the most widely used tools (Ojo et al., 2012). The MDADI is a self-administered, standardized questionnaire, and one of the first validated and reliable tools used to assess swallow-specific QoL in patients with cancers in the upper aerodigestive tract. The MDADI results in a composite score and four different sub scores: global, emotional, functional, and physical (Chen et al., 2001). Responses to 20 questions are recorded and scored from one to five: 1 (strongly agree); 2 (agree); 3 (no opinion); 4 (disagree); 5 (strongly disagree). Patients' scores are reported on a scale of 0 (extremely low functioning) to 100 (high functioning). The MDADI is patient-friendly (taking less than five minutes to complete), easy to administer, and is sensitive and reliable with respect to swallowing-related QoL in head and neck cancer (HNC) patients (Gillespie et al., 2005). A minimal clinically important difference (MCID) of 10 points in MDADI composite scores has been reported to differentiate patients based on feeding tube status, aspiration status, and level of restricted diet (Hutcheson et al., 2016).

Investigating the relationship between clinician-driven (e.g., MBSImP) and patient-reported (e.g., MDADI) swallowing outcomes at various time points is of value. A recent systematic review looking at clinician-driven swallowing outcomes, such as those based on the MBS observations, found that these instrumental evaluations are used less frequently than patient-reported outcomes, with only 30.2% of studies reporting clinician-driven measures (Li et al., 2020). On the other hand, patient-reported measures such as the MDADI are more likely to be

reported, with 75.4% of studies including these types of outcomes (Li et al., 2020). This preference for patient-reported outcomes may be due to questionnaires being more time efficient and easier to administer and analyze. Despite the preference for patient-reported outcome measures, these tools cannot be considered a substitute for instrumental assessments of swallowing function, as a lack of correlation between clinician-driven and patient-reported outcomes has been reported in OPSCC patients (Gillespie et al., 2005; Kendall et al., 2014). Understanding trends in these two types of measures and how they relate to one another at various time points may provide a multi-dimensional understanding of the impacts of OPSCC treatments on dysphagia.

Swallowing Outcomes in OPSCC Patients

Clinician-Driven Swallowing Outcomes

Studies have found that when clinicians measure swallowing outcomes following all types of OPSCC treatment, an initial decline in function is observed on the MBS (Borggreven et al., 2007; Schwartz et al., 2010). Following this decline, scores on various clinician-driven tools (e.g., Penetration-Aspiration Scale (PAS)) have been observed to remain impaired. For instance, Schwartz et al. (2010) examined swallowing function at six, 12, and 24 months post-treatment and found that swallowing function declined at six months post-treatment relative to pre-treatment scores, and remained stable between the six, 12, and 24 months appointments. Similarly, another study concluded that post-treatment swallowing outcomes remained impaired between six and 12 month appointments (Borggreven et al., 2007).

These trends may not hold true when examining patient populations based on treatment modality. Patients who receive organ preservation treatments may experience additional decline in swallowing function (as rated by a clinician) as time progresses (Kirsh et al., 2019). It has been hypothesized that this deterioration may be a result of late development or progression of

dysphagia (Hutcheson et al., 2012; Kirsh et al., 2019). These late effects of organ preservation treatments can include fibrosis of the pharyngeal muscles, noted in patients 12 months post-treatment (Gillespie et al., 2005). Taken together, the above clinician-driven findings suggest a general trend of worsening swallowing outcomes following treatment; swallow function remains impaired for up to two years. Patients who receive organ preservation treatment may experience a worsening of swallowing function over time. These trends are noted from clinician-driven measures; however, patient perceptions may differ.

Patient-Reported Swallowing Outcomes

Patient-reported outcomes have been observed to exhibit different trends, highlighting the importance of considering the patient-experience together with clinical impressions. Patient-reported outcomes (such as MDADI scores) have been found to worsen immediately after OPSCC treatment, followed by a gradual improvement observed from the six month appointment onwards. For instance, Goepfert et al. (2017) found that MDADI composite scores worsened at six months post-treatment when compared to pre-treatment, in organ preservation patients. These scores were noted to improve at the 12 and 24 month appointments. Similarly, Roe et al. (2014) also investigated organ preservation patients and found a worsening in MDADI composite scores from baseline to three months post-treatment, and an improvement at six and 12 months. Interestingly, the greatest contributor to the improvement in MDADI scores in this aforementioned study was the emotional subscale, an observation that led to the hypothesis that patient-participants were adapting to their new swallowing function (Roe et al., 2014). Hutcheson et al. (2014) also suggested that patients may develop coping strategies to lessen the social impact of their swallowing impairment. These latter researchers found that MDADI composite scores at 24 months post-treatment were comparable to those captured at baseline (Hutcheson et al., 2014).

Research on MDADI outcomes has primarily focused on organ preservation patients, and it is unclear if these trends align for patients receiving surgery alone or surgery followed by (C)RT.

When considering treatment modality, organ preservation patients have been found to report worse swallowing outcomes than patients who received surgery alone or both surgery and (C)RT (Roets et al., 2018). A recent literature review conducted by Roets et al. (2018) compared QoL measures related to swallowing in OPSCC patients who received surgery, organ preservation, or both surgery and (C)RT. At the 12 month appointment, there was a greater deterioration in QoL measures in organ preservation patients than patients who received other treatment modalities (Roets et al., 2018). These researchers noted that the effects of treatment modality on QoL is confounded by the lack of standardization of assessment tools and follow-up assessment times, heterogeneous samples and small sample sizes (Roets et al., 2018).

The Relationship Between Clinician-Driven & Patient-Reported Swallowing Outcomes

Limited research exists examining the relationship between clinician-driven and patient-reported swallowing outcomes following treatment for HNC (Arrese et al., 2017, 2019; Kirsh et al., 2019; Rogus-Pulia et al., 2014), and even fewer studies have examined this relationship following treatment of OPSCC specifically (Gillespie et al., 2005; Kendall et al., 2014). Of these studies, researchers reported a lack of correlation between clinician-driven and patient-reported swallowing outcomes. For instance, Kendall et al. (2014) examined the relationship between MBS and MDADI global and physical scores and found a lack of correlation between the two types of measures one year following organ preservation treatment. Other researchers have examined this relationship including organ preservation patients and patients who received both surgery and (C)RT (Gillespie et al., 2005). These researchers also found a lack of correlation between PAS scores and MDADI composite scores at least one year following treatment (m = 4.7 years post-

treatment). Some researchers have suggested that this lack of correlation could be due to poor patient awareness when reporting specific dysphagia symptoms (Rogus-Pulia et al., 2014). It is important to note these findings as patient-reported outcomes are more likely to be used in clinic and research than clinician-driven outcomes (Li et al., 2020). These findings also support prior recommendations that patient-reported swallowing outcomes be supplemented with more objective measures to identify patients at risk of airway penetration (Gillespie et al., 2005).

Overall, various studies report on swallowing outcomes in OPSCC patients following treatment (Borggreven et al., 2007; Goepfert et al., 2017; Roe et al., 2014; Schwartz et al., 2010), but most report on one time point only (Dixon et al., 2018; Gillespie et al., 2005; Hutcheson et al., 2014; Kendall et al., 2014; Kirsh et al., 2019). Moreover, previous researchers have combined data from several appointments within the first year following cancer treatment (Kendall et al., 2014; Rogus-Pulia et al., 2014) eliminating the subtleties of changes that may have occurred within this critical journey in patients' cancer care continuum. Investigating the trajectory of these swallowing outcomes post-treatment may allow for informed patient-clinician dialogue regarding recovery and quality of life (QoL). Setting realistic recovery and QoL expectations has been shown to be predictive of functional outcomes and patient satisfaction following medical treatments (Mahomed et al., 2002). Furthermore, understanding swallowing outcomes in large sample sizes may highlight when individual patients' swallow function is uncharacteristically negatively impacted by cancer treatment. This could be achieved by comparing patient swallowing outcomes to the trends reported in the present study. The present study examined clinician-driven and patient-reported measures within the first year following cancer treatment, allowing for a granular examination of the trends and relationship between the two types of measures.

Research Objectives and Hypotheses

The primary research objective was to report the MBSImP Pharyngeal Impairment (PI) and MDADI composite scores in OPSCC patients at four different time points: pre-treatment, one month post-, six months post-, and 12 months post-treatment. In line with Schwartz et al. (2010), MBSImP PI scores were hypothesized to worsen at the one month post-treatment appointment due to the anticipated impairments following cancer treatment. MBSImP PI scores were expected to remain stable across the remaining two time points. Furthermore, in line with Goepfert et al.'s (2017) findings, MDADI scores were hypothesized to worsen at the one and six month post-treatment appointments relative to pre-treatment scores. MDADI scores were expected to improve at the 12 month post-treatment appointment, as patients may have come to terms with their altered swallowing function and develop coping strategies that reduce the social and functional effects of swallowing impairments (Hutcheson et al., 2014; Roe et al., 2014).

The secondary research objective was to determine if clinical-driven swallowing outcomes (i.e., MBSImP PI scores) and patient-reported swallowing outcomes (i.e., MDADI composite scores) related to one another at the same four time points. It was hypothesized that there would be no correlation between these two measures (Gillespie et al., 2005; Kendall et al., 2014).

Methods

Participants

Participants were included if they had a diagnosis of OPSCC and also visited a tertiary health center between January 2013 and December 2017 for functional outcome evaluations. Patients were excluded if their appointments between these months were due to a recurrence.

Procedure

A retrospective chart review was conducted using paper charts and two electronic databases. First, researchers queried one proprietary electronic database (Head and Neck Research Network software) using participant inclusion and exclusion criteria as query parameters. This automated query yielded an Excel spreadsheet with MDADI scores, patient demographics (e.g., sex), treatment details, and patient chart IDs only for those patients who fit the pre-specified inclusion and exclusion criteria. Chart IDs were then used to obtain MBSImP scores from a separate electronic database (Excel spreadsheet). Once the preliminary data collection was complete, the following data were retained for subsequent analysis: date of birth, sex, MBSImP PI scores, MDADI composite scores, T-stage, treatment modality, and feeding tube status. Any missing information from these two electronic records was collected by referring to archived paper charts when available.

Outcome Measures

MPSImP PI scores were calculated by trained and certified SLPs using MBS videos captured at 30 frames per second and 30 pulses per second. MBSImP PI scores (i.e., items 7 through 16) were selected as the pharyngeal phase of the swallow was expected to be most impacted by OPSCC cancer treatment. MBSImP PI scores range from 0 to 33, with higher scores indicating more impairment. MDADI composite scores range from 0 (extremely low functioning) to 100 (high functioning) (Chen et al., 2001).

Analysis

Data analysis was carried out using Statistical Package for the Social Sciences software (SPSS) version 26. Demographic data were summarized using descriptive statistics with age calculated at the pre-treatment appointment. Sex, T-stage, and feeding tube status were reported

for each of the four appointments (pre-treatment, one month, six months, and 12 months post-treatment) and stratified by treatment modality (surgery, organ preservation, and both surgery and (C)RT).

To address the primary research objective (reporting swallowing outcomes within one year of treatment), MBSImP PI scores and MDADI composite scores for all participants were summarized using boxplots and non-parametric descriptive statistics. Next, the analysis was repeated, but this time stratifying MBSImP PI and MDADI composite scores by treatment modality.

To address the secondary research objective (relationship between clinician-driven and patient-reported swallowing outcomes), four Spearman tests were run to determine the strength and direction of the relationship between the MBSImP PI scores and the MDADI composite scores at each time point. Once again, results were then stratified by treatment modality. The strength of these correlations was interpreted using the following ranges: r = 0.0 to 0.3 (negligible); r = 0.3 to 0.5 (low); 0.5 to 0.7 (moderate); 0.7 to 0.9 (high); 0.9 to 1.0 (very high) (Mukaka, 2012). An a priori alpha level of 0.05 was set, and an adjustment for multiple comparisons was made using the Holm's Step-Down procedure (Zheng, 2018).

Results

General Patient Demographics

Data from 123 individual patients who fit the inclusion and exclusion criteria were examined. The majority of patients were male (80.5%, *n* = 99), with an average age of 60 years (*range* = 38 years). Following review of the data set, it was noted that not all patients attended all four scheduled follow-up appointments. Furthermore, due to constraints typically faced by clinicians in these appointments (e.g., time, fluoroscopy equipment availability), some patients

received just the MBS alone; others were administered the MDADI questionnaire, but did not complete an MBS exam.

Research Objective One: Trends in MBSImP and MDADI Composite Scores

Descriptive Statistics for Patients with MBSImP PI Data

Demographics for patients who completed an MBS exam and had MBSImP PI scores available (n = 116) are detailed in table 1. The majority of this patient subgroup were male (81.9%, n = 95), with an average age of 59.8 years old (*range* = 35 years). Fifty four percent of patients (n = 63) received both surgery and (C)RT as part of their cancer treatment. Data on T classification were unavailable for three patients. The majority of patients had a T2 tumor (32.8%, n = 38). There were two cases with an unknown primary tumor (Tx). The appointment with the highest number of patients in attendance was the pre-treatment appointment (n = 92), followed by the six (n = 62) and 12 months (n = 56) appointments. The appointment most often missed was the one month appointment (n = 48). The highest percentage of patients having a g-tube present was at one month (25.0%, n = 12), and the lowest was at pre-treatment (1.1%, n = 1).

Table 1
Descriptive Statistics for Patients with MBSImP PI Scores

	Overall (n = 116)		Pre-treatment (n = 92)		1 month (n = 48)		6 months (n = 62)		12 months (n = 56)	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*n*	*%*
Mean age in years (min-max)	59.8 (42-77)		60.2 (43-77)		60.6 (43-77)		59.9 (43-77)		58.8 (42-76)	
Sex										
Male	95	81.9	75	81.5	40	83.3	53	85.5	49	87.5
Female	21	18.1	17	18.5	8	16.7	9	14.5	7	12.5
G-tube presence										
Yes	-	-	1	1.1	12	25.0	12	19.4	10	17.9
No	-	-	90	98.9	36	75.0	50	80.6	46	82.1
T-stage										
T1	26	22.4	23	25.0	9	18.8	11	17.7	16	21.3

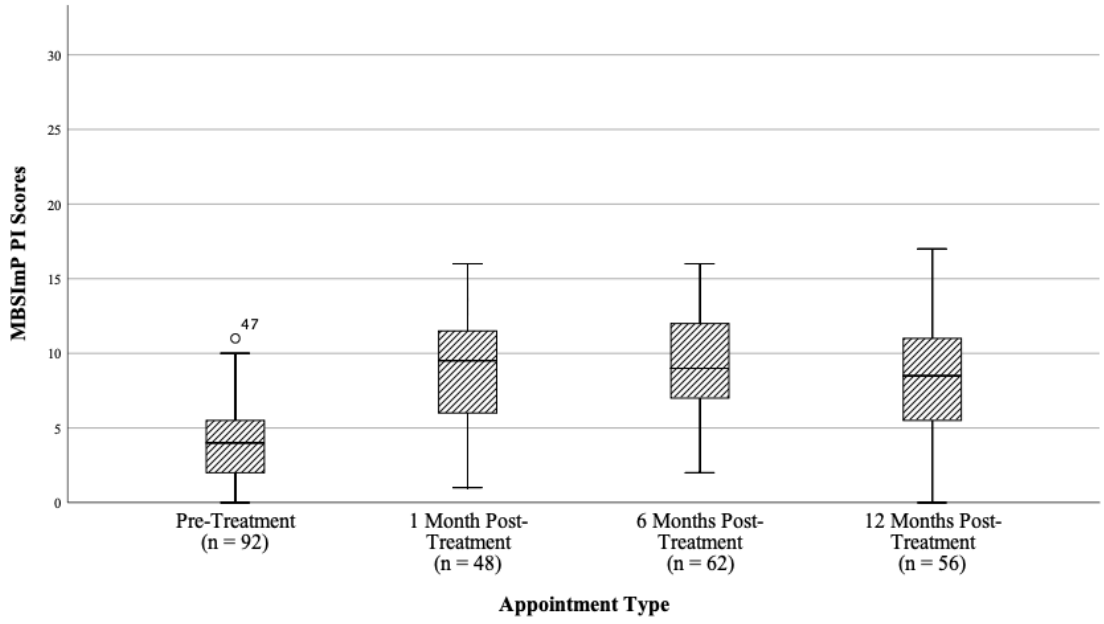
T2	38	32.8	28	30.4	15	31.3	19	30.6	26	34.7
T3	28	24.1	24	26.1	14	29.2	21	33.9	18	24.0
T4	19	16.4	13	14.2	8	16.7	11	17.7	13	17.4
Tx	2	1.7	1	1.1	1	2.1	0	0.0	2	2.7
Missing data	3	2.6	3	3.3	1	2.1	0	0.0	0	0.0
Treatment modality										
Surgery	31	26.7	28	30.4	15	31.3	15	24.2	18	24.0
Organ preservation	22	19.0	17	18.5	-	-	13	21.0	13	17.3
Surgery + (C)RT	63	54.3	47	51.1	33	68.8	34	54.8	44	58.7

Abbreviations: n = number of patients; g-tube = gastronomy tube; Tx = unknown primary tumor; (C)RT = chemotherapy or chemoradiation therapy.
Note. Age reported is the age of participants reported at the first appointment date attended. Each appointment column represents all patients who attended that appointment type, with some patients attending all four, while others may have attended just one appointment. T4 includes T4, T4a, and T4b.

Trends in MBSImP PI Scores

Median MBSImP PI scores were calculated for the overall sample (including all treatment modalities). Medians and interquartile ranges for MBSImP PI scores are reported in table 2. Overall, the lowest median (i.e., best) MBSImP PI scores were found for the pre-treatment appointment (*Mdn* = 4.00, *IQR* = 3.00), with an increased (i.e., worsened) score at one month post-treatment (*Mdn* = 9.00, *IQR* = 6.00). This median score remained stable from one month to six months post- (*Mdn* = 9.00, *IQR* = 6.00) and 12 months post-treatment (*Mdn* = 9.00, *IQR* = 6.00). These data are visually represented in figure 1 for all patients who had this score available.

Figure 1
MBSImP PI Scores for All Treatment Modalities



Abbreviations: PI = pharyngeal impairment.
Note. MBSImP PI scores plotted for each appointment type. Higher scores indicate higher impairment.

Data were then stratified by treatment modality, with MBSImP PI median scores presented in table 2. Irrespective of treatment modality, MBSImP PI scores followed the same general trend as the overall sample (i.e., including all treatment modalities) (figure 2). Upon visual inspection, patients who received organ preservation treatment appeared to have lower (i.e., better) median scores than patients who received surgery alone or both surgery and (C)RT at six and 12 months. Furthermore, patients who received both surgery and (C)RT had the highest (i.e., worst) median MBSImP PI scores at six and 12 months when compared to other treatment modalities.

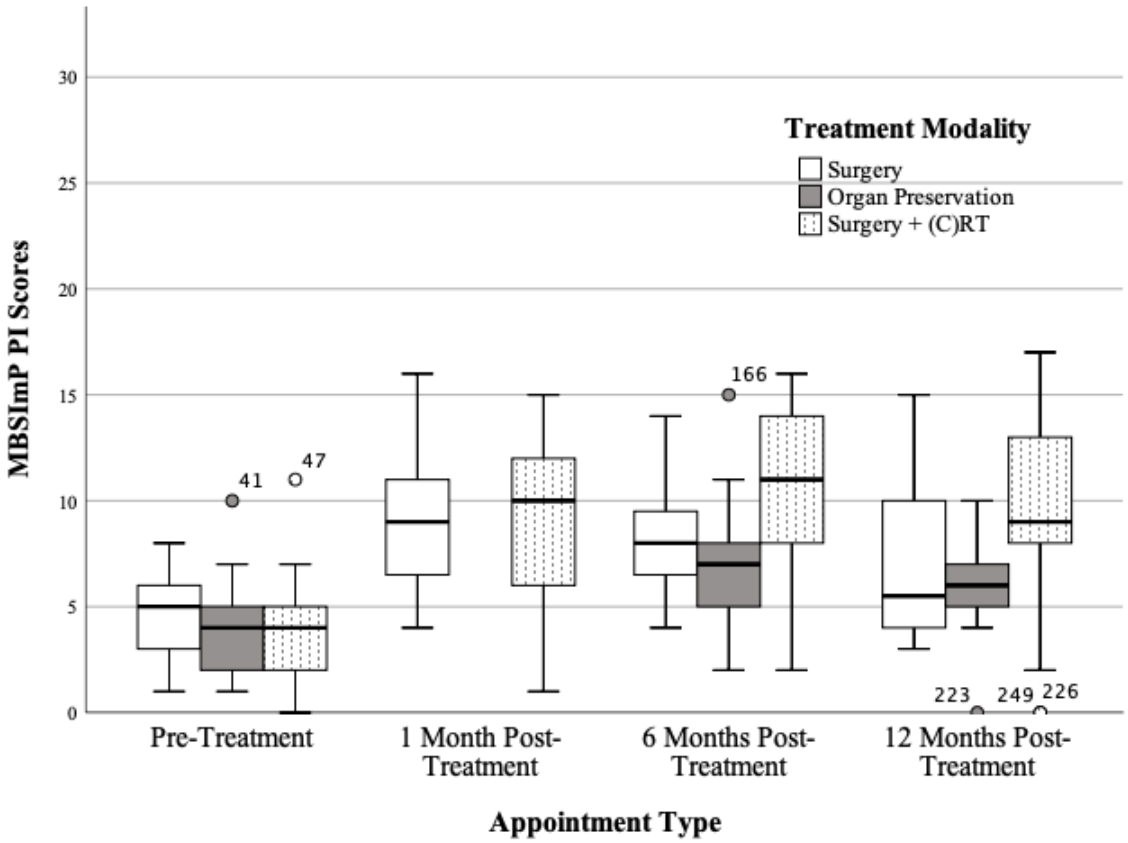
Table 2
MBSImP PI Scores Stratified by Treatment Modality

	All treatment modalities (n = 258)	Surgery alone (n = 68)	Organ preservation (n = 41)	Surgery + (C)RT (n = 149)

	Mdn	*IQR*	*Mdn*	*IQR*	*Mdn*	*IQR*	*Mdn*	*IQR*
All appointments combined	7.00	6.50	6.00	4.50	5.00	3.00	8.00	7.00
Pre-treatment	4.00	3.00	5.00	3.00	4.00	4.00	4.00	3.00
1 month post-treatment	9.00	6.00	9.00	5.00	-	-	10.00	6.00
6 months post-treatment	9.00	6.00	8.00	4.00	7.00	4.00	11.00	6.00
12 months post-treatment	9.00	6.00	5.50	6.00	6.00	2.00	9.00	5.00

Abbreviations: (C)RT = chemotherapy or chemoradiation therapy; *IQR* = interquartile range.
Note. Higher scores indicate higher impairment.

Figure 2
MBSImP PI Scores Stratified by Treatment Modality



Note. MBSImP PI scores plotted for each appointment type and stratified by treatment modality. Data for the one month post-treatment appointment only included MBSImP PI scores for patients who received surgery alone or surgery and (C)RT, as clinical protocol does not include this appointment type for those receiving organ preservation treatment. Higher scores indicate higher impairment.

Descriptive Statistics for Patients with MDADI Composite Score Data

As in the previous section, demographics for patients who completed the MDADI and had a score available (n = 123) were detailed first (table 3). One patient was excluded from the overall

sample due to missing details on treatment modality; this patient also was deceased following the pre-treatment appointment. The majority of patients were male (80.5%, *n* = 99), with an average age of 60 years old (*range* = 38 years). Fifty four percent of patients (*n* = 66) received both surgery and (C)RT as part of their cancer treatment. Data on T-classification were unavailable for four patients. The majority of patients were had a T2 tumor (30.1%, *n* = 37). There were five cases with an unknown primary tumor (Tx). The number of patients attending their pre-treatment appointment was highest of the four appointments (*n* = 96), followed by six months (*n* = 66), and 12 months (*n* = 60). Few patients attended their one month appointment (*n* = 49). The highest percentage of patients needing a g-tube was at one month post treatment (24.5%, *n* = 12), and the lowest was at pre-treatment (1%, *n* = 1).

Table 3

Descriptive Statistics for OPSCC Patients who completed MDADI Questionnaire

	Overall (*n* = 123)		Pre-treatment (*n* = 96)		1 month (*n* = 49)		6 months (*n* = 66)		12 months (*n* = 60)	
	n	*%*	*n*	*%*	*n*	*%*	*n*	*%*	*N*	*%*
Mean age in years (min-max)	60.0 (39-77)		60.6 (43-77)		60.3 (39-77)		69.8 (39-77)		59.2 (39-76)	
Sex										
Male	99	80.5	77	80.2	41	83.6	56	84.8	51	85.0
Female	24	19.5	19	19.8	8	16.3	10	15.2	9	15.0
G-tube presence										
Yes	-	-	1	1.0	12	24.5	14	21.2	11	18.3
No	-	-	95	99.0	37	75.5	52	78.8	49	81.7
T-stage										
T1	25	20.3	23	24.0	9	18.4	10	15.2	12	20.0
T2	37	30.1	26	27.1	15	30.6	21	31.8	19	31.7
T3	32	26.0	27	28.1	15	36.6	21	31.8	16	26.7
T4	20	16.3	14	14.5	7	14.2	12	18.2	11	18.3
Tx	5	4.1	2	2.1	2	4.1	2	3.0	2	3.3
Missing data	4	3.3	4	4.2	1	2.0	0	0.0	0	0.0
Treatment modality										

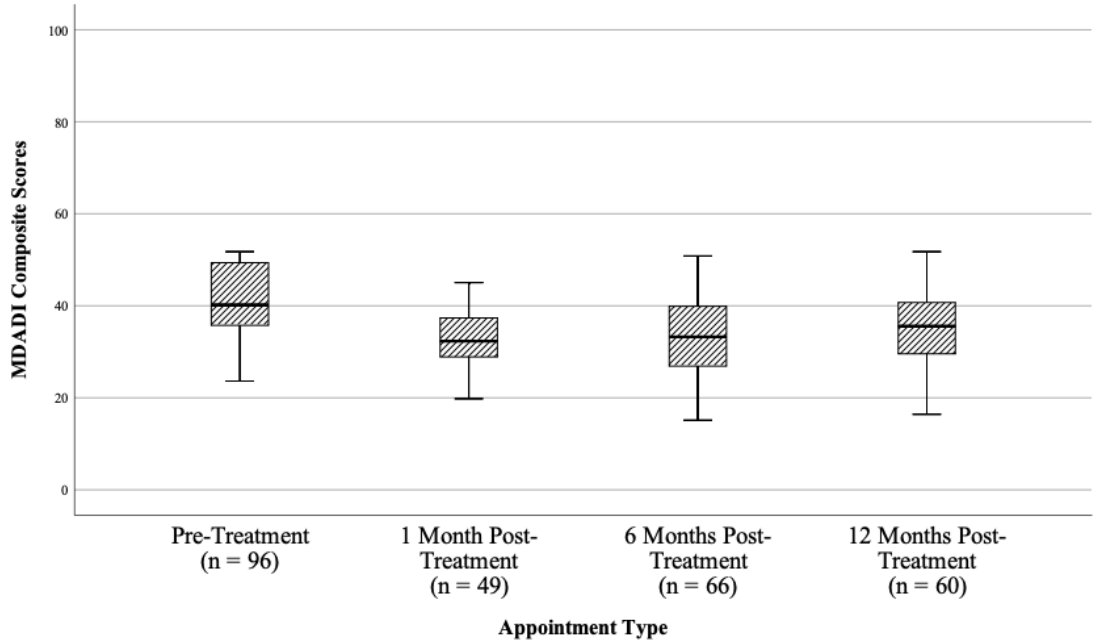
Surgery	31	25.2	28	29.2	16	32.7	16	24.2	10	16.7
Organ preservation	26	21.1	18	18.8	-	-	13	19.7	12	20.0
Surgery + (C)RT	66	53.7	50	52.1	33	67.3	37	56.1	38	63.3

Abbreviations: n, number of patients; g-tube, gastronomy tube; Tx*,* unknown primary tumor; (C)RT, chemotherapy or chemoradiation therapy.
Note. Age reported is the age of participants reported at the first appointment date attended. Each appointment column represents all patients who attended that appointment type, with some patients attending all four, while others may have attended just one appointment.

Trends in MDADI Composite Scores

Median MDADI composite scores were calculated for the overall sample (i.e., including all treatment modalities). Medians and interquartile ranges for MDADI composite scores are summarized in table 4. Patients self-reported the highest (i.e., best) median composite scores pre-treatment (*Mdn* = 40.18, *IQR* = 13.82), the lowest (i.e., worst) median scores at one month post-treatment (*Mdn* = 32.30, *IQR* = 8.79), and higher (i.e., improved) scores six months (*Mdn* = 33.25, *IQR* = 13.15) and 12 months post-treatment (*Mdn* = 35.56, *IQR* = 11.22). Notably, median scores at 12 months remained lower than pre-treatment scores (figure 3).

Figure 3
MDADI Composite Scores for All Treatment Modalities



Note. MDADI composite scores plotted for each appointment type. Lower scores indicate lower functioning.

Data were stratified by treatment modality and median MDADI composite scores were again presented in table 4 for each subgroup. Patients who received surgery alone or organ preservation treatment followed the same general trend as the overall sample (i.e., including all treatment modalities), but patients who received both surgery and (C)RT did not follow the same trends (figure 4). This latter subgroup reported their highest (i.e., best) median MDADI composite scores pre-treatment (*Mdn* = 41.27, *IQR* = 12.52); however, their lowest (i.e., worst) median MDADI composite scores were reported at the six month appointment (*Mdn* = 30.96, *IQR* = 10.02) rather than the first month appointment (*Mdn* = 32.54, *IQR* = 8.35). These scores were higher (i.e., better) at their 12 month appointment (*Mdn* = 32.13, *IQR* = 9.57) (figure 4c). Furthermore, visual inspection of figure 4 suggests this patient group reported the lowest (i.e., worse) median MDADI composite scores at their six and 12 month appointments when compared to patients who received surgery alone or organ preservation treatment.

Table 4

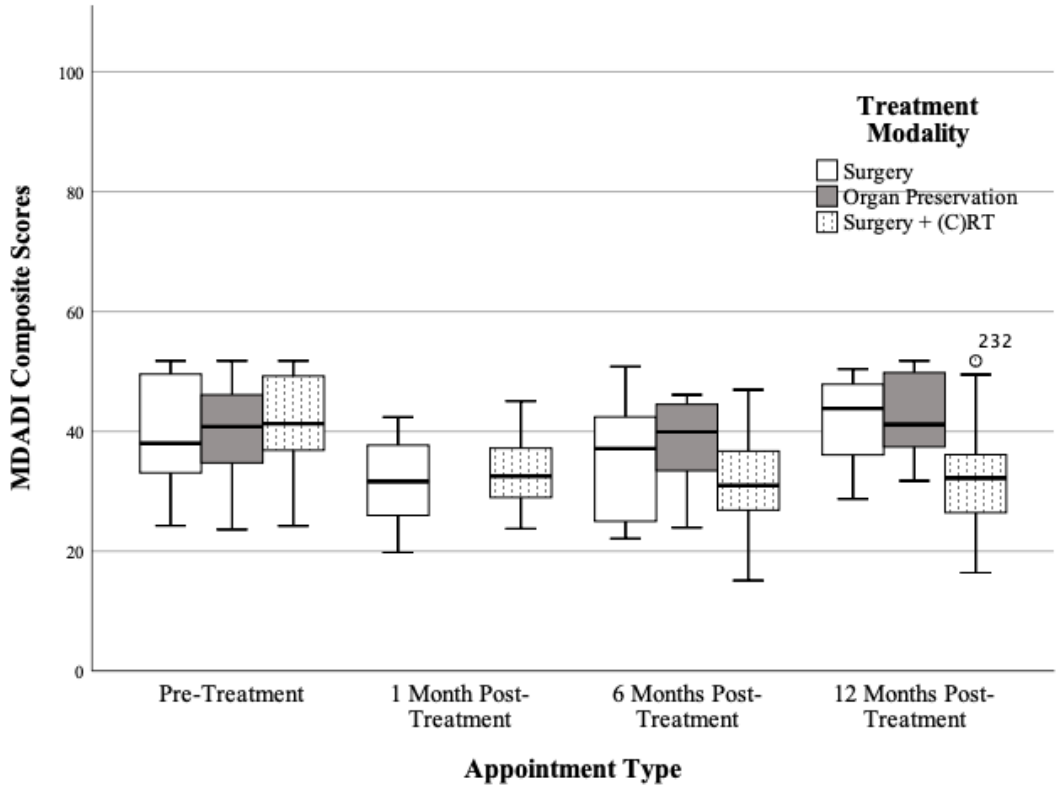
MDADI Composite Scores

	All treatment modalities (*n* = 271)		Surgery alone (*n* = 70)		Organ preservation (*n* = 43)		Surgery + (C)RT (*n* = 158)	
	Mdn	*IQR*	*Mdn*	*IQR*	*Mdn*	*IQR*	*Mdn*	*IQR*
All appointments combined	36.44	12.37	37.38	18.03	40.18	10.65	34.76	10.92
Pre-treatment	40.18	13.82	38.01	17.65	40.79	13.00	41.27	12.52
1 month post-treatment	32.30	8.79	31.64	12.25	-	-	32.54	8.35
6 months post-treatment	33.25	13.15	37.14	17.93	39.90	11.81	30.96	10.02
12 months post-treatment	35.56	11.22	43.82	12.09	41.15	12.55	32.13	9.57

Abbreviations: n = number of patients; (C)RT = chemotherapy or chemoradiation therapy; *Mdn* = median; *IQR* = interquartile range.

Note. Lower scores indicate lower functioning.

Figure 4
MDADI Composite Scores Stratified by Treatment Modality



Note. MDADI composite scores plotted for each appointment type and stratified by treatment modality. Data for the one month post-treatment appointment only included MDADI composite scores for patients who received surgery alone or surgery and (C)RT, as clinical protocol does not include this appointment type for those receiving organ preservation treatment. Lower scores indicate lower functioning.

Research Objective Two: Relationship between MBSImP PI and MDADI Composite Scores

Spearman's correlations between MBSImP PI scores and MDADI composite scores at various time points are outlined in table 5. For the overall sample (i.e., including all treatment modalities), MBSImP PI and MDADI composite scores were weakly in agreement (i.e., negatively correlated) at the pre-treatment (r_s = -322, p = .002) and 12 month appointments (r_s = -.418, p = .001). There was no significant correlation between the two outcomes at the one month or six month post-treatment appointments. Following stratification by treatment modality, there was only one significant moderate correlation noted for the pre-treatment appointment for patients who received organ preservation treatment (r_s = -.662, p = .004).

Table 5

Correlations Between MBSImP PI and MDADI Composite Scores at Various Appointments

	Pre-Treatment		1 Month Post Treatment		6 Months Post Treatment		12 Months Post Treatment	
	n	r_s *p*	*n*	r_s *p*	*n*	r_s *p*	*n*	r_s *p*
All treatment modalities	92	**-.322*** .002	48	-.304 .035	62	-.371 .003	56	**-.418*** .001
Surgery	28	-.386 .043	15	-.420 .119	15	-.310 .261	10	-.732 .016
Organ preservation	17	**-.662*** .004	-	-	13	-.236 .438	11	-.327 .326
(C)RT + Surgery	47	-.176 .237	33	-.273 .125	34	-.167 .344	35	-.137 .431

Abbreviations: n = number of patients; r_s, = Spearman's rho; (C)RT = chemotherapy or chemoradiation therapy.
Note. *Correlation is significant at the level of 0.0125 (pre-treatment); 0.017 (1 month post-treatment); 0.025 (6 months post-treatment); and 0.05 (12 months post-treatment) 2-tailed.

Discussion

The present study was a retrospective chart review of clinical data collected at a tertiary health center. The primary research objective was to report on trends in MBSImP PI and MDADI composite scores at four time points within the first year following treatment. Both clinician-driven and patient-reported swallowing outcomes followed the hypothesized trends: specifically, MBSImP PI scores worsened one month post-treatment and remained impaired at six and 12 months, while MDADI composite scores worsened one month post-treatment and subsequently improved at six and 12 months. The secondary research objective was to study the relationship between clinician-driven (in this case, MBSImP PI) and patient-reported (in this case, MDADI composite scores) swallowing outcomes at the same four time points, as previous literature suggested that there may be an incongruence between these two types of measures. The present study found weak agreement (noted as a weak negative correlation due to scores in opposing directions) between MBSImP PI and MDADI composite scores at the pre-treatment (r_s = -322, *p*

= .002) and 12 month appointments (r_s = -4.18, p = .001). No significant correlations were found at one and six months appointments. The implications of the primary and secondary findings are discussed in turn below.

Objective One: Trends in MBSImP PI and MDADI Composite Scores

Trends in MBSImP PI Scores

Looking at MBSImP PI scores, the findings from this study appear to align to previously reported trends in the literature (Borggreven et al., 2007; Schwartz et al., 2010). Specifically, whether looking at all treatment modalities combined or at each modality subgroup separately, MBSImP PI scores worsened one month post-treatment and remained impaired at six and 12 months. Similar trends have been reported in the literature, even when using different clinician-driven measures (e.g., Oropharyngeal Swallowing Efficiency (OPSE) measure), and even 24 months following treatment (Hutcheson et al., 2014; Schwartz et al., 2010). These impairments can be attributed to a variety of reasons, such as the resection of critical structures for swallowing (Pauloski & Logemann, 2000), the resection of muscles and nerves leading to sensory-motor impairments and incoordination (Baijens et al., 2021), and/ or chemoradiation toxicity resulting in edema, mucositis, pain, and tissue fibrosis (Wall et al., 2013). It is also worth noting that most patient participants in this study experienced some level of impairment in swallowing function preceding cancer treatments. This pre-cancer treatment swallowing impairment highlights the value of conducting MBS studies at the pre-treatment mark, especially considering that baseline swallowing function has been shown to be an important predictor of post-treatment swallow function (Hutcheson et al., 2015).

MBSImP PI Scores Stratified by Treatment Modality

To the best of our knowledge, this is the first study to report swallowing outcome trends in individual treatment modalities relative to one another. When visually inspecting trends in MBSImP PI scores across treatment modalities (figure 2), organ preservation patients appeared to have the best swallowing outcomes following treatment. These results should be interpreted with caution as organ preservation treatments have been reported to have late onset dysphagia, with some patients experiencing deterioration in swallow function months or years following treatment (Hutcheson et al., 2012; Patterson, 2019). In some cases, organ preservation patients are at risk for late effects that may go unrecognized, and may only be identified when they require hospitalization for aspiration pneumonia (Patterson, 2019). As a late deterioration in swallowing function has been reported in this patient subgroup, continued follow-up beyond 12 months post-treatment may be an effective strategy when monitoring their clinical outcomes.

On the other hand, patients who received both surgery and adjuvant (C)RT had the most impaired PI scores at six and 12 months post-treatment relative to patients who received other treatment modalities. Further investigation revealed that the surgery and adjuvant (C)RT subgroup also had the highest proportion of T4, T4a, and T4b tumors (table 6) compared to patients receiving other treatment modalities. This observation may suggest that patients receiving surgery and adjuvant (C)RT had larger tumors requiring more aggressive interventions. Interestingly, this patient subgroup also had the greatest spread (min, max) of MBSImP PI scores at six (2, 16) and 12 months (0, 17) (figure 2). This finding suggests that patients who receive both surgery and (C)RT are expected to have more variable swallowing outcomes, especially when compared to organ preservation patients (6 months min, max: 2, 15; 12 months min, max: 0, 10). However, the reader is again cautioned against making direct comparisons in swallowing outcomes based on

treatment modality as many patient-related factors (e.g., cancer stage and comorbidities) may play a role when selecting the appropriate intervention and be considered confounds.

Table 6
MBSImP PI Sample: T-Stages Stratified by Treatment Modality

	T-stage				
	T1	T2	T3	T4	Tx
All treatment modalities (*n* = 116)	22.4%	32.8%	24.1%	12.1%	1.7%
Surgery (*n* = 31)	29.0%	41.9%	16.1%	3.2%	0.0%
Organ preservation (*n* = 22)	31.8%	22.7%	31.8%	13.6%	0.0%
(C)RT + Surgery (*n* = 63)	15.9%	31.7%	25.4%	**23.9%**	3.2%

Abbreviations: Tx = unknown primary tumor; (C)RT = chemotherapy or chemoradiation therapy.
Note. Percent T-stages of patients included in the MBSImP PI sample stratified by treatment modality. T4 includes T4, T4a, and T4b. There were three patients with T-stage information missing from their chart, hence some rows will not add up to 100%.

Trends in MDADI Composite Scores

Similar to clinician impressions from the literature, a general consensus exists in the literature for trends in patient perceptions of their own swallowing outcomes within the first year of treatment (Goepfert et al., 2017; Roe et al., 2014). In the present study, when all treatment modalities were included, MDADI composite scores followed hypothesized trends, whereby scores worsened one month post-treatment, and subsequently improved at six and 12 month appointments. As previously highlighted by Hutcheson et al. (2014), this may suggest that patients might be developing coping strategies to compensate for their swallowing impairments following cancer treatment. This trend of progressive improvement in MDADI composite scores has been found to continue beyond five years following cancer treatment in approximately a third of patients (Martin et al., 2018). Observations made with respect to MDADI scores, however, are in contrast to trends noted in MBSImP PI scores; specifically, clinical impressions based on MBS studies did not demonstrate an improvement in swallowing outcomes six and 12 months post-treatment. This incongruence between the two assessment tools revealed that clinicians and researchers should not

rely solely on patient-reported outcomes as a means to evaluate swallow safety and efficiency in patients with dysphagia. This is especially of importance considering that patient-reported measures have been found to be used more frequently (Li et al., 2020). Complementing patient-reported measures with instrumental ones may offer a more complete picture of both clinical swallow safety and efficiency, as well as the impact of these difficulties on patient quality of life. This area merits further investigation to explore if improvements reported on MDADI by patients are a reflection of strategies to cope with dysphagia.

MDADI Composite Scores Stratified by Treatment Modality

When visually inspecting MDADI composite scores across treatment modalities (figure 4), the trends were less clear. Although it is difficult to interpret variations in median scores that are not clinically meaningful (i.e., greater than 10, the MCID for this tool), group differences in MDADI scores stratified by treatment modality did appear that are worth mentioning here.

Firstly, the median scores in the surgery group worsened by 6.37 points at one month but improved beyond pre-treatment levels at 12 months (table 4). This suggests that patients who received surgery alone surpassed their pre-treatment reports of swallowing function one year following treatment. Interestingly, this patient subgroup reported relatively more impaired pre-treatment swallowing function than other groups, indicating a worse initial point of comparison (figure 4). This depressed level of perceived swallowing function may have resulted in these patients reporting better than baseline swallowing function at 12 months post-treatment. Furthermore, patients who received surgery alone appeared to have better MDADI composite scores than patients who received other treatment modalities at 12 months (figure 4). Notably, patients who received surgery alone may have attended fewer cancer treatment appointments, whereas organ preservation and surgery and (C)RT treatments may have required multiple hospital

visits over a longer period of time. These better MDADI scores reported by patients who receive surgery might be attributed to patients experiencing a shorter period of cancer treatment, resulting in lesser psychosocial impacts .These findings align with those from previous studies where patients who underwent surgery as a single modality reported the best QoL compared to other treatment modalities (Broglie et al., 2013; Tschudi et al., 2003). Patients in these studies reported less difficulty related to dry mouth, integrity of dentition, and lack of sensation than patients who received organ preservation treatments or adjuvant (C)RT (Broglie et al., 2013; Tschudi et al., 2003). Importantly, these cited studies noted that patients who received surgical intervention as a single modality likely had small primary tumors, and no (or one single) lymph-node metastasis (Broglie et al., 2013). Thus, it is difficult to conclude that patients who receive surgery alone reported higher swallow related QoL outcomes as a result of treatment modality alone.

On the other hand, MDADI composite scores from patients who received organ preservation treatment appeared to remain stable throughout the first year following treatment. These findings are in alignment with other research that reported near-baseline MDADI scores 24 months following organ preservation treatment (Hutcheson et al., 2014). However, this observation is unlike findings from other studies, where MDADI scores of organ preservation patients declined by more than 20 points and gradually improved from the six month appointment onwards (Goepfert et al., 2017; Roe et al., 2014). Differences between patient MDADI reports across studies may be a reflection of treatment decisions (i.e., which patients receive organ preservation, and which do not) as well as additional variables such as varying radiation doses (i.e., higher doses have been associated with poorer swallowing function (More et al., 2013)) and/ or patient comorbidities.

Lastly, MDADI scores from patients who received both surgery and (C)RT worsened by 8.73 points at the one month appointment and did not recover to near pre-treatment levels in the one year of follow-up. These findings suggest that these patients remained at a depressed level of functioning relative to their baseline measures. Moreover, patients who received both surgery and (C)RT reported relatively greater swallow impairments than patients who received other treatment modalities at 12 months following treatment. Of note, at the 12 months appointment, this patient subgroup had a median MDADI composite score that was 11.69 points worse than that of patients who received surgery alone (i.e., higher than the MCID of 10 points). These poorer patient-reported swallowing outcomes in patients who received both surgery and (C)RT may reflect poorer coping mechanisms. One study found that patients who received multimodal HNC treatments were 2.78 times more likely to develop mental health disorders than patients who received a single treatment modality (Lee et al., 2019). This greater likelihood of mental health disorders may impact this patient subgroup's ability to develop coping mechanisms that have been associated with improved MDADI scores in the literature (Hutcheson et al., 2014). These patients did however have more impaired swallow function (i.e., poorer MBSImP scores) relative to patients who received other treatment modalities at 12 month post treatment (figure 2). The poor clinically validated swallowing function also may have contributed to poor patient-reports of swallow function.

With regards to patients who received both surgery and (C)RT, the findings of this study did not align with similar studies. For instance, other researchers found that patients who received surgery followed by adjuvant (C)RT had better patient-reported swallowing outcomes than organ preservation patients 12 months following treatment (More et al., 2013; Oates et al., 2014). However, Oates et al. (2014) included different QoL measures and More et al. (2013) reported

specifically on patients undergoing transoral robotic surgery (TORS). The divergence in findings points to the importance of standardization of assessment tools when trying to understand dysphagia specific QoL (Roets et al., 2018), as the absence of a gold standard reporting tool makes direct comparisons and aggregation of data across studies difficult. Furthermore, although the findings of this current study are exploratory in nature and should be interpreted with caution, it is important to note the differences in MDADI composite scores reported when data were stratified by treatment modality. Thus, caution should be taken when grouping patients who received different modalities into the same data set as these groups may have different impressions of their swallowing function.

Objective Two: The Relationship Between Clinician-Driven and Patient-Reported Measures

Previous studies have reported on the relationship between clinician-driven and patient-driven measures. In these, researchers have often grouped post-treatment appointments up to one year (Arrese et al., 2019; Gillespie et al., 2005; Kendall et al., 2014; Rogus-Pulia et al., 2014). Looking at aggregate data in this fashion may obfuscate variations in this relationship that may occur during the first year following treatment. The first year of survivorship is a critical time frame to investigate as it includes several events that may occur such as adjuvant therapy, the introduction of swallowing rehabilitation, and the resolving of post-treatment inflammation. The present study considered the relationship between these two types of assessment tools at four specific time points within the first year of treatment. When considering this relationship with all treatment modalities combined, an agreement (i.e., negative correlation, which indicate the two measures were in alignment) was found between MBSImP PI and MDADI composite scores at all appointments. However, only two of these correlations were significant, namely at the pre-treatment (r_s = -.322, p = .002) and 12 month appointments (r_s = -.418, p = .001). These findings

do not align with findings of previous studies that reported a discordance between clinician-driven and patient-reported outcomes at least one year following treatment (Gillespie et al., 2005; Kendall et al., 2014).

Previous researchers who have reported a lack of congruence between these two measures have hypothesized that patients may lack awareness when reporting symptoms of their dysphagia (Rogus-Pulia et al., 2014). This misalignment between clinician-driven and patient-reported outcomes has been documented even when patients exhibit poor swallowing outcomes on an MBS evaluation (Gillespie et al., 2005). The correlations found in the present study may reflect a possible increased patient awareness of dysphagia symptoms following a two-hour education program pre-cancer treatment. During this educational session, clinicians discuss treatment-specific details along with short-term and long-term swallowing outcome expectations. This may have impacted the findings in the current study, as setting realistic recovery and QoL expectations has been shown to be predictor of functional outcomes and patient satisfaction following other medical treatments (Mahomed et al., 2002). As patient awareness and expectations may play a role in patient-reported swallowing outcomes, educational programs such as this may be an important consideration when studying QoL measures in future studies. One study limitation specific to this objective is that the relationship between these two tools may have been confounded by the timing of MDADI questionnaire completion relative to review/ discussion of MBS findings between the patient and clinician. For example, if MBS findings were discussed prior to the patient completing MDADI questionnaires, MDADI scores may reflect a combination of both patient and clinician impressions. While it is known that patients may complete their MDADI questionnaires before or after the MBS appointment, this information was not documented for participants in this study.

Correlations Stratified by Treatment Modality

When stratifying by treatment modality, only one moderate correlation between clinician-driven (i.e., MBSImP PI scores) and patient-reported (i.e., MDADI composite scores) swallowing outcomes was found for organ preservation patients at their pre-treatment appointment (r_s = -662, p = .004), suggesting agreement between clinician impression and patient-reported outcomes at this appointment. No other significant correlations were found. It should be noted that these findings come from small sample sizes and should be considered exploratory in nature. The nature of these preliminary findings highlights the importance of considering treatment modality when investigating OPSCC patient swallowing outcomes.

Limitations

Although this study provides unique insights into dysphagia outcomes throughout the first year of cancer survivorship, as well as the relationship between clinician-driven and patient-reported swallowing outcomes, it is not without its limitations. First, this was a retrospective chart review, and hence, this study suffered from limitations typical of this study design (Wilkinson Krista, 2016). Data were obtained from medical records at a single tertiary site, resulting in a population convenience sample and missing data. These challenges may have an impact on the generalizability of findings; thus, further in investigation in this area would be beneficial. Furthermore, anecdotal clinical experience has shown that patients do not reliably attend all their scheduled appointments. Collecting data only from patients who attended their medical appointments may have led to selection bias, as this group may have differed from patients who had otherwise missed their medical appointments. It also should be noted that the patient sample was predominantly male, although there is no reason to believe that women may have different clinician-driven or patient-reported swallowing outcomes (Kendall et al., 2014). Lastly, due to the

nature of the OPSCC treatment, random assignment was not possible, as many factors are considered when designing individualized treatment plans. Despite several studies published examining treatment modalities and swallowing outcomes, it is challenging to understand how each treatment modality impacts swallowing function separately due to the non-randomized nature of the research and the variation in methodologies (Stelmes et al., 2019). Despite the aforementioned limitations, we have demonstrated through this retrospective chart review that when clinics administer both types of swallowing measures as part of their standard clinical care, there is a unique opportunity to report on subtle changes in swallowing function during a critical time in patients' cancer care continuum.

Conclusion

This retrospective study provides clinicians with a trajectory of pre-treatment and post-treatment swallowing outcomes from both a clinical and patient perspective. Findings from this work may allow patients and clinicians to set realistic recovery and QoL expectations. Furthermore, understanding long-term swallowing outcomes may allow clinicians to personalize dysphagia rehabilitation and potentially prioritize patients who have been uncharacteristically negatively impacted by cancer treatment. This could be achieved by comparing an individual's MBSImP PI and MDADI composite scores to the group data obtained in this study.

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