Critical Review:

Impairments in Swallowing as a Result of Oral Cancer and Surgical Intervention

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This critical review examines literature regarding swallowing outcomes following surgical resections due to malignancy in the oral cavity. This paper asks two fundamental questions to meet this goal; Does surgical intervention for oral cancer affect swallowing and if so, how? And what is the trajectory of swallowing recovery in the months following surgical resection? Four journal articles were evaluated and critically examined. The research designs included one case-control study, and three case series studies. Overall, findings suggest that the amount of tissue resected and type of surgery or reconstruction can have an impact on post-operative swallowing function. In the year following surgery, there is conflicting evidence over swallowing outcomes. This may be dependent on surgery type, location of the resection, swallowing function measurements or design of each of the studies. Integrating this information into clinical practice and direction for future research are discussed.

Introduction

Swallowing is a well-coordinated task involving multiple systems timed in a precise fashion. It requires structures to organize, maintain and move nutritional contents from the oral cavity to the esophagus. The careful formation and movement of the bolus to eventually evoke a swallow occurs during the oral preparatory and transport phases. During these phases the lips, tongue, soft palate, faucial pillars, and posterior pharyngeal walls are pivotal in executing a swallow. When these tissues have been physically altered, questions regarding functional integrity can arise.

Changes in anatomy can occur for many reasons including tumor formation or the surgical methods to remove excessive growth. Logemann (1998) mentions six frequently occurring tumor sites in the oral cavity. These include the anterior floor of the mouth, tongue (anterior or lateral), lateral floor of the mouth or the tonsils, base of the tongue, hard palate and the soft palate. Surgical intervention is currently one of the two principle methods practiced to remediate the above cancer sites (Canadian Cancer Society, 2014). Most surgical involvement occurs when the tumor site is small (Logemann, 1998). Smaller tumor sites allow the surgeon to remove both malignant and neighboring tissue with fewer complications. For larger growths, extraction of the tissue may be followed by the addition of non-native tissues (flaps or graft) with reconstructive surgery (Logemann, 1998).

Understanding the implications of surgical intervention is not only important for future treatment, but for recognizing the impact it has on the client. This includes swallowing efficiency and the consequences of dysphagia. Downstream effects of dysphagia in head and neck cancer can result in nutritional deficits and quality of life concerns (Nguyen, N., et al., 2005). Acknowledging both the positive and negative consequences of oral cancer and surgical resections can help improve patient care, as well as the contribution of Speech-Language Pathologists to the medical team.

Objective

The primary objective of this paper is to explore the effects of oral cancer on swallowing. This paper asks two fundamental questions to meet this goal; Does surgical intervention for oral cancer affect swallowing and if so, how? And what is the trajectory of swallowing in the months following a surgical resection?

Methods

Search Strategy

Literature was restricted to peer-reviewed journals from North American and Europe. Search engines used to identify journal articles included CINAHL, MED-LINE and PubMed. Search terms included: ((oral cancer) AND (swallowing) OR (dysphagia) AND (resection) OR (surgical intervention)).

Selection Criteria

Articles selected for inclusion were based on the following criteria: (a) individuals who received surgical intervention in the oral cavity due to malignancy (b) Modified Barium Swallow Studies

(MBSS) were used to evaluate swallows (c) comorbidities such as neurologic disorders, previous cancer or pre-existing swallowing or speech disorders were disclosed and accounted for or not present (d) information surrounding type of surgery and concurrent treatment was available.

Data Collection

Results of the literature yielded four studies that matched the aforementioned criteria. The research designs included one case-control studies and three case series studies.

Results

Question 1

Does surgical intervention for oral cancer affect swallowing and if so, how?

McConnel, et al. (1994) evaluated swallowing function on 30 oral cancer patients who received surgical resections. Surgical information including volume resected and reconstruction, was collected and compared to swallowing 3 months postoperatively. Two consistencies, liquid and paste, of one volume were given to patients.
Swallowing function for the oral phase was measured through oral and pharyngeal transit time, percentage oral residue and oropharyngeal swallowing efficiency (OPSE). In a factor analysis of the variables, oropharyngeal swallowing efficiency was shown to be representative of all other measures and used as a single overall measure of swallowing function. Appropriate statistical analyses including unpaired t-tests, a factor analysis and Pearson correlation coefficients were used to examine the data. The researchers concluded the greater the amount of oral tongue and tongue base resected, the less efficient the oropharyngeal swallow was. Furthermore, results showed that the patients experienced greater impairment on paste consistencies as opposed to liquid boluses.

This case series was the first to evaluate the effect of surgery on swallowing. It brought attention to dysphagia following surgical intervention for oral cancer. The authors carefully described their patients' surgical interventions and parameters for efficiency in swallowing. They included and provided inferences towards confounding variables such as the involvement of radiation. Although pioneering, several limitations are observed in this study. This includes a limited number of consistencies and volumes trialed, lack of baseline measures, reduced statistical details on all swallowing variables and limited information regarding site of tumor resection.

Overall, this paper provides a suggestive level of evidence to indicate swallowing function can change following surgical intervention in oral cancer patients. The change in function is dependent upon the percentage of oral tongue and tongue base resected. These two structures were significantly correlated with decreased oropharyngeal swallowing efficiency.

Pauloski, et. al (2004) examined surgical variables affecting swallowing in 144 patients 3-months post-surgery in oral and oropharyngeal cancer. Surgical information was collected and compared against swallows of multiple consistencies. Swallowing function for the oral phase was measured through oral and pharyngeal transit time, pharyngeal delay time, oral residue and oropharyngeal swallowing efficiency (OPSE). Appropriate statistical correlations and multiple regression analysis revealed that the total volume and the percentage of tongue resected had a significant impact on postoperative swallowing function with various bolus consistencies. Swallowing outcomes were poorer on liquid boluses when primary closure was used and more tissue was removed. Similarly, on swallows of paste consistencies, the greater amount of tissue that was extracted the poorer the outcome. Outcomes on cookie boluses revealed that total volume resected, had the greatest impact on swallowing function. The researchers found that when flap size was similar to the extracted volume, the swallowing function was better.

Greater efficacy could be attained through altering the study design to consider the impact of other variables. This includes baseline-swallowing status, varying the volume of consistencies, excluding data from patients who did not complete all swallows, and dividing subjects by surgical site. By obtaining baseline-swallowing status, the researchers could more confidently attribute swallowing outcomes to post-treatment measures. This would consider individual variation in swallowing patterns and the impact of tumor formation on the swallow inefficiencies from pain or size of the growth. Varying the volume of the consistency would provide more information regarding function, effects of a larger bolus size, and a volume that may be more comparable to the patient's ingestion patterns. Likewise, surgical site can contribute to the changes in function of swallowing (Pauloski, B., et al., 1993). By including this data, information on

swallowing function could be further explored by resection site.

In total, this case series provides a suggestive amount of evidence to indicate different surgical procedures result in altered swallowing outcomes post-treatment. Primary closure resulted in poorer swallowing function on liquid boluses, while the greater the amount of tissue removed resulted in poorer outcomes in all consistencies.

Question 2

What is the trajectory of swallowing recovery in the months following surgical resection?

Pauloski, et. al (1994) followed 38 patients who had an oral or oropharyngeal resection for one year following surgery to evaluate changes in swallowing function. Swallowing function for the oral phase was measured through oral and pharyngeal transit time, pharyngeal delay time, oral residue and oropharyngeal swallowing efficiency (OPSE). Data was collected at 1, 3, 6 and 12 months and analyzed. The authors concluded that swallowing function did not improve progressively in the year following surgery. Appropriate statistical analyses showed the level of functioning at 1-and 3-months post-surgery were characteristic of status at 1 year. No evidence of improvement over the year were found.

While the study clearly identifies its patient population, it does not take into account the site of the lesion and how this may alter swallowing outcomes. Studies have found resection site to make an impact on the type of functional impairment that is seen (Logemann, J., 1998; Pauloski, B., et al., 1993). In normal swallowing physiology, the structures of the oral cavity and oropharynx play a different role in the swallow. Comparing oral to oropharyngeal resections could therefore allow us more information around expected recovery and deficits. Other parameters such as the impact of radiation, pre-treatment measures, using a control group and removing data from participants that did not complete all trials of each consistency could have been implemented to strengthen the results in this study.

This case series offers a suggestive level of evidence that indicates swallowing function at 3-months is indicative of swallowing function at 12-months post surgery. It concludes swallowing function does not change between 3 months to 12 months post-surgery.

Brown, L., Rieger, J., Harris, J., & Seikaly, H. (2010) examined swallowing function of 15 patients who received a resection and reconstruction on the anterior 2/3 of their tongue. Participants were compared against a control group, which consisted of patients who had nasopharyngeal cancer. Swallowing function was measured using guidelines from a previous study (Dodds, W., Steward, E., & Logemann, J., 1990; Murray, J., 1999). Guidelines included tongue contact to hard palate, ability to form a cohesive bolus, base of tongue contact to the posterior pharyngeal wall, premature spillage into the pharynx, nasal regurgitation, ability to attempt a cookie bolus and number of attempts to clear the bolus. Tongue mobility was assessed using lateral still images. This case-control study, evaluated swallowing pre-operatively and 1,6, and 12 months post-operatively. A series of t-tests examined group differences and consistency over time. Significant differences were found between swallows pre-operatively and 1 month post-operatively; no differences were found from pre-operative measures to 12 months postoperatively.

Overall, this was a well-designed case control study that appropriately meets its objective. The patient group was well described including a specific tumor site, amount of tissue resected and procedure, and possible confounding variables were considered (e.g., impact of radiotherapy). Strengths of the study included utilizing a control group and attempting to control for observer bias by blinding the researchers to patient identities. While strong, the researchers identify limitations with their sample size, the effect of radiation in some participants, and the difficulty in quantifying tongue mobility. The study provides compelling evidence that swallowing status returns to baseline measurements following 1-year postoperative resection for the anterior portion of the tongue.

Discussion

Overall the evidence in the reviewed literature suggests that subsequent to surgery, there are changes in swallowing function. These changes are apparent in the outcome measurements each study group used. Pauloski and colleagues (2004) and McConnel and colleagues (1994) represented swallowing outcomes with: the duration of the swallowing phases, presence of residue and oropharyngeal swallowing efficiency. Together, the studies conclude a negative relationship between the percentage of tissue resected in the base and oral tongue, across all measurements. Although

consistent in this finding, the studies differed on significance regarding impact in the total volume of tissue resected. Because several of the authors who conducted the pilot study also published the 2004 study, outcomes may be more accurate in the latter research. The differences in results may be due to the structure/nature of the pilot study, the advancement of information in the field, or other limitations the authors noted. This included the acknowledgement of potential errors in the volume resection data.

The trajectory of swallowing function post-operatively in the reviewed studies, showed conflicting results. Pauloski and colleagues (1994) concluded that swallowing function may improve in the first month following surgery; however remains stable therefore after until 12-months. This may be attributed to the healing trajectory following surgery. In contrast, Brown and colleagues (2010) concluded that swallowing function initially declined and returned to pre-surgical measures by 12-months post-operatively. These findings may differ from previous studies due to the criteria of swallowing function or surgical procedure. Pauloski and colleagues examined transit times and OPSE, whereas Brown and colleagues looked at tongue function and other swallowing parameters.

Although videofluoroscopy is considered the gold standard in swallowing assessments, agreement upon how to evaluate these results has not yet been attained (O'Donogue, S., & Bagnall, A., 1999). Martin-Harris and colleagues (2008) attempted to account for this inconsistency through the creation of the MBSImp. While the tool measures many events during a swallowing study, it may not account for other events such as the duration of each phase or overall efficiency. While the MBSImp presents a possible solution for reliability in swallowing, it may not capture detail needed in evaluating changes following surgery in the oral cavity.

General Considerations

All studies that were reviewed, qualify as level II or III evidence as the necessity of proving appropriate treatments precluded randomization. A higher level of evidence is difficult to obtain in the head and neck cancer population due to ethical constraints on access to treatment, the variability in the progression of the disease and the inability to employ blinding of participants or subjects. Another consideration is the population size presented in each study. The head and neck cancer population is small prior to participation in research and the sample populations selected in each study reflect that. Because of this, the researchers are presented with the challenge of reductions in statistical power, as well as confidence in their findings.

Many of the subjects in each study had received chemotherapy and/or radiation therapy in combination with surgical intervention. While this intervention is often recommended in attempts to obliterate cancer, it does have an impact on swallowing function. A critical review by Mittal and colleagues (2003) highlighted the effects on swallowing following each treatment modality. The literature suggested radiation alone could impact multiple features of the swallow including increased orophayrngeal transit time, incoordination of bolus movement, reduced tongue base retraction, presence of xerostomia, as well as subsequent functions in downstream phases of the swallow. In more advanced stages of cancer, chemotherapy may be included to control for metastases. Combining chemotherapy with radiation or surgery, can significantly impact swallowing function across all phases (Mittal, et. al., 2003). This group suggests that this may be a result of neuromuscular fibrosis, though with concurrent treatment it is difficult to separate the distinct features of each modality.

Clinical Implications

Given the review, several considerations should be given in clinical practice. Overall, the outcomes of swallowing function following oral surgery are difficult to interpret due to multiple confounders. This includes the variable nature of each patient's cancer and the intervention needed in their care, as well as the limited research in this area and divided agreement on swallowing evaluations. Due to this variability, it is recommended that the Speech-Language Pathologist use the evidence with caution when reviewing swallowing function following oral cavity resections. Mindfulness towards the type of surgery used, the site of the tumor, as well as the methodology to evaluate swallowing function, must be given. From this review clinicians can acknowledge changes in swallowing occur post-surgery. Expectations can be formed around the amount of tissue resected and poorer swallowing function across multiple consistencies.

In conclusion, the reviewed studies have provided strength in our understanding of swallowing function post-surgery. Continued research in this area will allow us more clarity in the management of patients with oral cancer.

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