Speech and Swallowing Rehabilitation for Head and Neck Cancer Patients

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Head and neck cancer and its treatment frequently cause changes in both speech and swallowing, which affect the patient's quality of life and ability to function in society. The exact nature and severity of the post-treatment changes depend on the location of the tumor, the choice of treatment, and the availability and use of speech and swallowing therapy during the first 3 months after treatment. This paper reviews the literature on speech and swallowing problems in various types of treated head and neck cancer patients. Effective swallowing rehabilitation depends on the inclusion of a video-fluorographic assessment of the patient's oropharyngeal swallow in the post-treatment evaluation. Pilot data support the use of range of motion (ROM) exercises for the jaw, tongue, lips, and larynx in the first 3 months after oral or oropharyngeal ablative surgical procedures, as patients who perform ROM exercises on a regular basis exhibit significantly greater improvement in global measures of both speech and swallowing, as compared with patients who do not do these exercises. [ONCOLOGY 11(5):651-659, 1997]

Introduction

The presence of a tumor in the head and neck region often changes speech and swallowing prior to any treatment. The nature and severity of these changes vary with the tumor site and size. The therapeutic modalities used to treat head and neck cancers also cause alterations in speech and swallowing, which affect the patient's quality of life and ability to function in society.

This paper reviews the literature on speech and swallowing rehabilitation for treated head and neck cancer patients. In addition, new pilot data are presented on the effects of a specific speech-language pathology therapy program on the speech and swallowing abilities of oral and oropharyngeal cancer patients. Future research needs are also discussed.

Impact of Treatment on Speech and Swallowing

Treatment selection is the first line of rehabilitation.[1] Numerous authors have examined the effects of various tumor treatments on speech and swallowing abilities, including the impact of surgical resection and the type of reconstruction, as well as the utilization of radiotherapy for particular tumors.[2-14]

Patients With Oral Cancer

• Surgery—In patients with an oral or oropharyngeal cancer, the extent of resection of the oral tongue and tongue base has been found to be related to swallowing ability; ie, the more extensive the resection, the worse the swallowing function.[9] The reconstruction procedure selected after oral or oropharyngeal cancer resection also plays a major role in the ultimate speech and swallowing abilities of the patient. Although further research is needed, it appears that reconstruction procedures that pull existing oral tissues together (primary closure) result in the best speech and swallowing function, as compared with reconstructive procedures that introduce tissue from other parts of the body, such as the chest wall, arm, and foot. Introduction of tissues from other body parts produces areas of absent sensation, as well as lack of motion.

• Radiotherapy—In contrast to surgical procedures, the application of radiotherapy to the oral cavity leaves tissue and structure intact but introduces other difficulties, particularly with swallowing.[15,16] If the salivary glands are in the radiation field, the resultant xerostomia can make initiation of swallowing difficult. In addition, the fibrosis that can occur as a result of the devascularization of the oral tissues in the radiated field can reduce range of tongue and jaw motion and pharyngeal wall motion, thus affecting both swallowing and speech production.
In general, radiotherapy has a greater effect on swallowing than it does on speech.[17] Since many patients with larger oral and oropharyngeal tumors (T3 and T4) currently receive multimodality treatment (ie, radiotherapy following the surgical procedure), they exhibit the combined effects of both treatment procedures on their speech and swallowing.

- **Tumors of the Posterior Oral Cavity**—Patients with tumors involving the posterior oral cavity often exhibit disorders in the range of movement of oral and pharyngeal structures. Radiotherapy to the posterior oral cavity and oropharynx also results in changes in structural motion in the pharynx since the pharyngeal constrictors are usually included in the radiation field.[5,6] In addition, surgical treatment of the tongue base and tonsil area usually involves cutting the musculature that attach the tongue base to the pharynx. This pulls the oral tongue posteriorly and ablates sensory receptors critical to triggering the pharyngeal swallow, thus affecting both the oral and pharyngeal stages of swallowing.

**Patients With Laryngeal Cancer**

Treatment choices for laryngeal cancer range from partial laryngectomy or radiotherapy for small (T1-T2) tumors to total laryngectomy without total glossectomy or radiotherapy and chemotherapy (organ-preserving therapy) for larger (T3-T4) tumors.[2,12,18,19]

- **Radiotherapy**—Irradiation of the pharynx and larynx generally results in damage to the pharyngeal constrictors, either immediately or later after the completion of therapy.[16]

Radiotherapy can result in such significant damage to the pharyngeal constrictors that complete pharyngeal dysfunction during swallowing can result. This is particularly true in patients who receive the combination of high-dose chemotherapy and radiotherapy designed to preserve the structure of the larynx and pharynx.

- **Surgery**—If a surgical procedure is selected for treatment of laryngeal cancer, small tumors are generally treated with a partial laryngectomy, either a vertical partial laryngectomy (hemilaryngectomy) or a horizontal partial laryngectomy (supraglottic laryngectomy).[2,12,18]

Hemilaryngectomy usually involves the removal of one false vocal fold, the ventricle, and the true vocal fold on the same side. Patients with a tumor that requires a hemilaryngectomy exhibit a very brief change in swallowing postoperatively, specifically, reduced laryngeal closure, particularly when swallowing liquids.[20] However, the normal side of the larynx can generally compensate for the damaged side by crossing mid-line and accomplishing closure within a week or two.

In contrast to these short-term swallowing problems, hemilaryngectomy often leaves the patient with a long-term moderate to severe voice impairment, such that loud talking is significantly restricted and the patient's voice is moderately to severely hoarse.

If the tumor is located in the supraglottis, a supraglottic laryngectomy is usually the treatment of choice. This resection involves removal of the epiglottis, a part or all of the hyoid bone, the aryepiglottic folds, the false vocal folds, and the ventricle. The excision cuts right around the arytenoid cartilages, leaving the true vocal folds to protect the airway along with the reconstructed entry to the larynx, comprised of the base of tongue and arytenoid cartilages (Figure 1). Most patients who have undergone a supraglottic laryngectomy are able to speak clearly since the true vocal folds are not affected. However, these patients usually exhibit a prolonged period of swallowing difficulty, which requires swallowing therapy to restore normal deglutition.

Recovery of swallowing function in these patients generally involves retraining the tongue base and arytenoid to contact each other and close the airway entrance, thereby preventing the entry of food or liquid into the airway during swallowing.[21] In general, it takes 4 to 6 weeks for the patient who has undergone a supraglottic laryngectomy to resume safe and efficient oral intake.[20] If the surgical procedure is extended to include a part of the vocal fold(s) or the tongue base, the duration of rehabilitation is significantly prolonged. With a large tongue base resection, the oral contents will dump directly into the airway during swallowing and be aspirated. Thus, if a significant part of the tongue base is removed, the patient may never be able to relearn to swallow, and the procedure may need to be converted to a total laryngectomy.

Total laryngectomy for larger tumors (T3 and T4) results in complete loss of voice, requiring an artificial larynx, esophageal voice, or a surgical pros-thetic voice restoration procedure.[22]

Currently, surgical prosthetic voice restoration can be accomplished at the time of the total laryngectomy so that the patient's period of voicelessness is relatively short.

Total laryngectomy also results in changes in swallowing because of the reduction in pharyngeal wall contraction and pharyngo-esophageal pressure in the newly reconstructed pharyngoesophagus. Thus, the oral tongue and tongue base must increase their work to compensate for the lack of pharyngeal driving pressure on the food and to clear the bolus through the pharyngo-esophagus.[23]
As a result, after total laryngectomy, many patients complain that they must work harder in order to swallow. Despite this need for greater effort when swallowing, most patients should be able to eat a normal diet within a month after total laryngectomy. Several anatomic abnormalities that occur after a total laryngectomy can also impair the patient’s swallowing ability, including a pseudo-epiglottis (a fold of tissue coming from the pharyngeal wall into the tongue base, which results from the reconstruction). The pseudo-epiglottis forms a side pocket in which food is collected during swallow attempts. Also, a stricture may occur at some point along the reconstructed pharyngo-esophagus, which may block or narrow the food passage.

**Summary**—There is no treatment procedure for head and neck cancer that does not have some effect on speech and/or swallowing function. The importance of treatment selection cannot be overemphasized, however. Managing physicians, ie, medical, radiation and surgical oncologists, need to discuss each patient's case in a tumor board format in order to determine the best treatment alternatives that will cure or control the patient's disease while leaving the patient with the best possible post-treatment function. The patient's preference for a particular treatment and his or her lifestyle must also be taken into account.

**Schedule for Rehabilitation**

**Pretreatment Counseling**

Rehabilitation of a head and neck cancer patient should begin at the time of diagnosis with patient counseling regarding potential effects of treatment on functional abilities. Such counseling need not specify the exact severity and nature of the changes that the patient may anticipate. Instead, the counseling can focus on the potential for changes in both speech and swallowing after treatment. If more specific information relevant to the patient's individual treatment plan is available, this may also be provided. However, prior to treatment, many patients do not want to know the details of their future functional impairments. Rather, most patients are interested in knowing that a professional, such as a speech-language pathologist, will be available to them after treatment to assist them in speech and/or swallowing rehabilitation. Patients' understanding of their responsibility in the rehabilitation process is critical to their successful rehabilitation. Patients who do not understand that speech and swallowing changes will occur after treatment and that they must participate actively in the rehabilitation plan are often very angry following treatment when they learn of the severity of their speech and swallowing problems. Angry patients make poor rehabilitation candidates. Optimally, the surgeon, radiation oncologist, and medical oncologist, as well as the speech-language pathologist, will all provide pretreatment counseling.

**Post-treatment Evaluation**

Following treatment, the patient should be evaluated by a speech-language pathologist to define the exact nature of changes in speech, voice, and swallowing. The speech and voice assessment can be completed at the bedside, whereas the swallowing evaluation usually involves a video-fluoroscopic (radiographic) examination of movement patterns of structures in the oral cavity and pharynx. This type of examination is carried out while the patient swallows various types of foods in order to define the exact nature of the patient's musculoskeletal disorders in swallowing and to examine the effectiveness of some therapeutic strategies, including an appropriate swallowing therapy program.[24-28] This therapy may include interventions such as changes in head or body posture,[25,26] procedures to heighten sensory awareness, and swallowing maneuvers.[29]

**Initiation of Speech and Swallowing Therapy**

In general, patients treated surgically can begin speech and swallowing therapy when the suture lines are healed, whereas those receiving radiotherapy can begin rehabilitation prior to, during, or after treatment. No data are currently available to help determine the optimal time for beginning a speech and swallowing therapy program, although it appears that patients who receive therapy during the first 3 months post-treatment do best. There has been a feeling among physicians that head and neck surgical patients continue to improve function in at least the first year following treatment. However, results of a recent study from our group indicate that the function of oral cancer patients at 12 months post-treatment is essentially unchanged from function at 3 months post-treatment, indicating little improvement in speech or swallowing measures after the first 3 months.[17]
Intervention by a dentist and/or maxillofacial prosthodontist before and after treatment is often essential in order to preserve some teeth for functional chewing, as well as to attach a maxillofacial prosthetic device, as needed, following treatment.[30-34] Many patients who undergo surgical removal of tumors involving the tongue require a palate augmentation or reshaping prosthesis to lower the hard palate. This enables the remaining tongue tissue to articulate speech sounds against the lowered palate and to propel food efficiently backward by pressing the tongue against the lowered palatal vault.

**Pilot Study of ROM Exercises for Speech and Swallowing**

Although a number of case studies and several small group studies have documented the effectiveness of speech and swallowing therapy in patients who have been treated for tumors of the head and neck,[25,26,29,32,35] very few data are available on larger groups of subjects who have received any type of speech and swallowing therapy. Therefore, we examined speech and swallowing function in 102 patients with surgically treated oral and oropharyngeal cancer to determine whether there was a relationship between the total amount of speech and swallowing therapy received between 1 and 3 months postoperatively and changes in global measures of speech and swallowing functions. We also examined the relationship between the use of range of motion (ROM) exercises between 1 and 3 months postoperatively and the extent of change in the same global measures of speech and swallowing.

**Patients and Methods**

The 102 patients included in the pilot investigation were participants in a large study on the effects of oral cancer resection and reconstruction procedures on speech and swallowing. The patients were assessed prior to treatment and at 1 and 3 months post-treatment. Data were collected on the type of speech and swallowing therapy the patient received. All 102 individuals received therapy for speech problems and 92 also received therapy for swallowing problems. The patients were given instruction in how to perform ROM exercises for the lips, tongue, jaw, and larynx; other types of therapy to improve placement of the tongue and lips for production of speech sounds; and/or exercises to improve the coordination of structural movements during swallowing.[24]

**ROM Exercises**

Range of motion exercises involve extending the structure in the target direction as far as possible, holding the extended posture for 1 to 2 seconds, then releasing it. For example, ROM for the lips involves spreading them as far as possible, held and released and then to the opposite side. This sequence is repeated 10 times in a session. For the tongue, the directions used for ROM are extension straight outward as far as possible, retraction as far as possible, pointing to one side of the mouth (inside the mouth) as far as possible and then pointing to the opposite side as far as possible, and elevating the tongue tip and then the back of the tongue as far as possible with the mouth open as widely as possible. The tongue is held in extreme extension in each direction for 1 to 2 seconds and released.

For the jaw, ROM involves opening the mouth as widely as possible, extending the jaw to each side as far as possible, and moving the jaw in a circular motion as far as possible. Range of motion for laryngeal elevation involves sliding up the musical scale as high as possible into the falsetto range and holding the highest note produced for several seconds. Range of motion for laryngeal adduction includes exercises to move the arytenoid cartilages, such as repeating the vowel "a" using a hard attack, taking a breath and holding the breath with effort, coughing, throat clearing, and so on. In contrast, exercises to improve coordination involve chewing, manipulating something such as chewing gum or a button in the mouth from side to side, and chewing, as well as teaching placement of the tongue to produce particular speech sounds.

Patients were instructed to do the group of exercises for a total of 5 to 10 minutes, 10 times daily, if possible. Patients were given the exercises by their speech-language pathologist and practiced them with the clinician until the patient was able to perform the exercise(s) well. Patients were seen for one to two follow-up sessions to check their performance of the exercises.

**• Measures of Speech and Swallowing Function**—At 1 and 3 month post-treatment, data were collected on four global measures of speech and swallowing function: (1) understandability of speech, as judged by naive listeners; (2) percent accuracy of production of consonant sounds; (3) oropharyngeal swallow efficiency (OSPE) on liquid; and (4) OSPE on paste.

To define speech understandability, a 5-minute conversational speech sample was recorded for each
patient at 1 and 3 months post-treatment. The speech-language pathologist present during the recording transcribed each word produced by the patient and verified the accuracy of the transcription with the patient. Then, five naive listeners were asked to transcribe the patient's speech word for word, and the percentage of words that were correctly understood by each listener was determined. The mean of the understandability scores for the five listeners was calculated. In addition, the patient’s reading of the sentence version of the Fisher-Logemann Test of Articulation Competence was recorded at 1 and 3 months post-therapy and was used to determine the percentage of correctly produced consonant sounds. A trained speech-language pathologist made the determinations regarding the correct articulatory production of the consonants at each time point.

Oropharyngeal swallow efficiency is a measure of swallowing function that takes into account all of the types of swallowing disorders that may occur.[36] It is calculated from video-fluorographic studies of swallowing. To generate the OPSE measure, the percentage of each bolus type swallowed into the esophagus is divided by the total oral and pharyngeal transit time (the time it takes the bolus to move through the mouth and pharynx). Most normal swallows generate an OSPE of over 50.[36] In people with normal swallowing function, the entire bolus (100%) is usually swallowed at a rate of 2 seconds or less (total oral and pharyngeal transit time). Changes in the four global measures of speech and swallowing between 1 and 3 months post-operatively were calculated. The total amount of therapy provided during the first 3 months post-treatment and the time spent doing ROM exercises during the first 3 months were calculated for each patient.

Results

Table 1 presents the Pearson correlations (r)[37] between the total time spent in speech/swallowing therapy and the change(s) in the four global measures between one and three months postoperatively, as well as the correlations between total time spent doing ROM exercises and the change(s) in global measures of speech and swallowing during the same time period. Using the t-test for zero correlation,[37] the only significant correlation found was between total time spent in ROM exercises and OPSE on liquids. No significant correlations with total therapy time were noted.

• Effect of ROM Exercises—Because ROM exercises appeared to have some effect on at least one of the global measures of speech and swallowing, a second analysis was performed to compare the extent of change in global measures of speech and swallowing from 1 to 3 months in patients who did and did not receive instruction in ROM exercises (Table 2). Significant differences (by the unpaired t-test[37]) were found between the two groups of patients with respect to both global swallowing measures. Differences in speech intelligibility approached statistical significance. In all three of these measures, patients who performed ROM exercises exhibited significantly better function, as compared with those who did not do these exercises.

Discussion

The results of this pilot study support the use of ROM exercises to improve both speech and swallowing in patients who undergo surgical procedures for oral and oropharyngeal cancer. These results are not unexpected. Range of motion of the lips, tongue, jaw and larynx is critical for the production of many speech sounds that require close approximation or contact of the tongue to the palate. Efficient swallowing also depends on ROM of these structures, as oral tongue pressure against the palate and contact of the tongue base with the posterior pharyngeal wall are critical to moving food through the mouth and pharynx.[38] Surgical procedures to remove cancers in the oral cavity and oropharynx typically restrict the motion of remaining lingual and oral tissues. It is not surprising, then, that ROM exercises are more significantly correlated with improvement in speech and swallowing than are other types of exercises.

It is interesting but not surprising that ROM exercises affected both speech and swallowing functions, as both functions require ROM of the oral, pharyngeal, and laryngeal structures. Clearly, to prevent formation of restrictive scar tissue, it is particularly critical to begin ROM exercises in the early postoperative period.

Additional studies are needed to compare the effects of ROM and other specific therapy programs on both speech and swallowing in oral and oropharyngeal cancer patients and in other groups of head and neck cancer patients treated with surgery and/or radiotherapy. Better definition of the optimal timing of rehabilitation after treatment for head and neck cancer is also needed. We do not know whether patients must receive therapy early after treatment or whether they can benefit from therapy months or years after the completion of antitumor treatment. Such a study to look at the
effectiveness of swallowing therapy in patients who have received treatment for head and neck cancers 12 months or more after receiving treatment is underway. Another important question centers on the ability of one set of exercises to effect improvements in both speech and swallowing functions. Our pilot data on ROM exercises indicate that these exercises improve both functions. However, other therapy programs need to be studied for their dual effects on speech and swallowing.

**Future Research Needs**

In addition to the studies on speech and swallowing therapy described above, studies are needed to define the particular aspects of both speech and swallowing physiology that require rehabilitation post-treatment and to identify which rehabilitation procedures are most effective for each specific type of treated patient. Critical pathways for rehabilitation are also needed. For example, the pathway shown in Figure 2 defines the optimal timing and types of interventions for patients with a T2 laryngeal cancer treated with supraglottic laryngectomy. It is based on existing data on rehabilitation needs and optimal rehabilitation procedures for these patients. Development of critical pathways would ensure that each patient receives the best rehabilitation procedures at optimal times. Unfortunately, at present, we do not have the data needed to develop such pathways for all treated patient types.

Other investigations should examine the greatest level of function that can be achieved in a specific time frame (such as 1 month post-treatment) in specific groups of patients. In addition, studies of quality of life after treatment for head and neck cancer patients are needed. Such work would help identify the particular types of problems of greatest concern to each type of patient so that interventions can be targeted to those problems. It is quite likely that patient complaints and concerns about their functional abilities may vary at different times following treatment. We are currently collecting data on this issue. Such data would also contribute to the development of critical rehabilitation pathways for specific types of head and neck cancer patients (described above).

**References:**


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