Tutorial

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SWALLOWING EVALUATION AND MANAGEMENT: A PRIMER FOR THE OROFACIAL MYOLOGIST

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Swallowing is usually taken for granted. It begins with a short volitional stage that serves to trigger a reflex. The reflexive stage may last only two seconds. Yet during this brief period of time, a series of coordinated movements rapidly and safely propel the bolus past the airway and into the esophagus. The bolus is propelled by a strong peristaltic or stripping action that leaves little or no residue behind. Dysphagia is the disruption of these coordinated events. Dysphagia can result from surgical procedures, neurological disorders or anatomical defects.

Recently, a strong interest has been generated regarding the evaluation and nonsurgical treatment of dysphagia. Much of this interest has been generated by speech/language pathologists who have refined radiographic procedures for evaluating the mechanism of dysphagia (Chierney, Cantieri, and Pannell, 1986; Groher, 1984; Logemann, 1983). Of special importance is the development of therapeutic approaches for facilitating safe swallowing that have emanated from these investigations. It is conceivable that many orofacial myologists already are trained, skilled, and practicing in this area.

In this article we describe the mechanism of normal swallowing, the clinical or bedside evaluation, radiographic evaluation of swallowing disorders. The material is taken from selected references and information obtained from our experiences in the study of this area. The purpose of this article is to present this discussion in the hopes of generating a new or in some cases a continued interest in the study of this disorder.

THE PHASES OF NORMAL SWALLOWING

A normal swallow involves both volitional and reflexive actions. Four individual phases are usually identified: oral-preparatory, oral-reflexive, pharyngeal, and esophageal. Dividing an event that takes only several seconds into four phases may seem overly precise. However, each phase has a distinct (though overlapping) anatomical and neurological mechanism. Disruption of the anatomy or neurological function at any point in the swallow sequence can result in specific problems and require specific treatment (Table 1).

TABLE 1

TYPES OF DYSPHAGIA

ORAL DYSFUNCTIONS

POOR LIP SEAL
TONGUE THRUST
TONGUE WEAKNESS
LIP WEAKNESS
REDUCED TONGUE MASS

PHARYNGEAL DYSFUNCTIONS

REDUCED VELAR MOVEMENT
POSTERIOR TONGUE WEAKNESS
PHARYNGEAL WEAKNESS

LARYNGEAL DYSFUNCTIONS

LIMITED ELEVATION
VOCAL FOLD WEAKNESS
REDUCED CRICOPHARYNGEAL
FUNCTION

ORAL-PREPARATORY PHASE

Oral preparation is the volitional phase of swallowing. It is difficult to time because it will vary with the consistency of the food. This phase supplies the "oral gratification" that is important to so many of us. The primary function of this phase is to prepare the bolus for actual swallow. Mastication is a part of this phase although it is not a required part. A blender can prepare food for swallowing and digestion as well as or better than the mouth.

During this phase, lip closure is required so that the food is not lost anteriorly. Mastication prepares solid food for eventual swallowing. Chewing is accomplished by the rotary movement of the jaw. During this process, the velum is actively pulled downward to maintain a patent nasal airway for breathing. Adequate buccal tension is required to prevent food from being lost into the lateral sulci and to help maintain the bolus between the teeth for mastication. The tongue must also help maintain the bolus between the teeth for mastication. Its force is opposite the cheeks. The tongue must also be able to lateralize in order to move the bolus from the biting surface on one side to the other. The tongue should be able to retrieve food from the lateral sulci if necessary. At the end of this phase, it is the tongue that collects the bolus and puts it in a form that is ready to be swallowed.

ORAL-REFLEXIVE PHASE

The oral-reflexive phase is comprised of volitional and reflexive movements. A volitional upward and backward movement of the tongue initiates the reflexive movements that follow. This phase is generally one second long although it may increase to two seconds with age. The volitional component occurs when the bolus is at the anterior faucial pillars. Volitional tongue movement initiates and precedes the actual reflex, which is mediated by the reticular formation of the brainstem. The reflexive component involves several rapid and coordinated actions: closure of the nasopharynx, during which breathing ceases briefly; elevation of the larynx; approximation of the vocal cords; a strong peristaltic action that moves the bolus rapidly through the pharynx; and, relaxation of the cricopharyngeus muscle. The

PHARYNGEAL PHASE

Smooth, rapid, and safe transit of the bolus through the pharynx is the most important aspect of the reflexive swallow. During the pharyngeal phase, the larynx elevates, the epiglottis falls over the airway, and the vocal folds close. The pharyngeal constrictor muscles are responsible for a very strong peristaltic stripping action which moves the bolus rapidly and smoothly through the pharynx. At the end of this phase, there is no residue in the pharynx. Pharyngeal transit requires one second and does not slow with age.

ESOPHAGEAL PHASE

The bolus is propelled into and through the esophagus during the reflexive esophageal phase. The cricopharyngeus -- also called the upper esophageal sphincter or the pharyngo-esophageal (P-E) segment -- is a muscular sphincter. It operates in a manner that is complementary to the peristaltic waves of the pharyngeal constrictor muscles. As the bolus reaches the P-E segment (propelled by peristalsis) the cricopharyngeus relaxes to allow the smooth and rapid entry of the bolus into the esophagus. The bolus continues through the esophagus propelled by the peristaltic action of the esophageal muscle.

EVALUATION OF SWALLOWING

A thorough evaluation of swallowing ideally involves an interdisciplinary team. The members of this team are from the professions of neurology, otolaryngology, gastrointestinal radiology, speech/language pathology, oral myology, and occupational therapy. Preliminary information is obtained from a thorough review of available medical records (Table 2). A protocol for patient evaluation generally includes both clinical (or bedside) and video-fluoroscopic evaluations.

THE BEDSIDE EVALUATION

The purpose of the bedside evaluation (Table 3) is to examine the oral-facial structures, to observe oral sensory-motor function, to identify clinical signs suggesting presence or risk of aspiration, and to observe the actual swallow. These data provide the basis for an assessment and a set of recommendations.

TABLE 2**REVIEW OF RECORDS**

Patient's age/sex	Signs of Pulmonary Compromise:
Etiology/Onset	Shortness of Breath
Unilateral/Bilateral Neurologic Signs	Chest Pain (non-cardiac)
Mental status	Fever
Patient Complaint?	Sputum/Increase Secretions
Nurse's Observation of Problem	Other
	Medical Evaluation:
	Vital Signs
	Arterial Blood Gas (ABG)
	Chest X-ray
	Other

TABLE 3**BEDSIDE EVALUATION**

Patient's subjective complaints:				
Slowness	Food Sticks		Change in Smell	
Choking	Problem Foods		Congestion/Colds	
Drooling	Change in Taste		Other	
Objective:				
Patient's current feeding status:				
Diet/Texture:	Regular	Soft	Pureed	Full/clear liquid
Feeding:	Mouth	NG Tube	Gastrostomy	Other
Dentures:	None	Upper	Lower	Other
Chest X-ray:	None	Normal	Abnormal	
Evaluation:				
Isolated Oral Movements:				
Jaw	Lips	Tongue	Velum	
Light Touch sensation:				
Face	Lips	Tongue		
Reflexes:				
Gag	Cough	Swallow		
Volitional:				
Cough	Swallow			
Speech/Voice Characteristics:				
Observation of Swallow:				
Posture	Lip Closure		Tongue Movement	
Chewing	Initiation		Effort	
Laryngeal Elevation	Cough		Voice Quality	
Other				

ASSESSMENT:**RECOMMENDATIONS:**

During the bedside evaluation, one notes head and torso posture, as well as the symmetry of structures at rest and during movement. Any unusual structural or neurological findings such as fasciculation, tremor, or atrophy should be noted.

During the oral-motor exam, the clinician elicits from the patient a series of discrete oral movements and postures. The lips should be closed at rest, should maintain closure against resistance, and should close during bilabial-loaded sentences. Inadequate closure may reflect a structural lip incompetency or neuromuscular weakness. Finally, the lips should retract fully and protrude symmetrically.

At rest, the tongue should appear symmetrical and show no involuntary movement. It should be able to protrude, elevate, and lateralize. It also should be able to make these motions rapidly and demonstrate strength against resistance. Tongue tip-alveolar contact should be adequate for producing the /t/ and /d/ phonemes. The posterior tongue should elevate adequately to produce the lingual-velar consonants. The lingual furrow for the sibilants should be central and the sibilants should be made without distortion.

Evaluate the function of the mandible to open and close both with and without resistance in order to assess cranial nerve V.

Evaluate velar elevation for sustained "ah." If the velum does not elevate, ask the patient to say "kah." Often the patient will make a nasalized vowel and the velum will not elevate. The "pressure" consonant /k/ necessitates velar movement and often results in more accurate diagnosis of velar functioning. Although velopharyngeal closure cannot be determined by oral exam, evaluate the velum for symmetry on elevation. Asymmetrical elevation may indicate a unilateral neurological deficit.

During the oral-sensory exam, the clinician evaluates sensitivity to light touch. Specifically, a cotton swab is touched lightly against the lower face, including the lips, the tip, side, and back of the tongue, the anterior faucial pillars, the cheeks. The gag reflex is elicited by touching the back of the tongue or the posterior pharyngeal walls bilaterally. The lack of a gag reflex may indicate neurological dysfunction of cranial nerves IX or X.

Following the oral motor-sensory examination, the "4 point swallow test" (Logemann, 1983) is used to evaluate several consecutive functions

that are necessary for complete and safe swallowing. For this test the index finger is placed in the submandibular region, the middle finger is placed on the hyoid bone, the third finger is placed at the top of the thyroid cartilage, and fourth finger placed at the bottom of the thyroid cartilage. The consecutive movement of these structures can then be assessed. Pressure should be avoided and contact with the neck tissue should be very light. As the patient swallows, the clinician should be aware of the tongue movement at the index finger, the elevation of the hyoid by the second finger, and the elevation of the larynx by the third and fourth fingers as the swallow reflex is triggered.

Immediately following this swallow, the patient should be asked to phonate "ah" for several seconds while the clinician evaluates the vocal quality. A wet hoarseness generally indicates pooling of saliva (or portion of the bolus) at the laryngeal level with a possibility of silent aspiration. Silent aspiration is the penetration of the lower airway by material without reflexive coughing (Linden and Siebens, 1983). Assess the loudness and breathiness of the voice. Inadequate loudness or breathiness may represent poor respiratory support or may indicate a vocal fold paresis or paralysis. Evaluate oral-nasal resonance and nasal air escape. The presence of these qualities generally indicates a velar paresis or paralysis.

If the patient has been eating orally, the patient may be evaluated during or after his feeding. Look for pocketing of food in the lateral oral sulci. This may represent poor buccal tension. Also look for pocketing of food in the anterior oral sulcus or beneath the tongue. This may represent lingual weakness. Evaluate the hard palate for collection of food. If food collects on the hard palate this may represent lingual weakness or poor lingual elevation. If food is forced out of the mouth, this may represent a tongue thrust or poor labial closure with normal tongue movement. If food remains in the mouth or is coughed out after several seconds, this may indicate an absent swallowing reflex.

Aspiration results when the airway is not protected adequately and material passes through the larynx into the lower airway. Individuals with an intact cough reflex and adequate respiratory support will cough reflexively in an attempt to clear the foreign material. Thus, coughing is usually an indication of aspiration. The dangers of aspiration include aspiration pneumonia and airway obstruction.

tion.

However, not all patients will cough when food enters the airway. This is "silent aspiration," a drawback of the bedside evaluation is that silent aspiration cannot be diagnosed. Rather, an accurate diagnosis requires radiographic study. A wet voice may indicate silent aspiration. Excessive amounts of secretions may also be a sign of aspiration. Excessive secretions generally indicate a response of the cilia of the respiratory tract to clear away the aspirated matter.

Finally, expectoration or regurgitation of food material through the mouth or nose may be the result of pharyngeal or esophageal obstruction. Or, it may result when the swallow reflex is not triggered and the patient must dispose of the bolus.

If a patient has a tracheostomy tube, any food material that is expelled from it is a sign of aspiration since the tracheostomy site is below the level of the vocal folds.

In summary, the bedside evaluation serves to evaluate oral-facial structure and function. This evaluation is helpful but not adequate for identifying aspiration since aspiration may be "silent." However, the bedside evaluation should help identify abnormalities in the structure or function. Any of the abnormal findings listed above are indicative of swallowing problems and should be cause to recommend a radiographic study of swallowing.

RADIOGRAPHIC STUDY

A radiographic study of swallowing generally uses videofluoroscopy. A swallowing therapist performs and interprets the study in collaboration with a GI radiologist. This study is often called a videofluoroscopic or a modified barium swallow since it is a modification of the standard barium swallow which is performed solely by a GI radiologist. The purpose of the modified barium swallow is broader in scope, however, than is the standard barium swallow. The purpose of the modified barium swallow is to evaluate the safety of oral feeding by analyzing the function of oral and pharyngeal phases of swallowing under controlled and standardized conditions. Whereas the standard barium swallow also fully evaluates esophageal function, the modified barium swallow serves only to screen the upper esophageal or the cricopharyngeal sphincter.

There are other major differences between the modified barium swallow and the standard barium

swallow. In addition to identifying aspiration, we also seek to identify the risk of aspiration, to identify where and why the problems in the swallow process occur, and to evaluate the usefulness of facilitating techniques for providing a safe swallow.

The modified barium swallow uses several textures including a barium liquid, a barium paste, and a cookie with barium paste to help identify which textures, if any, are safe for a patient. For example, often the patient with a vocal fold paralysis will have difficulty with water or other liquids because they demand more complete laryngeal closure. On the other hand, the same patient will swallow solids without difficulty. The patient with a lingual weakness may have difficulty propelling solid foods to the pharynx, but will be able to propel liquids more easily because liquids are less viscous and flow more easily.

Postural adjustments that may help a patient achieve a safer swallow are also evaluated. For example, a patient with a unilateral vocal fold weakness may benefit from turning the head to the side of the weak vocal fold to help laryngeal closure. A patient with a pharyngeal weakness resulting in residue on that side will benefit from turning the head to that side to help close off the vestibules on that side, or may benefit from tilting the head to the opposite side to direct food down the stronger side of the pharynx.

The modified barium swallow attempts to simulate normal feeding conditions. The various bolus textures are administered from a spoon by the swallowing clinician. Bolus size is $\frac{1}{3}$ teaspoon for the liquid and paste, and $\frac{1}{4}$ teaspoon for the cookie swallow. Bolus size is small to prevent obstructing our view of anatomical landmarks (figure 1) and to reduce the amount of aspiration, should it occur. Two boluses of each texture are given in a lateral view. The anterior-posterior view is then used to view swallows of the texture that presented the most difficulty to the patient.

Under optimal conditions, the patient is seated upright. The lateral view allows transit times to be measured, identification of the site of stasis, timing of the reflex, and the amount and reason for any aspiration. The anterior-posterior view is used to identify asymmetries in function -- especially vocal fold function --, and residue collection. The anterior-posterior view is less helpful when measuring transit times or identifying aspiration.

If a patient has specific difficulty with one

Figure 1. Lateral cephalometric radiograph.

Figure 2. Line drawing labeling anatomical landmarks that should be identified during a videofluoroscopic swallow study. Familiarity with normal anatomy is essential for orientation to the deformed anatomy visualized after head and neck surgery or radiation.

texture, additional boluses may be given in order to evaluate more fully this problem. Also, postural changes may be made during the study in order to evaluate the effect of these changes on swallowing.

Since the bolus may be propelled rapidly and the whole swallow sequence may be very short, it is often useful to use a videotape recorder with slow motion, forward, and backward play with on-screen monitoring. Specifically, the oral stage of swallowing is evaluated for the amount of transit time required to propel the bolus once the backward movement of the tongue has begun. This should be no more than one second. Oral transit time is the amount of time taken from the initiation of the swallow reflex until the bolus passes through the faucial pillars. The oral cavity is evaluated for stasis of the bolus in either any of the sulci or under the tongue. Any residue left on the palate generally indicates an incomplete or weak tongue-to-palate contact. This problem generally increases as the viscosity of the bolus increases. Evaluate the movement of bolus; i.e., is it controlled or uncontrolled? When there is poor tongue control, the bolus may fall over the base of the tongue prematurely before a voluntary swallow reflex can be initiated. A bolus of $\frac{1}{3}$ to $\frac{1}{2}$ teaspoon of material should be swallowed in its entirety and should not be broken apart into multiple "piecemeal" swallows.

The pharyngeal stage should be evaluated for the pharyngeal transit time, i.e., the time that it takes the bolus to pass from the faucial pillars through the cricopharyngeus into the esophagus. This should normally be no more than one second. The swallow reflex should be initiated shortly after a command is given to swallow. If the reflex is not triggered after 30 seconds, it should be considered absent. Evaluate the valleculae for stasis of material, and evaluate the pharyngeal walls for residue of barium. Both of these findings indicate a reduction in the strength of pharyngeal peristalsis. Evaluate the elevation of the laryngeal cartilages which should begin simultaneously with the triggering of the swallow reflex. The purpose of this elevation is to assist in closing the airway. If this does not elevate actively or adequately, part of the bolus may remain in the laryngeal vestibule and may be aspirated later. If the larynx does not close, aspiration may be seen during the swallow so that part or all of the bolus enters the airway while only a part of it enters the esophagus. Evaluate the presence of material in the pyriform

sinuses. Ordinarily, food passes through the pyriform sinuses into the esophagus as the cricopharyngeus relaxes. If the cricopharyngeus fails to relax, food may collect in the pyriform sinuses.

Aspiration may occur before, during, or after the swallow. Aspiration before the swallow may be due to poor tongue control or a delayed or absent swallow reflex. Aspiration during the swallow usually is due to poor laryngeal closure. Aspiration after the swallow generally is due to residue that subsequently falls into the airway.

The severity of the swallowing problem may be defined, rating the parameters of oral transit time, delay of swallowing reflex initiation, and aspiration. Ratings of normal, mildly impaired, moderately impaired, or severely impaired may be used. Lazarus and Logemann (1985) suggest that an overall rating of severe swallow dysfunction should be used if any one parameter is labeled severely impaired. Moderate swallow dysfunction requires that any two parameters are labeled as moderate. A mild swallow dysfunction requires that two of three parameters are labeled as mild.

TYPES OF DYSPHAGIA

Dysphagia may be due to one problem or a combination of problems. Mechanical dysphagia refers to impairment in swallowing typically resulting from surgery or trauma to the oral-facial area. Facial trauma and head and neck cancer are typical etiologies.

Dysphagia paralytica refers to weakness of the oral-pharyngeal mechanism. This has a neurological basis and may range from a weakness to a total paralysis. Reflexes are often diminished or absent. Disease of, or trauma to, the brainstem or cranial nerves are typical etiologies.

Upper motor neuron problems lead to pseudobulbar dysphagia. This refers to the inability to initiate the act of swallowing on command and the inability to coordinate the sequential steps involved in swallowing even though spontaneous swallow or gag may be intact. Bilateral lesions of the upper motor neuron system or cortex are possible etiologies.

The etiologies of swallowing problems are numerous (Table 4). Two frequently encountered patient populations are those with head and neck cancer and those with neurogenic impairment. Some common problems found in each of these groups will be discussed.

TABLE 4

**ETIOLOGIES OF
DYSPHAGIA**

CENTRAL

Stroke

Brainstem

Unilateral

Bilateral

Cortical

Subcortical

Other

Parkinson's Disease

Myasthenia Gravis

Palatal Myoclonus

Amyotrophic Lateral

Sclerosis (ALS)

Dementia

Multiple Sclerosis

Cerebral Palsy

PERIPHERAL

Neurologic

Focal Tumor

Lower Motor CVA

Muscular Dystrophy

ANATOMICAL/STRUCTURAL

- MECHANICAL

Maxillectomy

Loss of Soft Palate

Pharyngectomy

Mandibulectomy

Laryngectomy

Hemilaryngectomy

Supralaryngectomy

Glossectomy

Floor of Mouth

Anterior Tongue

Posterior Tongue

Radiation Therapy

HEAD AND NECK CANCER

Malignant tumors generally occur at the border of structures. Thus, primary surgery is usually extensive and often affects multiple structures and

their functions. When the tumor involves the anterior of the mouth, the resection of this tumor generally results in considerable swelling. Thus, lip closure is impaired and the bolus can be lost anteriorly. There is often very poor tongue control and the bolus may be lost posteriorly and result in aspiration prior to the initiation of the swallow reflex. If the tongue is unable to move posteriorly, there may be a temporary loss of the swallow reflex since the posterior movement of the tongue, the movement needed to trigger the reflex, is limited.

The resection of lingual tumors at the lateral or posterior portion of the tongue can result in poor lingual control and thus aspiration prior to a swallow. The swallow reflex may be either delayed or absent temporarily, and this can result in aspiration prior to a swallow reflex. Pharyngeal peristalsis may be weak leaving excessive residue that may be aspirated after a swallow reflex.

A partial laryngectomy (such as a hemilaryngectomy or a supraglottic laryngectomy) can result in aspiration during the swallow if the airway is not protected at the laryngeal valve. The supraglottic laryngectomy may suffer from reduced pharyngeal peristalsis and aspirate after the swallow.

Head and neck cancer patients that undergo radiation therapy may also suffer from reduced peristalsis or delays in the swallowing reflex. They may exhibit aspiration after the swallow or before the swallow, respectively.

NEUROLOGIC DISORDERS

The "neurodysphagias" result from numerous etiologies including stroke, head trauma, cerebral palsy, amyotrophic lateral sclerosis, multiple sclerosis, parkinson's disease, cerebellar degeneration, myotonic dystrophy, myasthenia gravis, and so on. This population may present with single or multiple insults which affect the swallow process.

Neurologic insult to the tongue may result in poor lingual movement necessary for bolus formation and oral transit. Oral residue may result ultimately in aspiration if the patient is unaware of the bolus or is unable to expectorate it, or if lingual-palatal contact is weak. If posterior move-

ment of the tongue is impaired, the swallow reflex may not be triggered in a timely fashion. A delayed or absent reflex may result in aspiration before the swallow.

Any neurogenic impairment to the pharyngeal musculature will result in very poor or weak peristalsis. This is manifest as residue in the pharynx and is likely to result in aspiration after the swallow. Impairment of the cricopharyngeal muscle will result in the pooling of the bolus in the pyriform sinuses and hypopharynx and also result in the likelihood of aspiration after a swallow.

Neurogenic insult to the laryngeal mechanism frequently results in aspiration during the swallow since the laryngeal valve cannot close.

THERAPY FOR SWALLOWING DISORDERS

Therapy for swallowing disorders may take many forms. Therapy may include muscle strengthening, modification of bolus viscosity, placement of bolus, stimulation of the reflex, modifications of posture, as well as prosthesis and surgery. Examples of surgical and prosthetic treatments are listed in Table 5. Our discussion will focus on nonsurgical and nonprosthetic treatments.

THERAPY FOR ORAL DYSFUNCTION

When lip closure or cheek tension is weak, strengthening exercises such as closing against resistance might be helpful. When the tongue is structurally intact but weak, tongue exercises against resistance might also be helpful in increasing the strength of the tongue to elevate and lateralize. Introducing the bolus to the strong side of the tongue or positioning the bolus posteriorly may also help to overcome oral transit and oral preparatory difficulties. In glossectomy patients, a palatal prosthesis may be constructed that is built up to compensate for the loss of the tongue and reduction of tongue elevation.

When jaw movement is limited or weak, range of motion exercises in a rotary fashion might be helpful. Also closing the jaw against resistance may be helpful in strengthening biting force.

When the swallow reflex is absent, stimulation of the reflex may be facilitated by thermal stimulation of the anterior faucial pillar as described by Logemann (1983). A small, long-handled laryngeal or dental mirror (sizes 00 or 0 - these

are approximately one-half inch in diameter) is used. The mirror is cooled in ice water for approximately 10 seconds and then is lightly touched to the anterior faucial pillar for 5-10 times. This heightens the sensitivity of the swallow reflex and may not actually trigger the reflex itself. The patient will be asked to swallow after stimulation (a dry swallow if the patient is not allowed oral feedings). The 4-point swallow test is used to assess the appropriate tongue, hyoid, and laryngeal movements for swallow. Adequate stimulation of the swallow generally requires 4-5 sessions daily for 5-10 minutes each time. The entire course of therapy may run from several weeks to a month.

THERAPY FOR PHARYNGEAL STAGE PROBLEMS

The clearing of excessive pharyngeal residue may be accomplished by alternating liquid and solid swallows. The liquid is used to clear the more viscous residue. A unilateral pharyngeal dysfunction that results in pooling on only one side of the pharynx may be assisted by laying the patient on the less affected side so that the bolus transits the stronger side of the pharynx. If the problem is bilateral, the patient may lie on his back, and this will direct the food equally and posteriorly.

If there is a unilateral weakness and the bolus is moving asymmetrically, resulting in aspiration before the swallow, have the patient tilt his head toward the good side. Again, this will avoid stasis or residue on the weak side and make use of the stronger side of the pharynx.

An asymmetrical problem with pharyngeal peristalsis may also be treated by turning the head toward the affected side. This will close off the pyriform sinuses on that side and should limit pooling. This should also help direct the bolus to the stronger side.

If aspiration results from a delayed reflex, this might be triggered by a head down position. This increases the size of the valleculae and helps the epiglottis overhang and protect the airway. This also directs the bolus more directly into the esophagus.

If aspiration results from the inability to close

TABLE 5

PROSTHETIC AND SURGICAL MANAGEMENT

MANAGEMENT	TYPE DYSFUNCTION
PALATAL PROSTHESIS	MAXILLECTOMY
	GLOSSECTOMY
TEFLON INJECTION	TVC PARALYSIS
CRICOPHARYNGEAL MYOTOMY	CRICOPHARYNGEAL
NASOGASTRIC TUBE	DYSFUNCTION
ENTREFLEX	ASPIRATION REQUIRING NPO
DUBHOFF	
PHARYNGOSTOMY	
ESOPHAGOSTOMY	
GASTROSTOMY	
JEJUNOSTOMY	

the airway, such as in a unilateral laryngeal paresis or a partial laryngectomy, the head down position may also help. Another useful technique is to use the "supraglottic swallow." This technique involves the patient holding his breath, introducing the bolus, swallowing, then coughing immediately to clear any possible residue in the hypopharynx.

CASE STUDIES

The following two case studies represent a neurological and a mechanical dysphagia. They serve to illustrate the diagnostic and treatment processes. Not all patients are able to feed safely by mouth as the second case demonstrates. It is of the utmost importance to recognize this situation and to discontinue treatment when a safe swallow is not possible.

CASE I, NEUROLOGIC DISORDER: L.P.

A 55-year old female presented with severe dysarthria with oral apraxia and severe dysphagia following multiple strokes. In March 1984, she sustained a left pons stroke. Dysarthria was present initially but improved. In July 1985, she suffered a large left posterior parietal infarct, and in August 1984, a right thalamic infarct.

She initially presented as alert, conversant, and nonaphasic. Due to audible chest congestion and

patient complaints of discomfort in her chest and throat, a swallowing evaluation was conducted. On evaluation, she showed bilateral weakness in oral-facial musculature, greater on the right than left. Oral sensation was grossly intact. The gag reflex was brisk. Movements were slow overall with concurrent signs of oral-nonspeech apraxia (oral groping and associated hand and head movement). Severe dysarthria was characteristic of bilateral upper motor neuron disease, i.e., short phrases, monotone voice, strained voice with stoppages, hypernasality with nasal air emission, and articulatory imprecision due to reduced range and strength. Voluntary and reflexive coughs were weak. The patient was partially edentulous and, when first seen, was eating a soft diet.

The bedside swallowing evaluation consisted of water from a cup and straw and a small piece of cracker. Postural control of head and torso was within normal limits. Some drooling of liquids was observed. Tongue movement was slow with reduced range during bolus management. Mastication appeared to be adequate. The "4-point test" was limited due to obesity. Overall, the oral-pharyngeal phases of swallowing were executed slowly. Most notable was the presence of frequent coughing during liquid swallows.

A videofluoroscopic swallowing evaluation was conducted under standard conditions. The major findings were delayed swallow reflex and

aspiration of liquids during the swallow. Non-protective coughing occurred. Paste and paste-on-cookie were not aspirated and showed adequate pharyngeal peristalsis. During the radiographic evaluation, liquids were then presented using a modified posture. The patient was instructed to tip her chin to her chest before initiating a swallow. This served to widen the vallecular spaces in the pharynx and effect a slight temporal delay in the pharyngeal transit of boluses. Using the chin down position, the patient was able to swallow small liquid boluses consistently without aspiration.

The following recommendations were made: 1) diet texture, puree; 2) bolus size, small ($\frac{1}{2}$ regular teaspoon); 3) oral feeding of all textures from a spoon; 4) head position, consistently tipped toward the chest for liquids. Supervision was given, and the patient was followed closely during her hospitalization on the Duke Rehabilitation Unit. As oral function (including strength of cough) gradually improved, she was able to advance to a soft, moist diet. A followup videofluoroscopic evaluation showed improved oral motility. The swallow reflex continued to be delayed, but pharyngeal peristalsis for liquids improved, and aspiration was absent.

CASE II, MECHANICAL DYSPHAGIA: D.C.

A 67-year old male presented on 6/18/85 with a history of swallowing problems for approximately one year. Medical history was remarkable for a lymph node enlargement of the right neck noted in March 1984. This was excised and the biopsy revealed a diffuse histiocytic lymphoma in May 1984. He was subsequently treated with several courses of chemotherapy followed by 3000 Rads of radiation therapy in October 1984. This led to a reduction in the size of the neck nodes. However, the patient complained of increasing dysphagia and retropharyngeal pain. In November 1984, a new mass at the base of the tongue developed. This was subsequently biopsied to be lymphoepithelioma. A tracheostomy and gastrostomy were performed in February 1985. In March 1985, a CT scan and otolaryngological exam revealed a necrotic tumor at the base of the tongue, extending into the lateral pharynx.

The patient was started on oral feedings on June 4, 1985. There was a question of aspiration almost immediately. In addition, the patient reported coughing up blood and was admitted to the

hospital through the emergency room on June 8, 1985.

The bedside exam revealed an alert, cooperative patient who was anxious to begin oral feeding. Postural control of head and torso was good. Voice quality was characterized by a chronic wetness. The wetness cleared with a volitional cough, however, the patient did not exhibit a reflexive cough. The swallowing was observed adequate for drinking water from a cup and straw. The "4-point swallow test" revealed minimal elevation of the larynx. The swallow reflex appeared delayed. Although the patient did not exhibit a reflexive cough, he did report a sensation in his chest associated with aspiration.

A videofluoroscopic swallow evaluation was conducted under standard conditions. The oral preparatory phase was remarkable for very weak tongue to palate contact with excessive oral residue. The oral phase was remarkable for a consistently delayed swallow reflex. The pharyngeal phase was remarkable for very slow movement of the bolus. The bolus moved more with gravity than with peristalsis. Peristalsis was extremely weak with no contact of the tongue to the posterior pharyngeal wall. The oral pharyngeal anatomy was distorted because of tumor erosion. The base of the tongue and epiglottis suffered tissue loss. Excessive residue remained in the valleculae. The PE segment appeared somewhat weak and may not have been sufficiently elicited with the weak and delayed swallow reflex.

Silent spillover aspiration was observed from the pyriform sinuses after the swallow. The supraglottic swallow, with frequent volitional coughs after the swallow, prevented aspiration.

Recommendations were to maintain NPO but to begin training with the supraglottic swallow technique using less than $\frac{1}{4}$ teaspoon of water for each bolus. The patient was instructed to clear his throat when his voice sounded wet.

The patient practiced the supraglottic swallow, but discontinued when he began suffering chest pains. He was successfully monitoring the wetness of his voice and was clearing his throat quite consistently when his voice became wet. A followup videofluoroscopic swallow study was done on October 17, 1985 that revealed findings similar to the initial study. That is, there was poor tongue to palate contact with excessive oral residue, a late and inconsistently triggered swallow reflex, a very large oral pharynx with very poor pharyngeal peri-

stalsis and excessive residue with silent, spillover aspiration. As a result of this study, recommendations were to continue the gastrostomy feedings and to discontinue the supraglottic swallow. The patient remains on gastrostomy tube feedings at this time.

SUMMARY

In summary, we have described normal swallowing function, the evaluation of swallowing function, the evaluation of swallowing using clinical and videofluoroscopic examination, the treatment of swallowing disorders, and specific dysfunctions often associated with neurologic and mechanical disorders.

This, by no means, is intended to make a clinician fully competent for the evaluation and treatment of swallowing disorders. Rather, it is intended to stimulate interest in this area. An adequate education in this area should include one or more of the various short courses that are offered through the American Speech, Hearing and Language Association, several independent continuing education companies, or by various medical centers that have ongoing swallowing programs. This is an area in which the orofacial myologist can join with other health care professionals and can make a very important contribution to the treatment of individuals by applying specific skills on oral facial function. However, since the health of the individual is often at risk, it is of the utmost importance that the patient be carefully and completely evaluated. Objective data obtained from clinical and videofluoroscopic examination is paramount to successful management. Treatment plans must be carefully thought out without the risk of compromising the patient's health or nutrition.

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