Any guide to the evaluation and treatment of a disorder must begin with an understanding of the anatomy, physiology, and normal development of the structures and functions.

The relationship between sucking, swallowing, and breathing is a critical one to understand as this is one of the main ways that pediatric swallowing differs from swallowing disorders in adults. These three processes are very interrelated because the structures for these three functions are anatomically close together and they share neurologic innervation. Because of the relationship of the processes, the structures of the upper and lower aerodigestive tracts must be understood. The upper aerodigestive tract consists of the nasal and oral cavities, pharynx, larynx, trachea, and esophagus. The lower airway consists of the lungs. The lower digestive tract is the stomach and small and large intestines.

» Structures

Nasal Cavity

The nasal cavity warms and cleans air before it enters the lungs. The nasal cavity is separated from the oral cavity by the hard palate and soft palate.

Oral Cavity

The oral cavity (i.e., mouth) plays an important role in eating, vocalizing, and breathing. The major structures of the oral cavity include the following:

- lips
- mandible
- maxilla
- floor of the mouth
- cheeks
- tongue
- hard palate
- soft palate
- anterior and posterior faucial arches
- teeth (in older children)

Although they are not actually structures, it is also important to pay attention to the anterior and lateral sulci (i.e., the spaces between the mandible or maxilla and the cheeks or lips).

Pharynx

The pharynx is crucial in both swallowing and respiration. It has three parts:

- Nasopharynx – The nasopharynx does not have much of a role in the act of swallowing. In fact, it should be closed off by the soft palate during swallowing. If there is any velopharyngeal incompetence, there may be some nasal reflux or back flow into the nasopharynx, especially with liquids. The adenoids are on the back wall of the nasopharynx. Sometimes the adenoidal pad contributes to velopharyngeal closure as the place of contact for the soft palate. If the adenoids are much enlarged, they can stop an infant from breathing adequately through his nose and can sometimes interfere with feeding.
- Oropharynx – The oropharynx begins with the tonsillar pillars and extends to the posterior pharyngeal wall. The top boundary of the oropharynx is the lower surface of the soft palate. The oropharynx also extends to the base of tongue, the hyoid bone, and the tip of the epiglottis.
- Hypopharynx – The hypopharynx extends from the tip of the epiglottis down to the upper esophageal sphincter. It also is the inlet to the larynx down to the level of the false cords.

Larynx

The larynx serves three primary functions:

- protects the airway
- aids in respiration
- aids in phonation

Movement of the larynx and surrounding muscles and cartilages are responsible for achieving airway closure during swallowing. The arytenoid cartilages rock medially and tip forward toward the base of the epiglottis. The true and false vocal folds close and the hyoid and larynx lift up and forward, tipping the epiglottis down. (The force of the bolus completes the inversion of the epiglottis.) All of these mechanisms work together to close off the airway for protection during swallowing. The anterior and superior movement of the larynx (paired with relaxation of the muscles) triggers opening of the upper esophageal sphincter.

Trachea

The trachea is comprised of C-shaped cartilaginous rings. A soft membrane makes up the posterior part of the trachea and the anterior wall of the esophagus. This is a common wall.

Esophagus

The esophagus is a muscular tube that remains closed until food travels through it. The muscles of

Structural Differences in Suckling and Sucking

Oral Structure	What happens in suckling? (birth to 6-9 months)	What happens in sucking? (begins around 6-9 months)
tongue	backward and forward motion of tongue tongue does not protrude past border of lips front of tongue (with the lips) seals against nipple— back of tongue seals against soft palate to keep liquid in the mouth until child is ready to swallow tongue is flat, thin, cupped, or bowl shaped	tongue body raises and lowers there is more room for tongue movement because oral cavity has grown down and forward tongue is flat, thin, slightly cupped, or bowl shaped
jaw	moves up and down	moves up and down less, but still helps produce suction (i.e., negative pressure)
lips	loose approximation on nipple	tight approximation on nipple helps seal and stabilize it in mouth
cheeks	fat pads provide stability in cheeks and keep food from accumulating in buccal cavities	continue to provide stability provide boundary on either side of tongue to keep liquid on tongue
hard palate	tongue presses against palate during forward and back motion	tongue presses against palate to create positive pressure on nipple
soft palate	seals against back of tongue to keep liquid in mouth—may even move toward tongue lifts during swallowing to seal nasopharynx to prevent liquid from entering nasal cavity	same as in suckling except soft palate does not move toward tongue

patterns. The **gag reflex** appears to have no relationship to swallowing in adults, but in infants, it begins to diminish in strength at around six months of age when solid foods are usually introduced.

It is not clear what the role of these primitive (infant) reflexes is on development of later voluntary movement. Although they may not form the basis for later developed, more complex motor skills (Bahr, 2003), it is important to consider the impact these reflexes have on the infant's swallowing skills.

In children with neurological disorders, the reflexes may be impaired depending on whether there is upper motor neuron damage (reflexes tend to be hyperresponsive or persistent) or lower motor neuron damage (reflexes tend to be hyporesponsive, diminished, or delayed). Children with low muscle tone (e.g., Down syndrome, velocardiofacial syndrome) also demonstrate diminished reflexes (Bahr, 2003).

Reflexes and their relationships to swallowing are summarized in a chart, *Reflexes and What They Mean*, page 17. Information about the nerves and the muscles they innervate, as well as the related functional feeding/swallowing skills is reflected in another chart, *Muscles and Nerves for Eating, Drinking, and Swallowing*, pages 18-23.

» Normal Development of Feeding Skills

Infants basically receive all of their nourishment through nipple feedings for the first four to six months of life. At that stage, transitional feeding begins. The change from nipple feeding to transitional feeding is related to central nervous system maturation more than any changes in the characteristics of the face and mouth (Bosma, 1986).

Feeding and Swallowing Evaluation, *continued*

	0-4 months	4 months-5 years/5-18 years
• Normal (Adaptive) Reflexes,* *continued*	**suck-swallow** | appears in utero at 18 weeks gestation. Touch your finger or the nipple lightly to the child's lips or tongue to see if sucking begins. If so, the finger or nipple will be drawn into the mouth and active sucking will be observed. If you get no response initially, evaluate again. The child may not have been alert enough or may not have been hungry. This reflex can also be stimulated with touch at the junction of the hard and soft palate. If a reduced sucking reflex or absent sucking reflex is consistently found, it usually indicates a neurological disorder (Wolf & Glass, 1992). **transverse tongue** | seen in utero at 28 weeks gestation. To test, stroke the sides of the tongue. The tongue should move toward the side of the stimulus. **tongue protrusion** | develops in utero at 38-40 weeks gestation. To stimulate, touch the tongue tip. The tongue should protrude from the mouth. **phasic bite** | seen in utero at 28 weeks gestation. Test by stimulating the gums. The response should be a rhythmic up and down jaw movement.	
• Abnormal Reflexes	Do not specifically elicit abnormal reflexes. Observe for the occurrence of any of these reflexes during feeding. **tonic bite** | strong closure of the jaw when teeth or gums are stimulated. It may be difficult for the child to release the bite. **jaw thrust** | strong downward extension of the lower jaw. The jaw may appear to be stuck open. **tongue retraction** | strong pulling back of the tongue into the hypopharynx. The tip of the tongue may be held against the hard palate. **tongue thrust** | forceful protrusion of the tongue from the mouth **overactive gag** | gag reflex stimulated in the front of the mouth	
• Feeding Position	If possible, begin the feeding evaluation by observing the caregiver in a typical feeding session.	
	Note how the caregiver holds the child while feeding. Is the child lying on her back with her head elevated just a bit or is her whole body slightly elevated? Is the child lying on her side or on her belly? Does the child use any special seating device?	Is the child able to sit independently? Is the child placed in an adapted position for more stability (e.g., prone, reclining/elevated)? Is head support necessary for feeding?
• Bottle/Breast-Feeding*	Note if the evaluation is completed with child using bottle or breast.	
	suck/swallow/breathe pattern | In young infants, the typical pattern is one suck, one swallow, and one pause for breathing. That is, the child sucks once to draw fluid into the mouth, stops breathing to swallow the fluid, and then breathes. In older infants, two or three sucks may occur per swallow.	
	burst cycles | With nutritive sucking, a child usually shows an initial continuous sucking burst for at least the first 30 seconds, and sometimes as much as 60-80 seconds before pausing to rest. As the child becomes satiated, there are fewer suck/swallow/breathe sequences in each burst and longer pauses (Mathew et al., 1985; Shivpuri et al., 1983). By the end of a feeding, the child may only show two to three sucks in a burst.	

* not assessed on the 5-18 years form

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Problems **Not Unique to Increased or Decreased** Tone

Problem	Cranial Nerve/Muscle	Caused or Exacerbated by
Tongue Thrust | forceful protrusion of the tongue out of the mouth	CN XII - hyoglossus - genioglossus - transverse - inferior and superior longitudinal	• child's compensation to low tone (pushes tongue forward more forcefully) • hyperextension of the neck with shoulders retracted (causes an increase in extensor patterns) • child's compensation for difficulty breathing (keeping the tongue forward helps the child breathe) • delayed development of tongue lateralization, so the child has to use tongue thrust to move food around in the mouth
Note: The difference in tongue thrust and suckling pattern is that tongue thrust is more forceful. Also, suckling is 50% protrusion and 50% retraction (Rosenfeld-Johnson, 1999). By six months of age, suckling is 75% retraction and 25% protrusion and tongue and jaw have begun to dissociate.		
Tonic Bite Reflex | occurs when the mandible clenches on an object. It is usually seen in individuals with severe neurological damage.	CN V & XII - digastric - mylohyoid - geniohyoid - temporalis - masseter - medial pteryygoid - temporalis	• poor sitting position with too much hip flexion or extension with posterior pelvic tilt (increases body flexion and tension) • reaction to an overstimulating environment • oral hypersensitivity
Note: Tonic bite reflex is different from a child clenching teeth shut on purpose to keep anything out of her mouth. The latter behavior is a voluntary action.		
Oral Hypersensitivity | reaction to stimuli that is much stronger than expected; may result in abnormal reflex patterns and increased postural tone	CN V, IX, & X	• low threshold to stimulation secondary to neurological damage • overall lack of oral stimulation in children who are tube fed • hypersensitive gag
Oral Hyposensitivity | decreased response to sensory input	CN V, IX, & X	• reduced sensitivity to stimuli secondary to neurological damage • sensory integrative dysfunction

Continued on next page

» Establishing a Dysphagia Team and Program

Many school districts employ the professionals needed to form a dysphagia team. The SLP is typically the leader and facilitator of the team. Other essential members of the team include:

- teacher
- teacher aides
- occupational therapist
- physical therapist
- school nurse
- cafeteria manager
- registered dietitian
- social worker
- administrator/principal
- physician

The ideal way for students to receive services is by having a school-based dyphagia team model (Homer, 2008). Being on site, members of the team are able to provide regular monitoring of the students' swallowing program. Adopting a school-based team approach requires that the district employ a dysphagia-trained SLP in every school.

In many districts, school-based personnel may not have the experience or training required to work with students with dysphagia. A solution may be a team of professionals who can travel to various schools to provide service to students with dysphagia. The team would focus primarily on students with feeding and swallowing disorders and work collaboratively with school staff to ensure the swallow safety of these students.

All members of the team contribute to the development and implementation of the IEP, swallowing and feeding plan, and emergency plan. The specific role of each team member should be clearly defined.

Note: It is not the sole responsibility of the SLP to feed the student with dysphagia *unless she is only fed therapeutically* and relies on tube feeding for nutrition. As outlined below, the SLP is responsible for providing dysphagia intervention which may include oral intake and may or may not occur during snack or meal times.

Typical team member contributions are outlined by ASHA (2007).

Speech-Language Pathologist

- accepts referrals and identifies at-risk students
- completes assessment
- recommends videofluoroscopic swallow studies (VFSS) when indicated and assists in obtaining a doctor's order
- communicates with SLP completing the VFSS (with parental approval)
- trains school staff (*In-Service Guide on Dysphagia in School-Age Children* lists topics to cover in a short in-service for regular education teachers. The *Guide to Developing a School-Based Feeding and Swallowing In-Service* is an outline of a more detailed in-service for other hands-on caregivers, such as the child's teacher, classroom aide, school nurse, etc. Both guides are provided on the CD enclosed with this book.)
- trains parents as needed (For frequently-asked questions and answers, see *What Is a Modified Barium Swallow Study and Why Does Your Child Need One?* on the CD enclosed with this book.)
- provides intervention

Occupational Therapist

- provides fine-motor skill training needed for self-feeding
- obtains positioning and adaptive equipment needed for eating
- addresses sensory and regulation issues

Physical Therapist

- obtains positioning and adaptive equipment needs related to positioning for meals
- provides services for postural skills and mobility issues

School Nurse

- administers, trains, or assists with tube feeding as needed
- monitors respiratory status via lung checks
- troubleshoots issues related to tracheostomies, feeding tubes, etc.
- trains staff on emergency procedures such as CPR and the Heimlich maneuver

ET-5 Child will be presented with liquids from a regular straw, a straw in a squeeze bottle, thick-walled tubing, and/or a straw dipped into liquid.

ET-6 Child will be presented with foods that have to be masticated on lateral chewing surfaces and/or on the midline of the tongue.

ET-7 When child is presented foods that have to be masticated, child will be assisted with jaw support and/or lip support.

The following short-term goals are designed for behavioral feeding disorders:

- Non-Feeding Activities to Increase Cooperation and Compliance (NF)
- Food Tolerance Through Component Parts (FTCP)
- Food Tolerance Through Shaping (FTS)
- Food Tolerance Through Reinforcement (FTR)
- Appropriate Behavior at Mealtimes (AB)
- Food Refusal (FR)
- Intake Amount in Transition From NPO (IAT)
- Generalization of Appropriate Eating (GAE)
- Oral Stimulation of Non-Oral Feeder (OSNO)

Since there is often a physiological component to behavioral feeding disorders, you may also choose short-term goals and treatment objectives to improve function depending on a child's deficit areas. Many children with behavioral feeding disorders will also exhibit oral hypersensitivity and hyperactive gag, so you might add OH and HG short-term goals to one or more of the goals listed below. The Oral Stimulation of Non-Oral Feeder (OSNO) goal is grouped with behavioral feeding as a preventive goal. If children who are totally non-oral are not provided with appropriate stimulation, they are more likely to develop behavioral feeding disorders when later introduced to PO intake.

Non-Feeding Activities to Increase Cooperation and Compliance (NF)

Child will increase readiness for oral feeding through non-feeding activities designed to gain the child's trust and reduce fear.

» Treatment Objectives

NF-1 Child will play with utensils in a non-mealtime situation.

NF-2 Child will play with utensils and place them in the mouth with no food present, but in the environment in which the child is fed.

NF-3 Child will sit in a chair for increasing periods of time.

NF-4 Child will participate in non-feeding activities while seated at the table.

NF-5 Child will follow simple directions without oppositional behavior.

Food Tolerance Through Component Parts (FTCP)

Child will increase the number and types of foods tolerated through development of component parts.

Note: Each of the treatment objectives can be written to address different qualities of the food that might be causing the child's intolerance (e.g., texture, taste, temperature, color). For example, treatment objectives might include: child will touch food with grainy texture to the lips; child will hold salty food in the mouth; child will place a larger bite of cold food in the mouth. If the child is not a self-feeder, the feeder can follow these same steps.

» Treatment Objectives

FTCP-1 Child will hold non-preferred food in the hand for _____ seconds.

FTCP-2 Child will hold a utensil with non-preferred food on it for _____ seconds.

FTCP-3 Child will touch non-preferred food to the lips.

FTCP-4 Child will touch non-preferred food to the tongue.

FTCP-5 Child will place non-preferred food in the mouth and hold it for _____ seconds (increase the size of the food placed in the mouth as sub-steps for this objective).

FTCP-6 Child will expel non-preferred food when a timer rings (increase the length of time as sub-steps for this objective).

FTCP-7 Child will swallow non-preferred food.