

EVIDENCE-BASED PRACTICE IN DYSPHAGIA: A SCOPING REVIEW

OTAC 2025 Annual Conference – Session 68
November 8, 2025 3 hour session

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Objectives

- 1. Examine the anatomy and physiology of the oral and pharyngeal phases of the swallow
- 2. Identify common issues during each phase that result in swallowing disorders (dysphagia)
- 3. Describe evidence-based interventions that can be used in clinical practice to specifically address these two phases of the swallow
- 4. Apply the specific interventions to case presentations using professional reasoning to consider the client context(s)

Advanced Practice Requirements

- "Swallowing" as used in Code section 2570.3 is the passage of food, liquid, or medication through the pharyngeal and esophageal phases of the swallowing process.
- "Instrumental evaluation" is the assessment of any aspect of swallowing using imaging studies that include, but are not limited to, endoscopy and videofluoroscopy.
- Swallowing assessment, evaluation or intervention may be performed only when an occupational therapist has demonstrated to the Board that he or she has met the post professional education and training requirements established by this section as follows:

Advanced Practice Requirements

- Education: Completion of 45 contact hours in the following subjects:
 - (A) Anatomy, physiology and neurophysiology of the head and neck with focus on the structure and function of the aerodigestive tract;
 - (B) The effect of pathology on the structures and functions of the aerodigestive tract including medical interventions and nutritional intake methods used with patients with swallowing problems;
 - (C) Interventions used to improve pharyngeal swallowing function.
- Completion of 240 hours of supervised on-the-job training

Four Phases of the Swallow

- Oral Preparatory Phase
- Oral Phase – focus of this presentation
- Pharyngeal Phase – focus of this presentation
- Esophageal Phase

Anatomical Structures

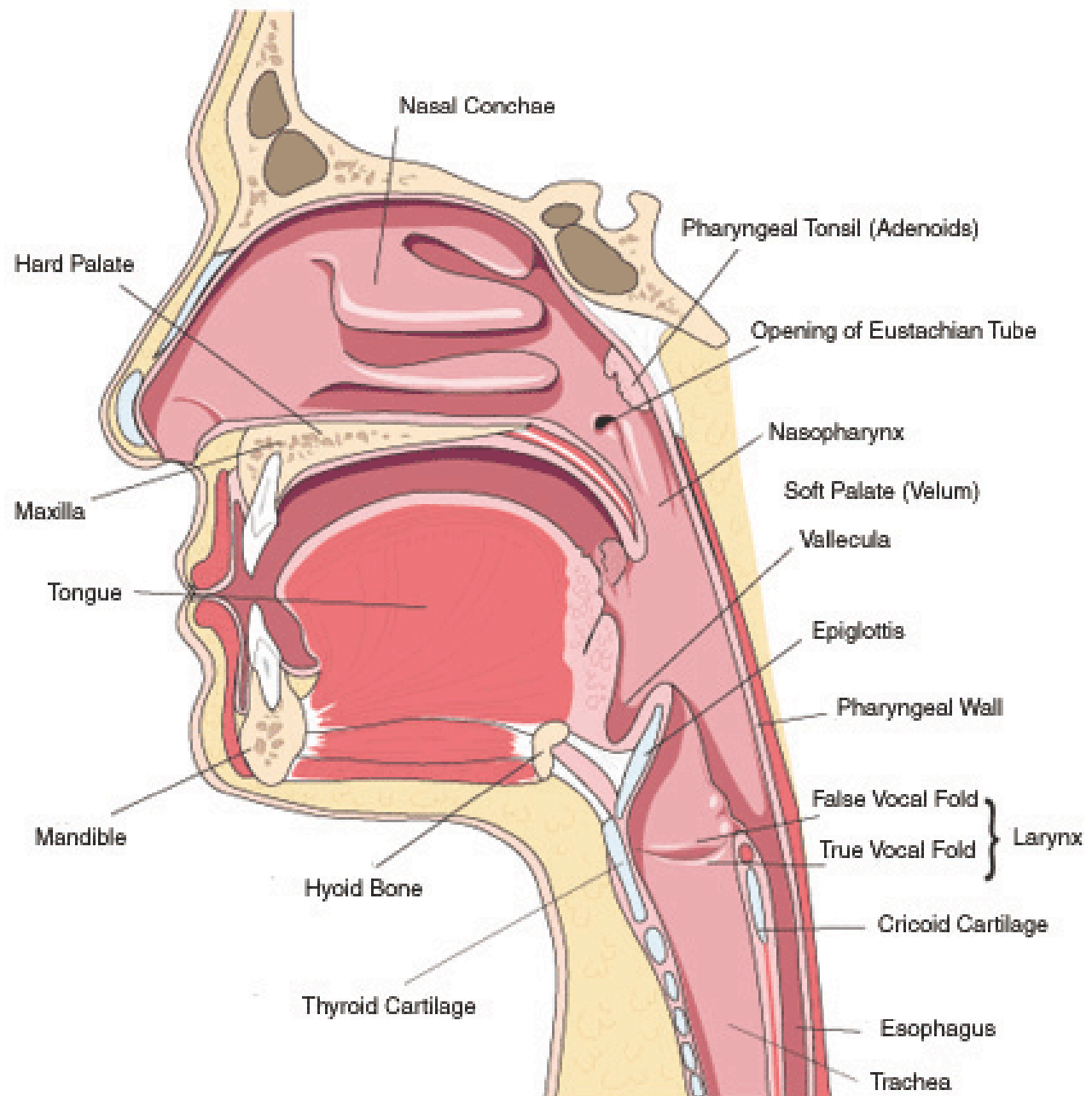
Extra-oral structures involved in the swallow process

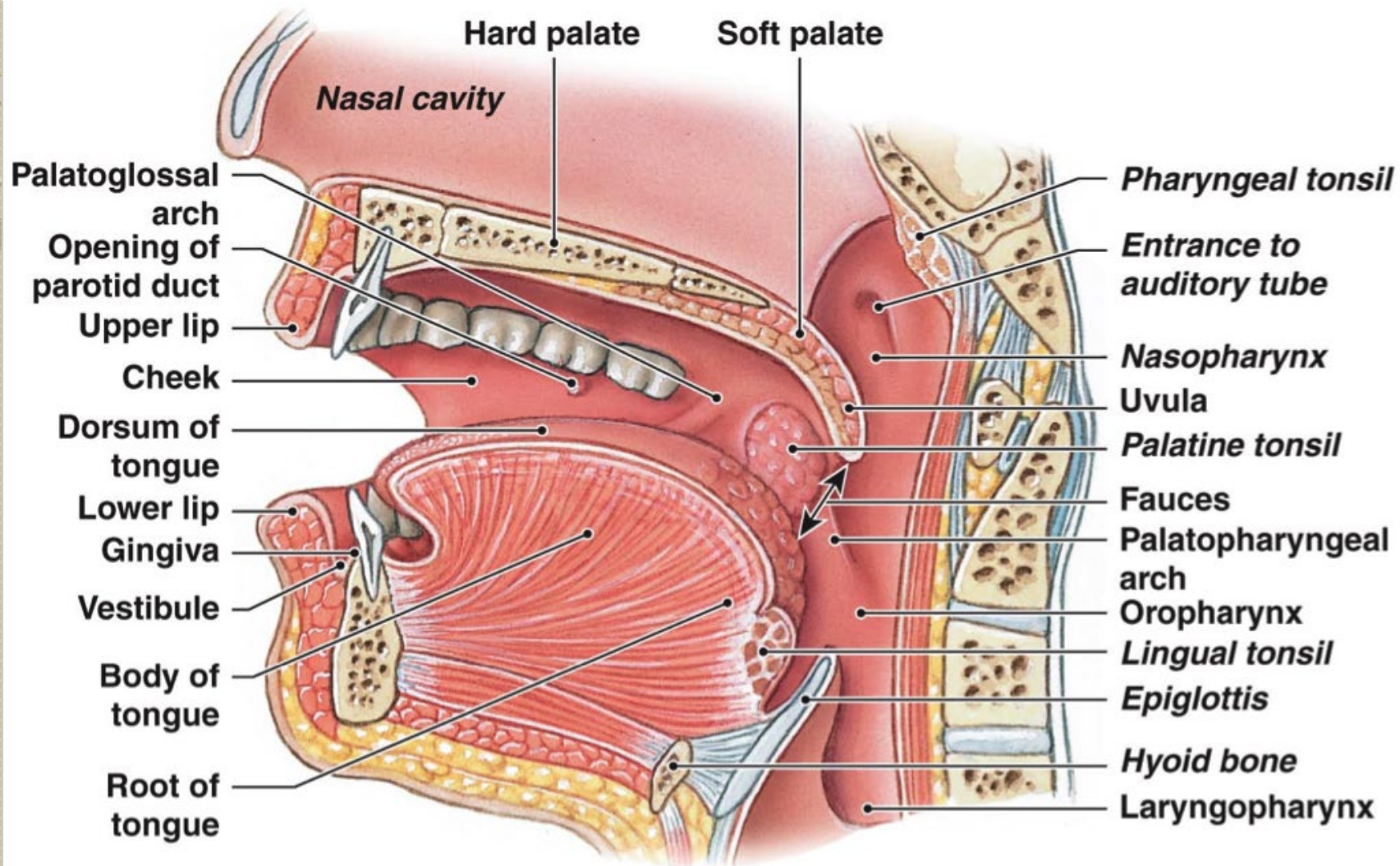
- Head/neck positions influence the swallowing process
 - 1. Normal alignment of head/neck in upright allows for pressure gradients for swallow to occur with least effort
 - 2. Reduces the risk of aspiration
- Trunk position influences the swallowing process
 - 1. Neutral pelvic alignment as the supporting surface facilitates respiratory capacity
 - 2. Alignment of head and trunk fosters improved control and organization of oral preparatory and oral phase
- Basic Clinical Assessment
 - Assume symmetrical position
 - Sustain position throughout the meal

Anatomical Structures

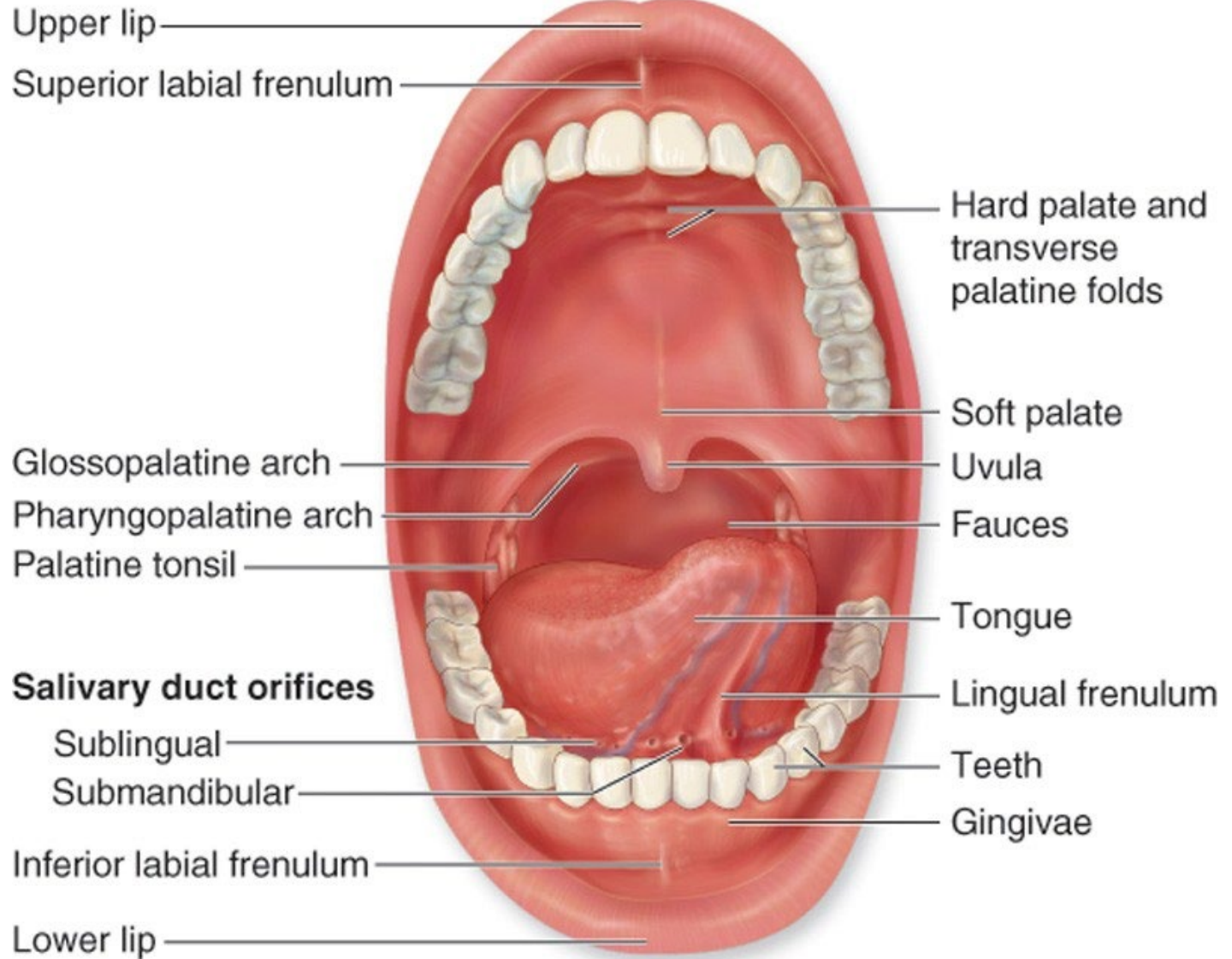
Intra-oral structures involved in the swallow process

- Structures of the oral cavity
 - Teeth
 - Lips
 - Tongue (oral cavity portion)
 - Hard Palate
 - Mandible





(a) Oral cavity, sagittal section

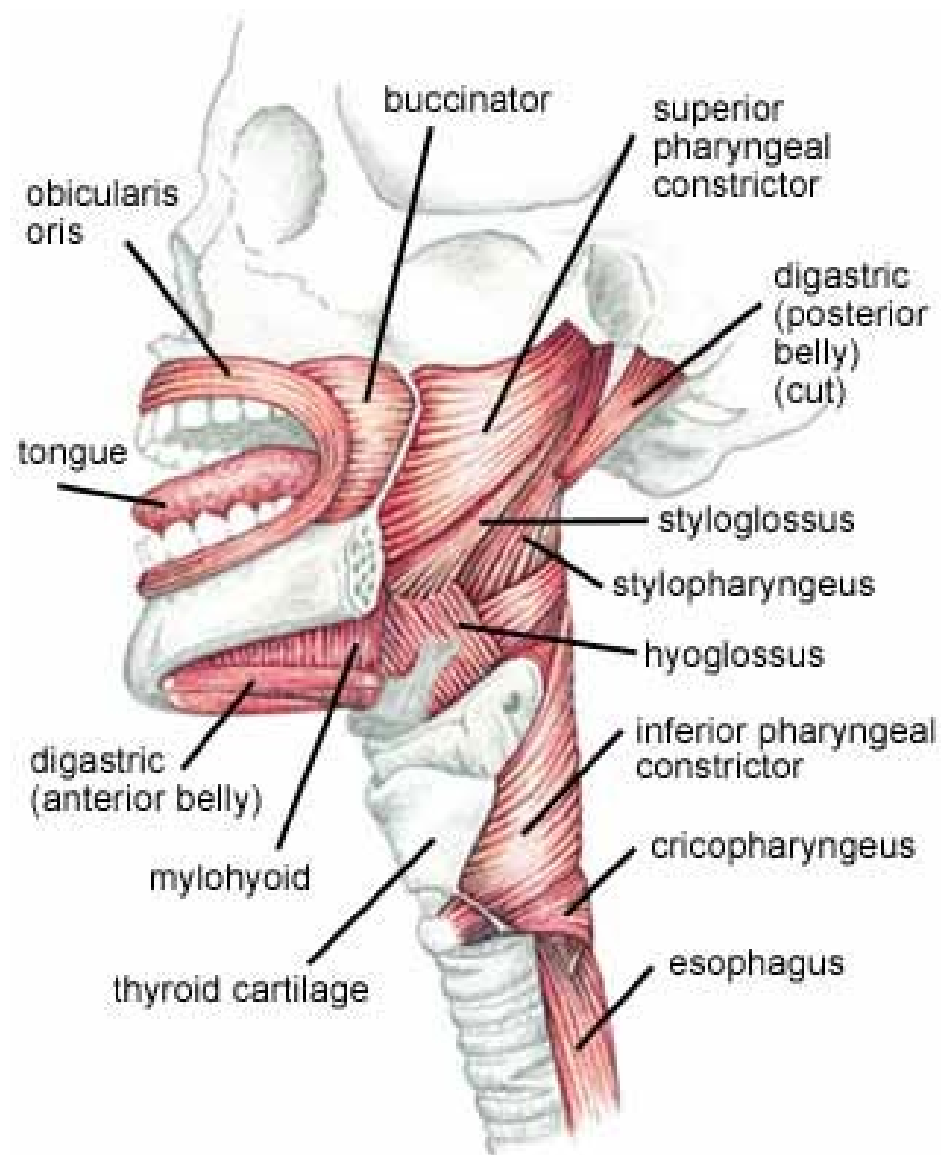


(a)

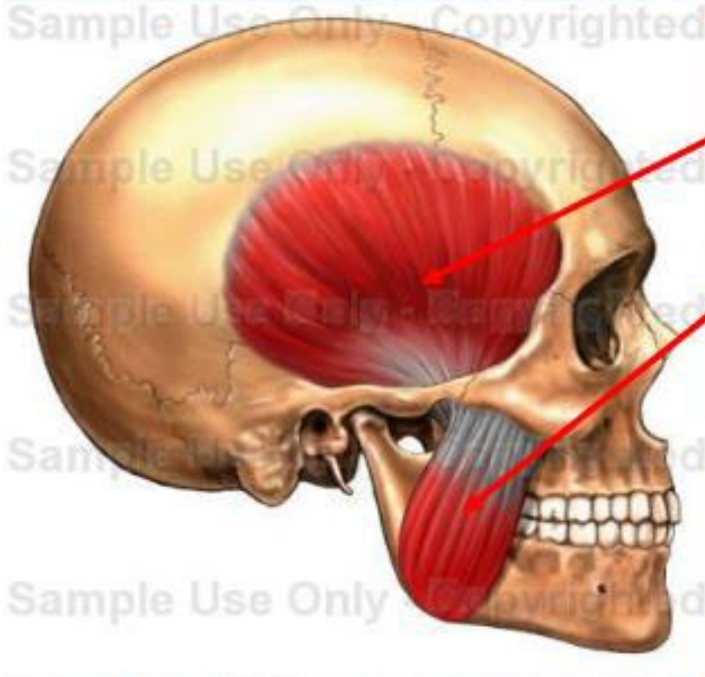
Anatomical Structures

- Muscles of the Face, Tongue, and Jaw
- Facial Muscles
 - Orbicularis oris
 - Buccinator
 - Levator anguli oris/risorius
- Mastication
 - Temporalis
 - Masseter
 - Lateral and medial pterygoids
- Tongue
 - Intrinsic tongue muscles
 - Extrinsic tongue muscles

Facial Muscles



Muscles of mastication

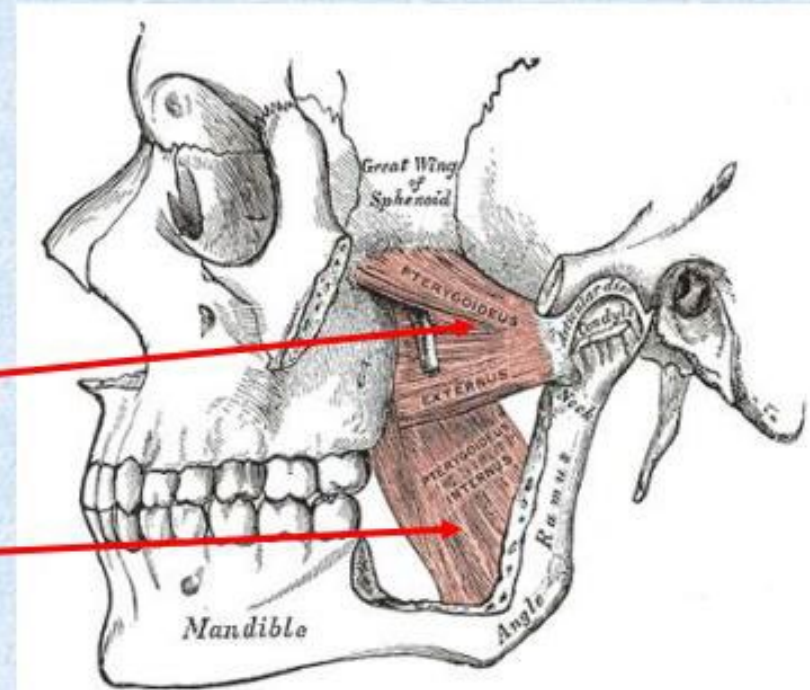


Temporalis

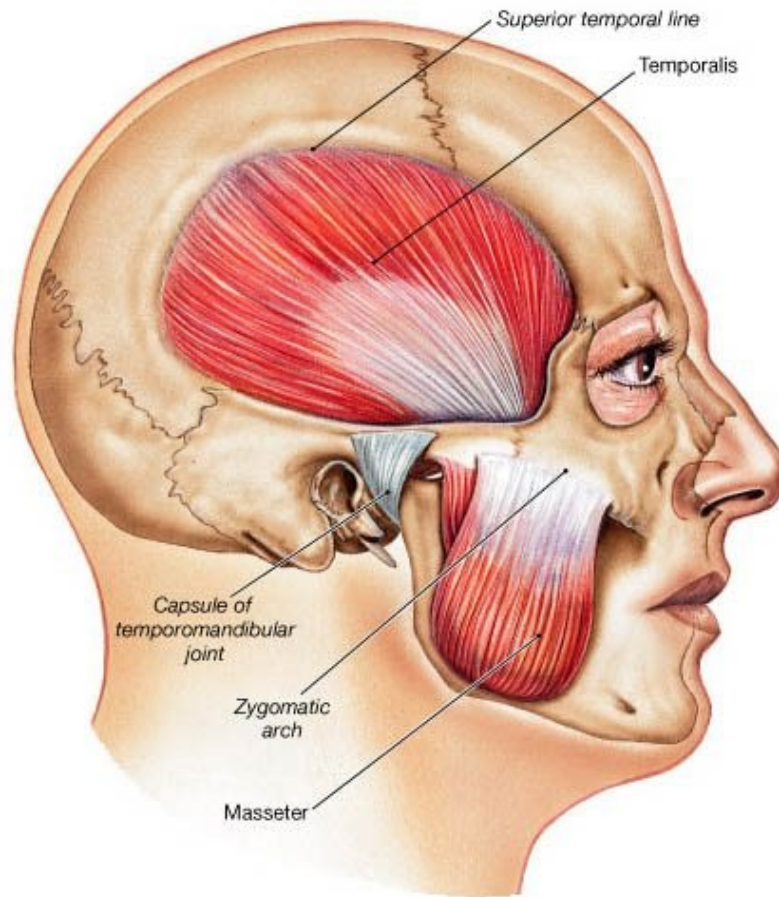
Masseter

Lateral pterygoid

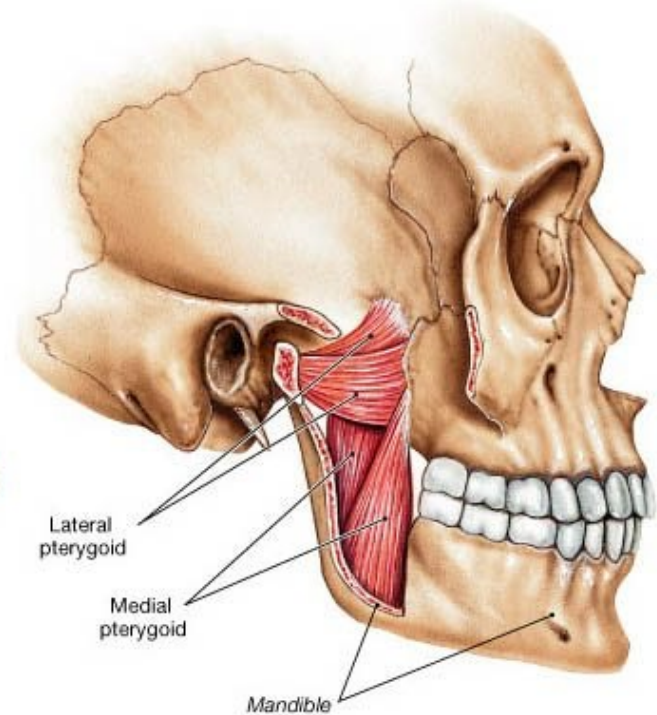
Medial pterygoid



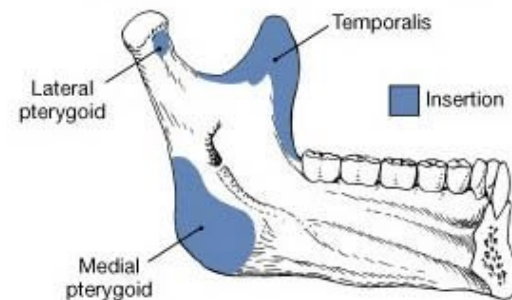
Muscles of Mastication



(a) Lateral view

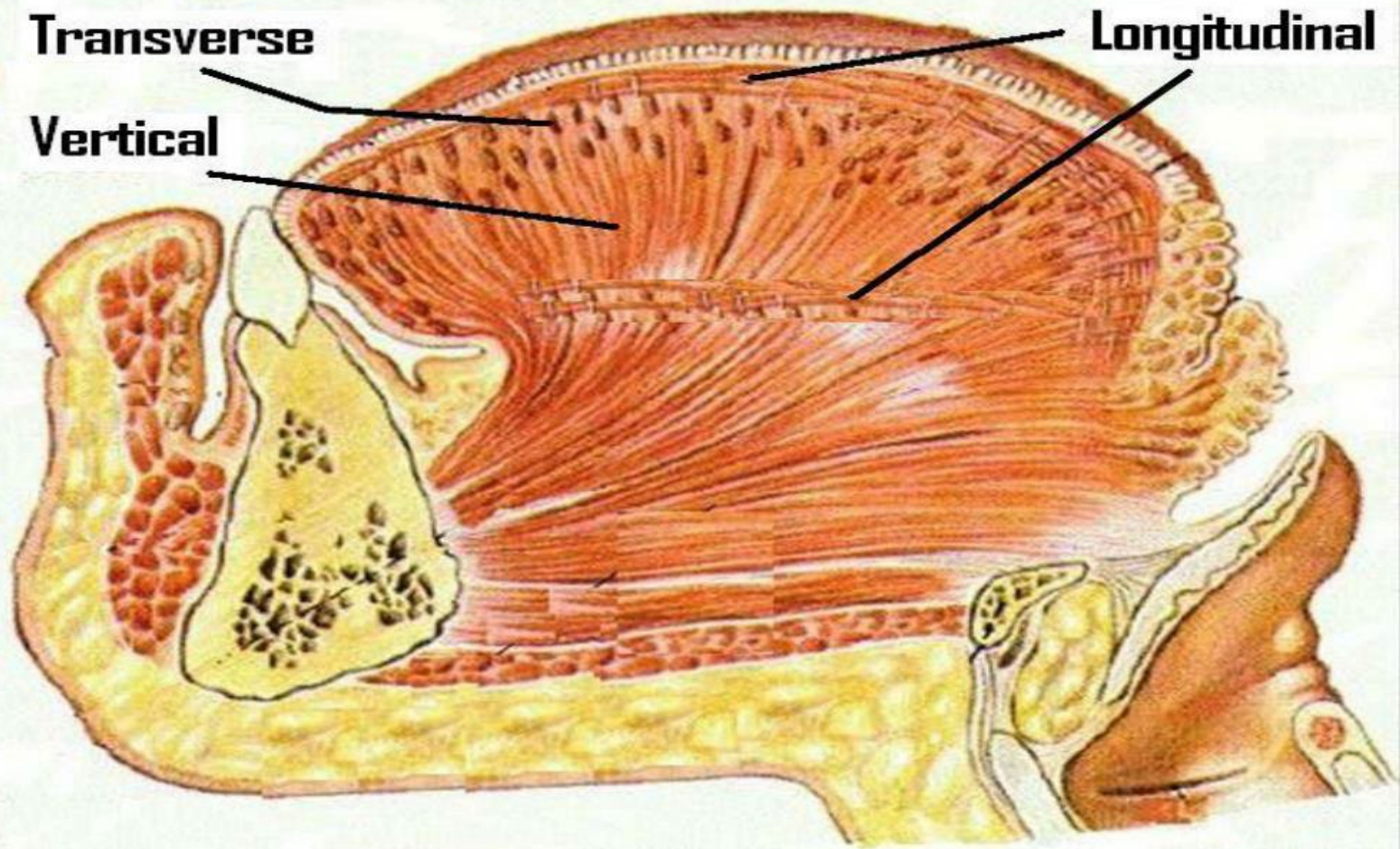


(b) Lateral view, pterygoid muscles exposed

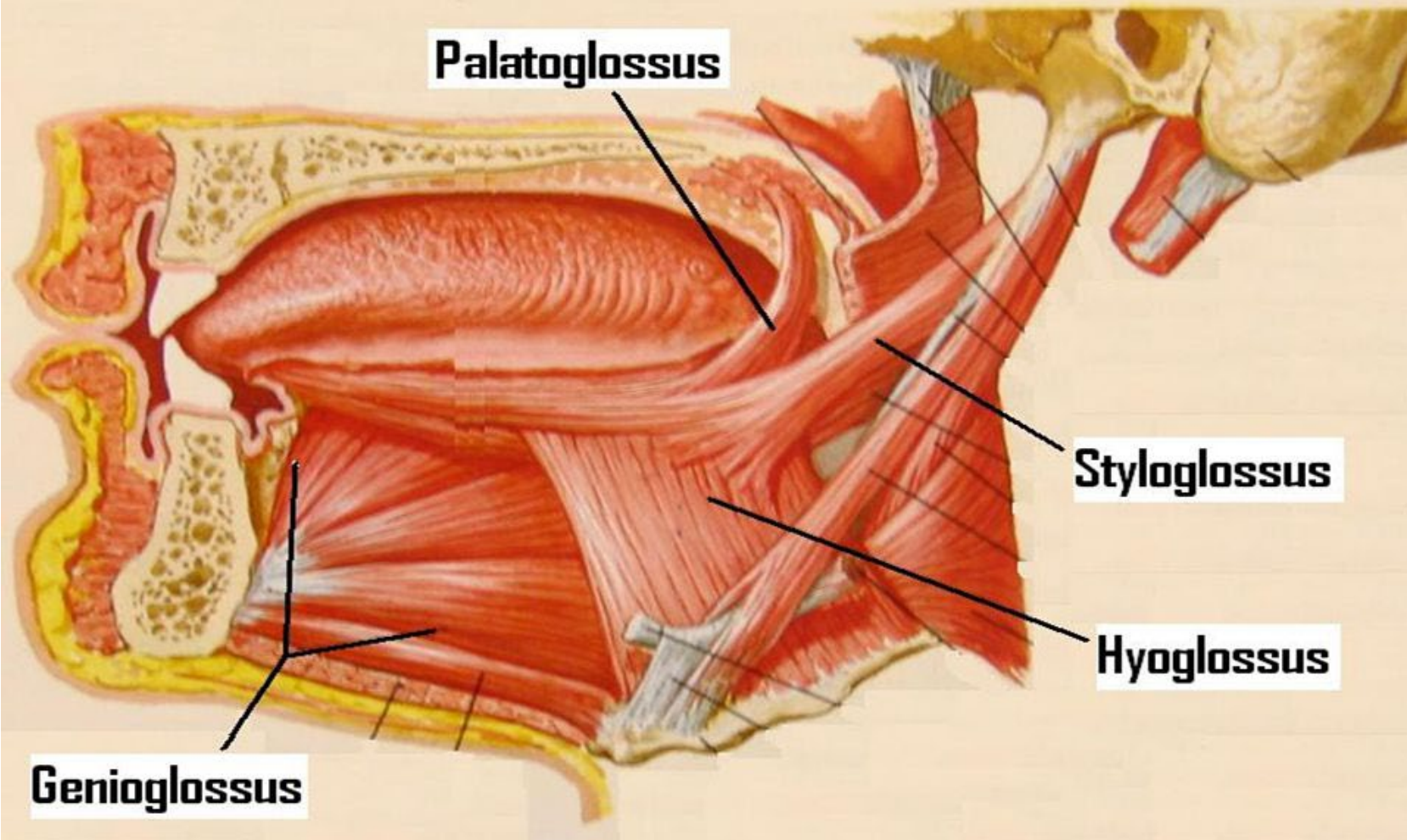


(c) Insertions, medial view of left mandibular ramus

Intrinsic tongue muscles



Extrinsic tongue muscles



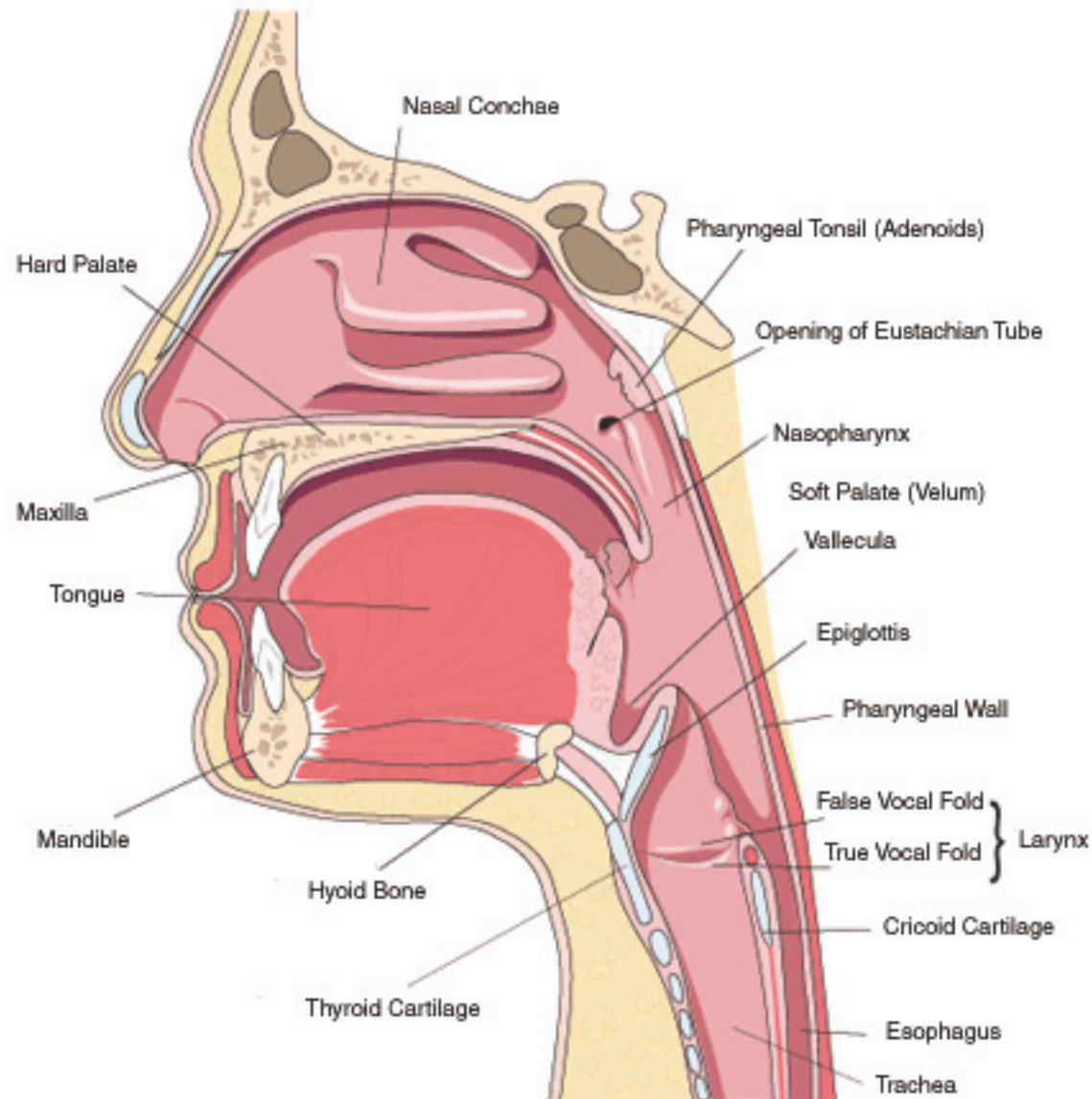
Role of tongue muscles

- Both intrinsic and extrinsic tongue muscles are critical for the normal swallow to occur
- Given the structure of the tongue muscles being striated tissue these muscles can be strengthened, and coordination can be improved with practice
- The tongue performs significant functions in the oral preparatory, oral transit, and pharyngeal phase of swallowing, including major contributions to bolus manipulation and transport
 - Youmans et al, 2009

Anatomical Structures

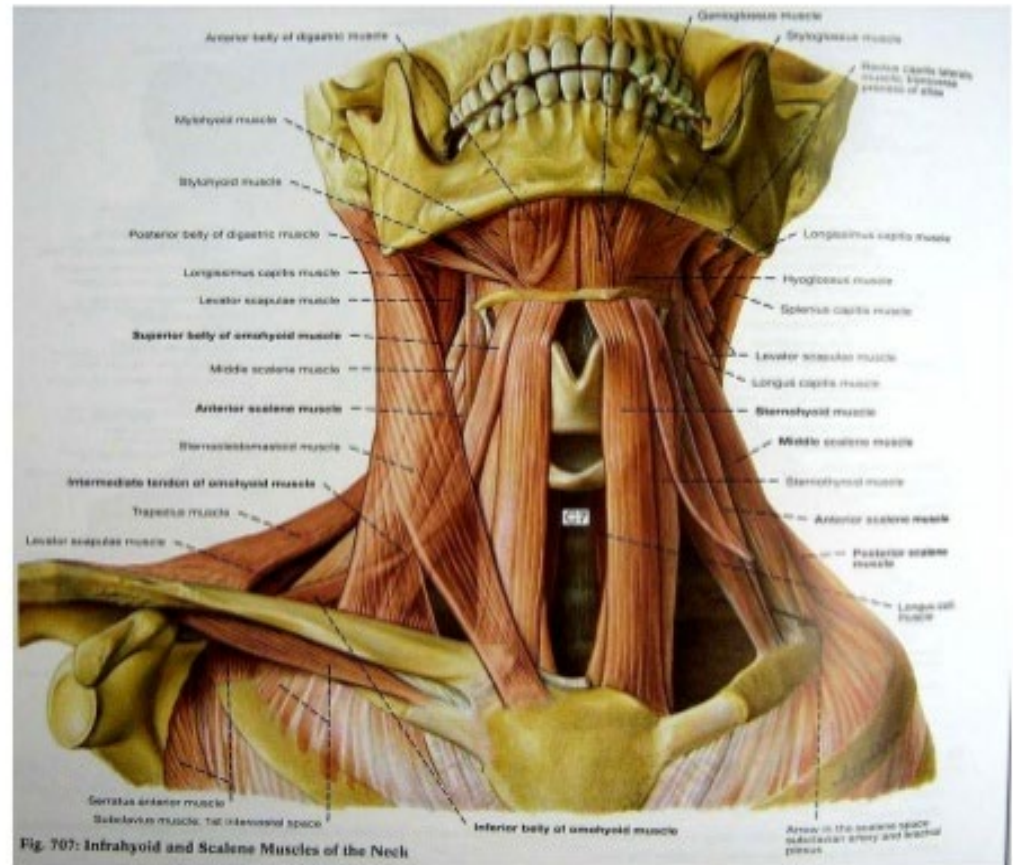
- Structures of the Pharynx
- Pharyngeal arches (faucial arches, faucial pillars)
- Tongue (pharyngeal portion)
- Pharyngeal wall
- Valleculae
- Epiglottis
- Anterior to pharynx is the larynx and trachea
- Musculature of throat
 - Suprahyoids
 - Infrahyoids

Structures of the Pharynx



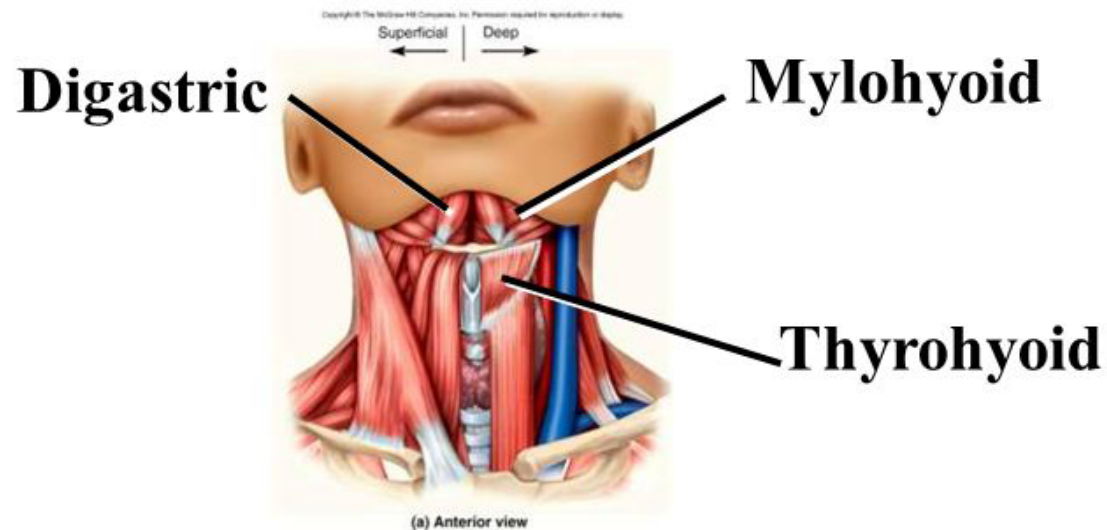
The Accessory Muscles of Mastication

Other muscles that are active in mastication include the suprahyoid and infrahyoid muscles of the anterior area of the neck. Both groups of muscles are active in helping depress the mandible



Suprahyoid Muscles and Swallowing

- **Digastric and Mylohyoid = open mouth**
- **Geniohyoid = widens pharynx during swallowing**
- **Stylohyoid = elevates hyoid**
- **Thyrohyoid = elevates larynx, closing glottis**



Suprahyoid Muscles

They are 4 suprahyoid muscles in submental and submandibular triangles. They pass from hyoid bone to skull or mandible and raise the hyoid.

1. Stylohyoid: arises from base of styloid process and passes anteroinferiorly to attach to lateral area of the body of hyoid bone. During swallowing it pulls hyoid bone posterosuperiorly and is innervated by facial n.

2. Digastric: has two bellies connected by a tendon, which attaches to the body of hyoid bone:

Posterior belly arises from mastoid notch on medial side of mastoid process of temporal bone;

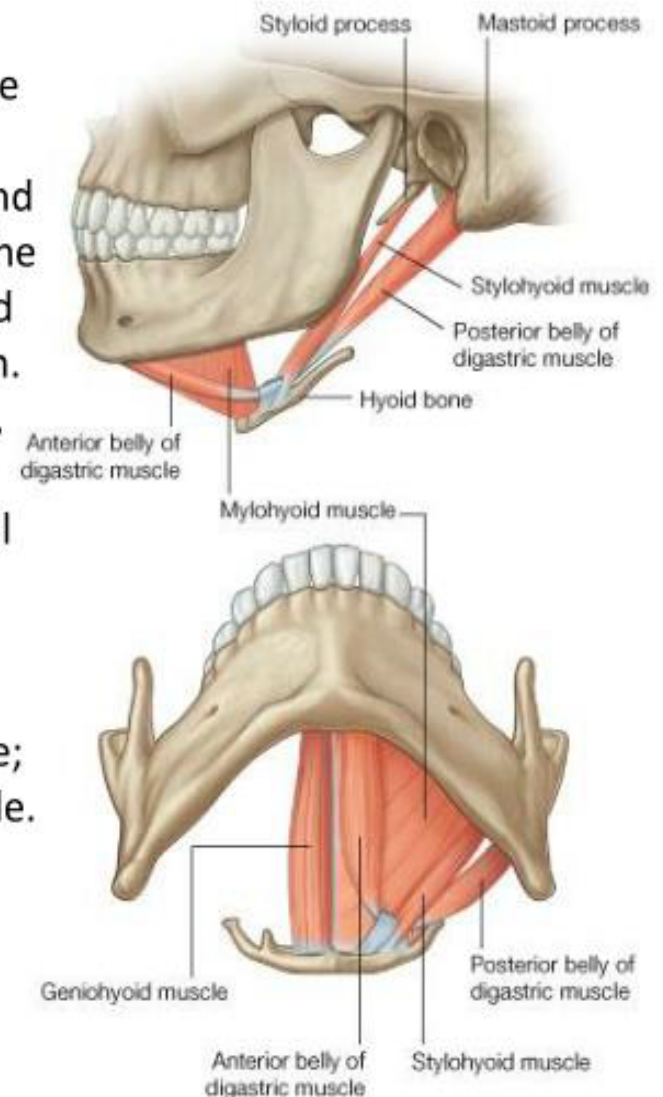
Anterior belly arises from digastric fossa on lower inside of mandible.

Action: When mandible is fixed, it raises hyoid bone; and when hyoid bone is fixed, it lowers the mandible.

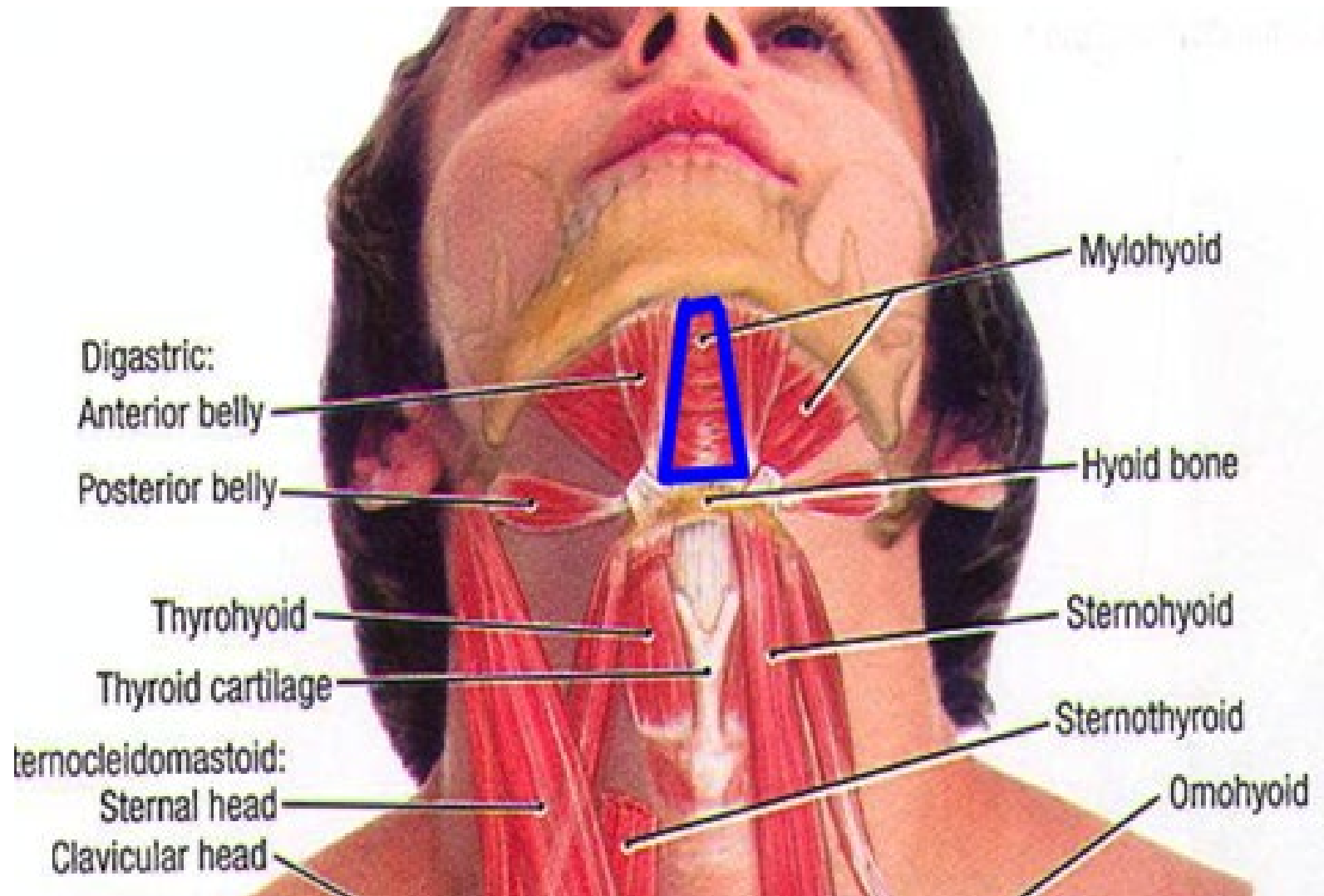
Innervation: posterior belly by the facial nerve, whereas anterior belly is by trigeminal nerve.

3. Mylohyoid: Floor of the mouth

4. Geniohyoid: Floor of the mouth



SUBMENTAL TRIANGLE



SUBMENTAL TRIANGLE

- **Formed by the :**
 - anterior midline of neck
 - hyoid bone
 - anterior belly of digastric muscle

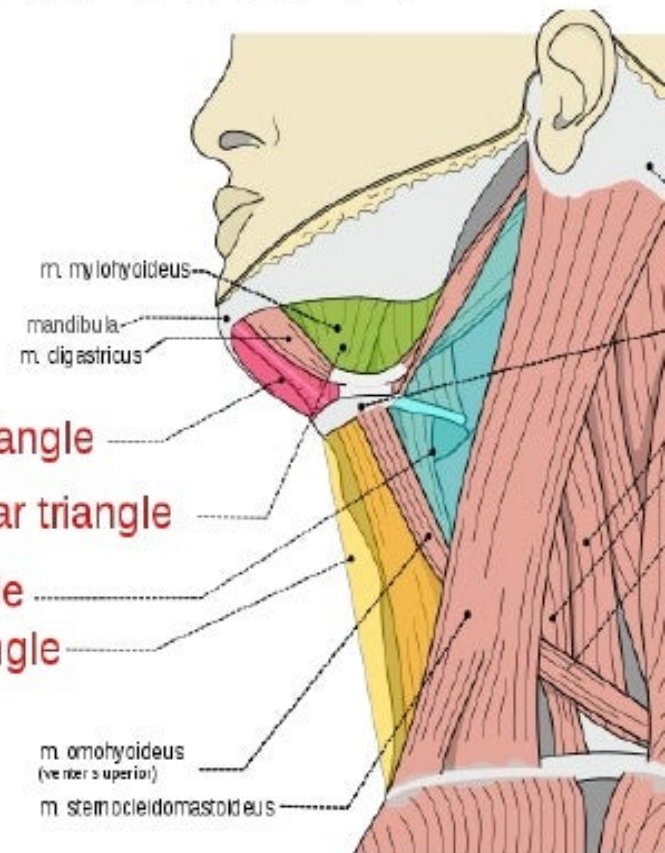
Anterior triangle

Submental triangle

Submandibular triangle

Carotid triangle

Muscular triangle



Anatomical Structures

- Structures of the Esophagus
- Cricopharyngeal sphincter (upper esophageal sphincter)
- Lower esophageal sphincter

Review of the Action during the Four Phases of the Swallow

- Oral Preparatory Phase
- Oral Phase – primary focus of this presentation
- Pharyngeal Phase – primary focus of this presentation
- Esophageal Phase

Review of Normal Anatomy and Physiology of the Swallow

- Oral preparatory phase
 - This phase is under voluntary control and requires task recognition, head and neck control, intact tongue, jaw and lip control.
 - The length of time for the oral preparatory phase varies depending on the consistency of the food
 - These actions are sometimes included as part of the oral phase
 - The duration of the oral preparatory phase varies depending on the resistive quality of the food and strength of chewing needed

Review of Normal Anatomy and Physiology of the Swallow

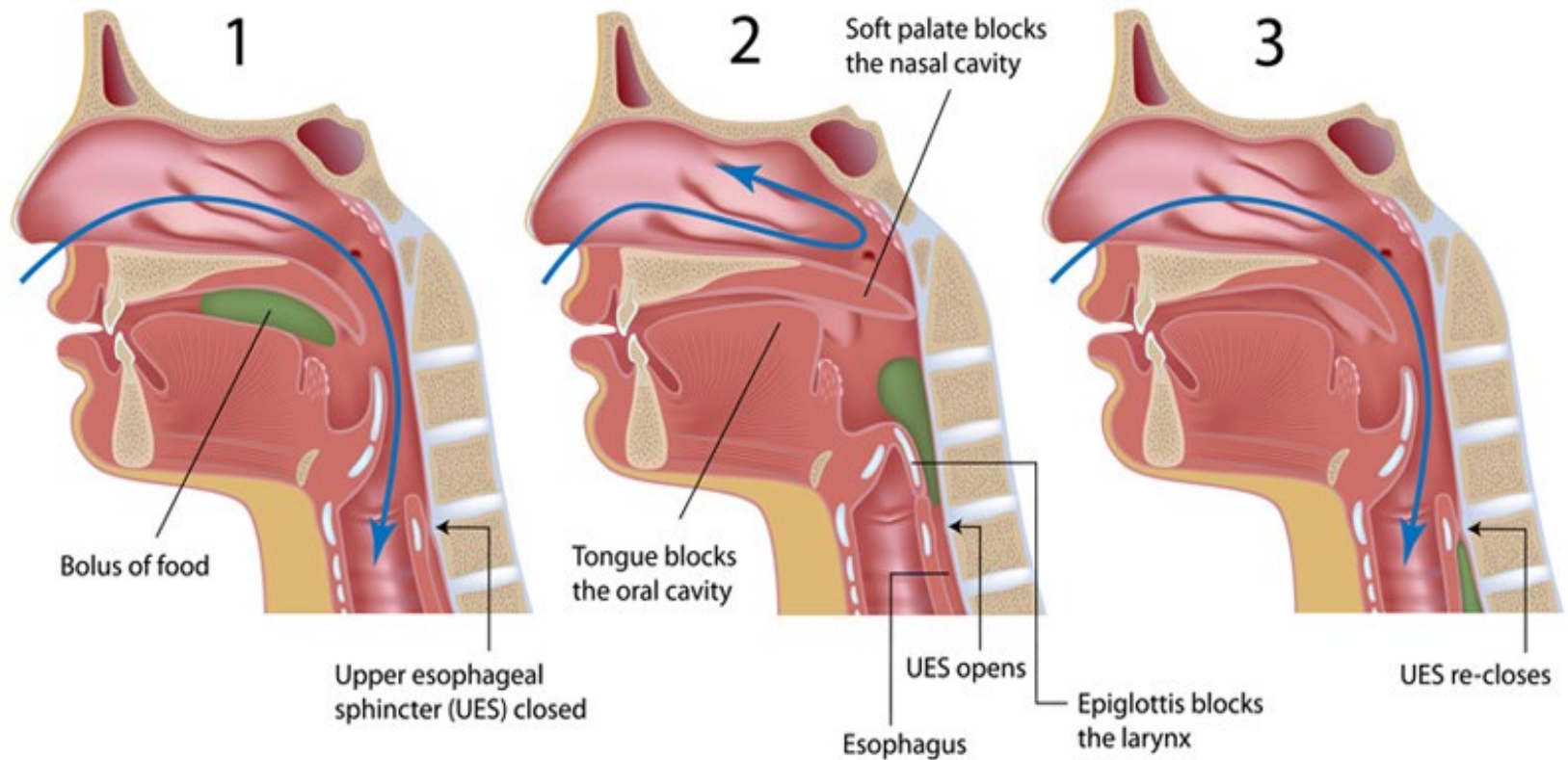
- Oral phase
 - During this phase the bolus of food or liquid is propelled to the pharynx by the tongue
 - The tongue creates a trough to control the bolus with the intrinsic tongue muscles
 - The tongue then elevates and flattens against the hard palate using a front to back motion to propel the bolus posteriorly

Review of Normal Anatomy and Physiology of the Swallow

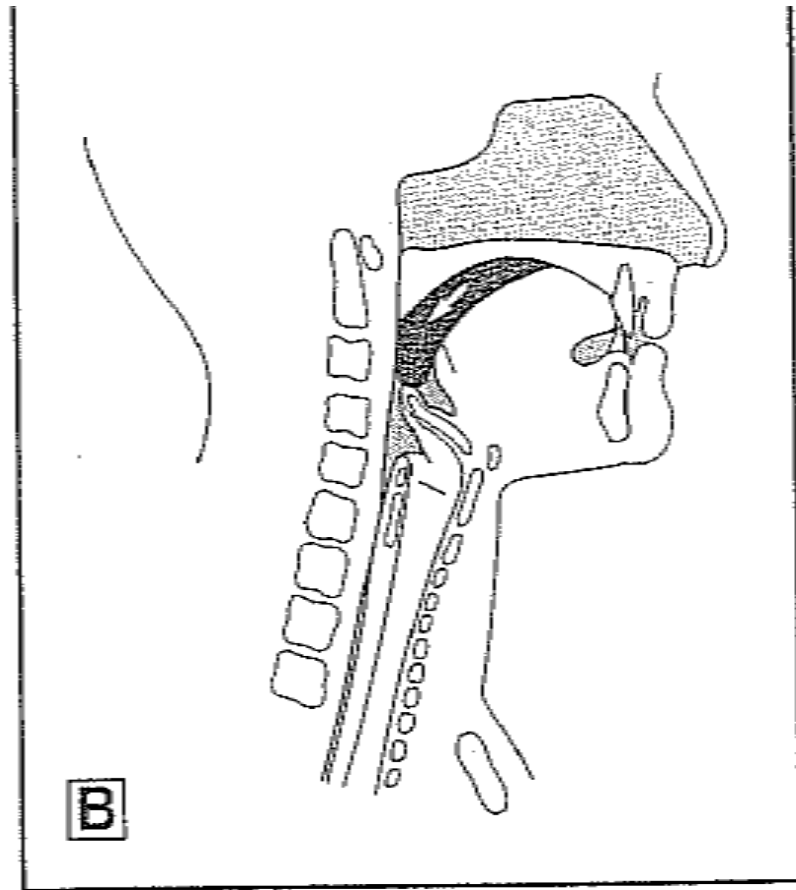
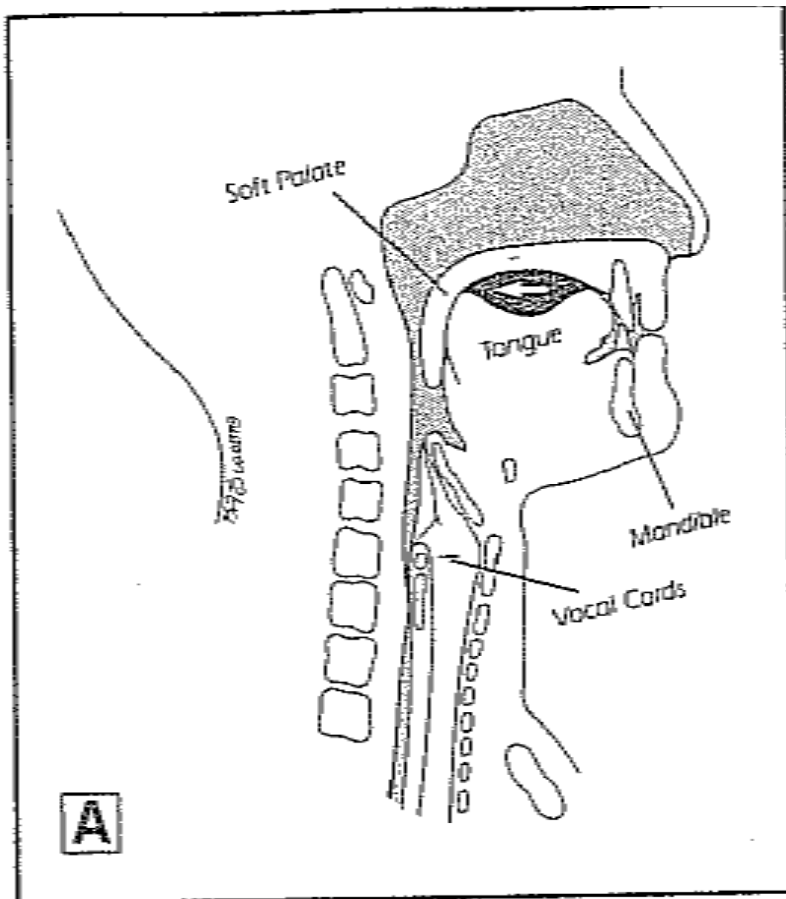
- Oral phase
 - Requires: Intact labial musculature, intact lingual movement, intact buccal musculature, normal palatal musculature, and the ability to breathe comfortably through the nose
 - Typically respiration stops as the food moves posteriorly
 - The soft palate begins to flare and elevate
 - This phase is under voluntary control and typically lasts approximately 1 second

Swallowing process – All phases

Swallowing



Oral Phase of Swallow



Review of Normal Anatomy and Physiology of the Swallow

- Pharyngeal phase

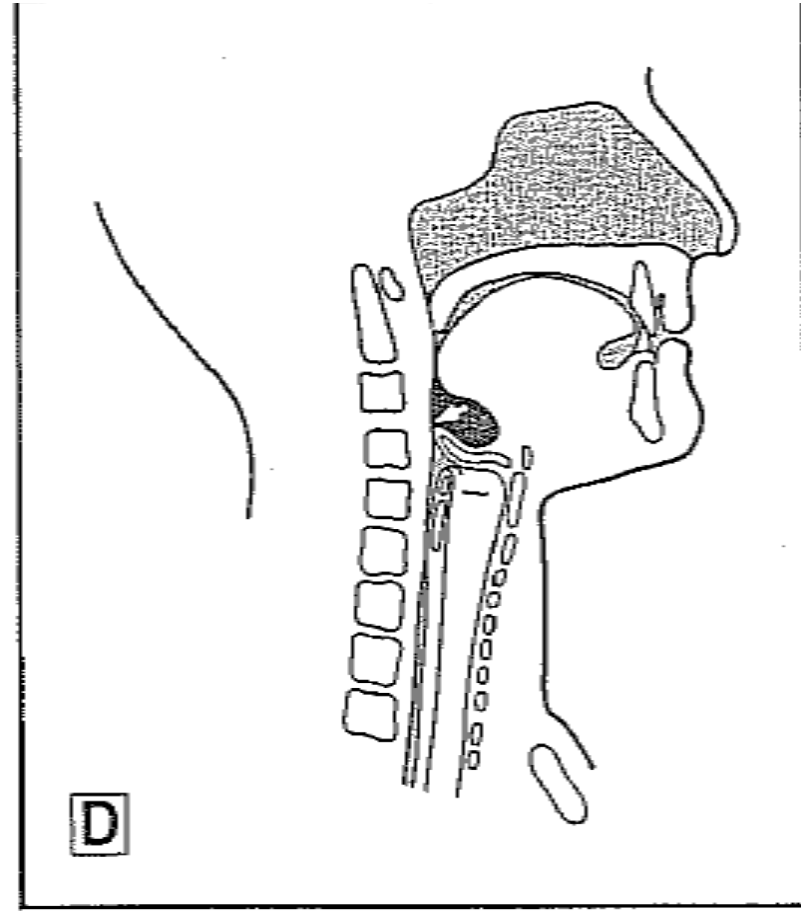
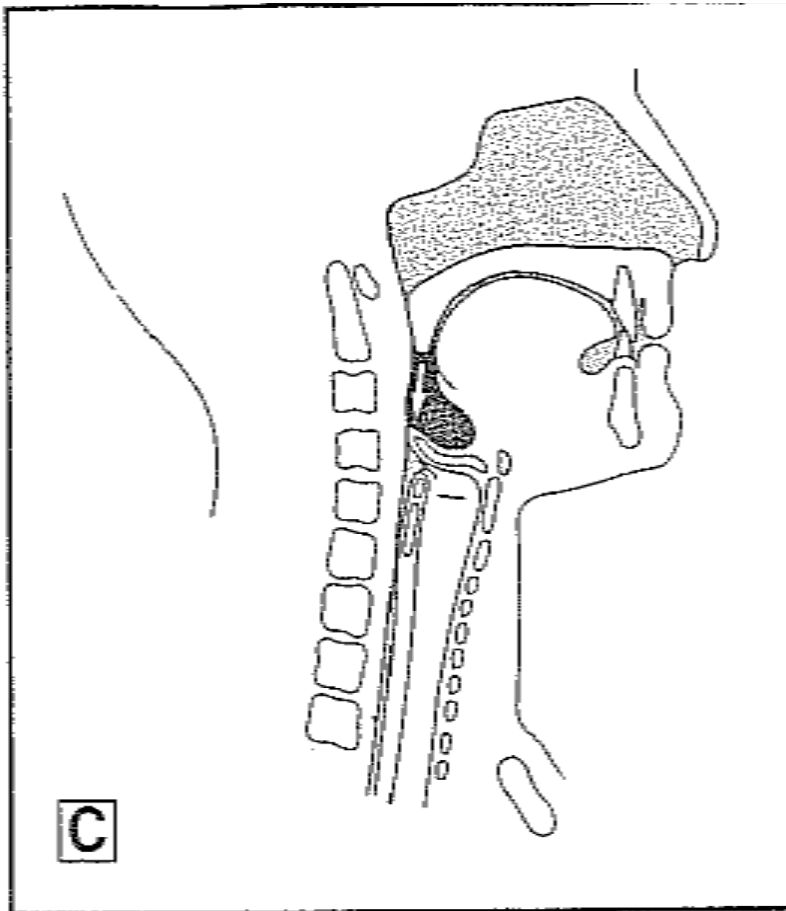
- Swallow response occurs when bolus passes through faucial arches and the middle of the tongue base.
- Respiration does not occur during this phase
- Physiological activities:
 - Velopharyngeal closure (nasopharynx) to avoid nasal regurgitation
 - Elevation and closure of the larynx to avoid aspiration
 - Progressive top to bottom peristaltic action of the pharyngeal wall
 - Relaxation of the cricopharyngeal sphincter

Review of Normal Anatomy and Physiology of the Swallow

- **Pharyngeal phase**

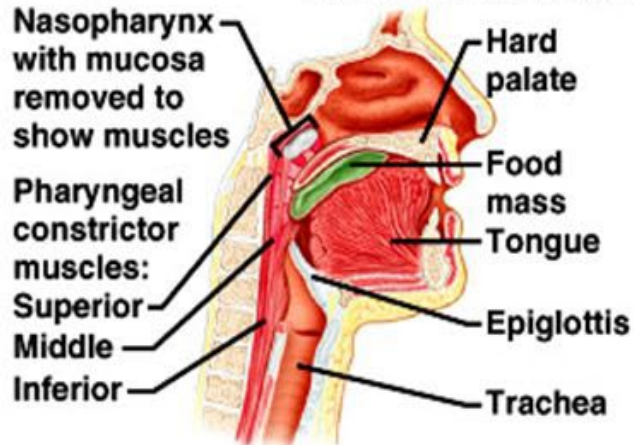
- This is the phase where the “reflexive swallow” is initiated; this is considered the involuntary phase of the swallow
- Ramping of the base of the tongue followed by tongue base retraction
- This phase lasts approximately 1 second

Pharyngeal Phase of Swallow

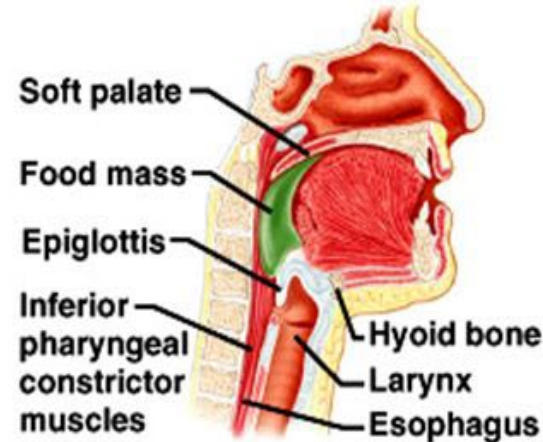


Swallowing Mechanism

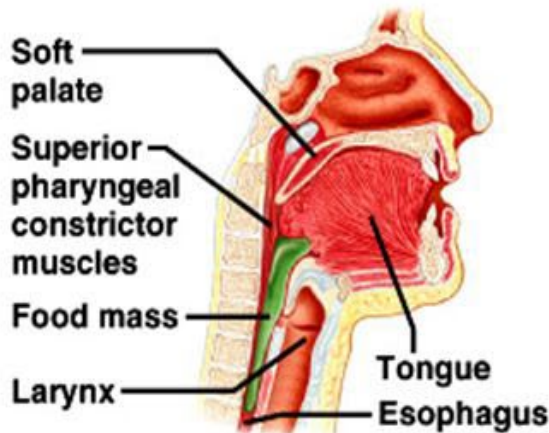
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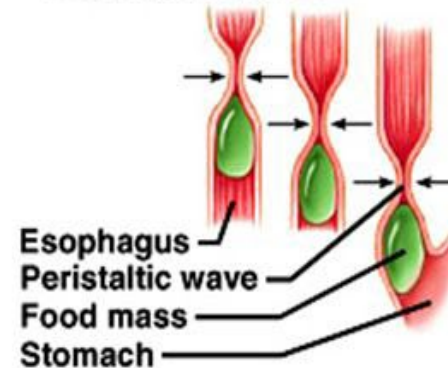
(a) The tongue forces food into the pharynx.



(b) The soft palate, hyoid bone, and larynx are raised, the tongue is pressed against the palate, the epiglottis closes, and the inferior constrictor muscles relax so that the esophagus opens.



(c) Superior constrictor muscles contract and force food into the esophagus.



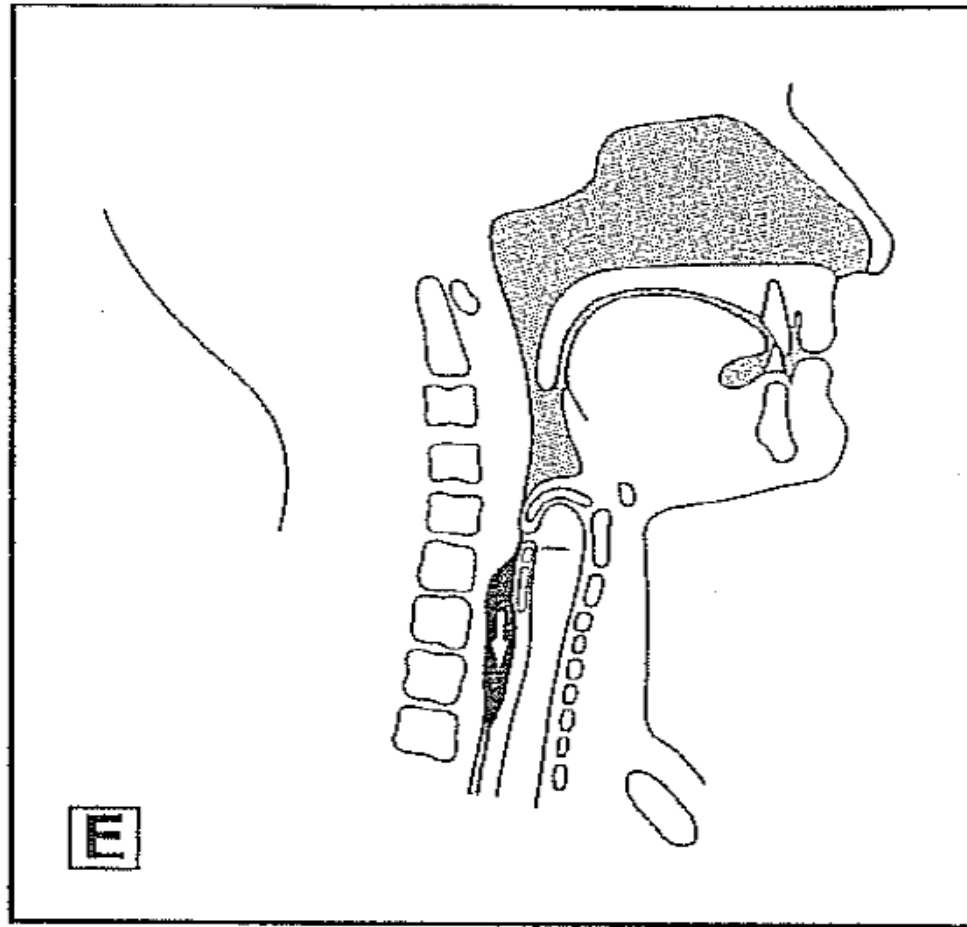
(d) Peristaltic waves move food through the esophagus to the stomach.

Review of Normal Anatomy and Physiology of the Swallow

- Esophageal phase

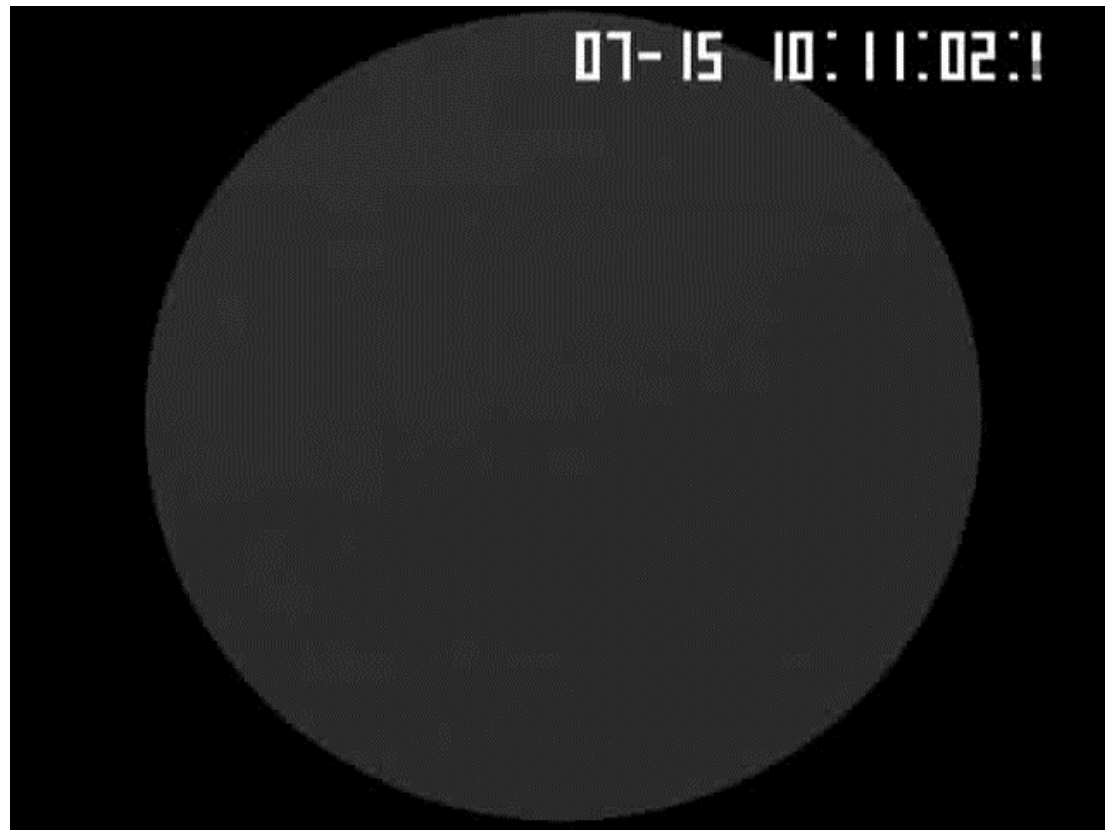
- This phase is also involuntary during the process of swallowing
- Peristaltic action propels the food through the esophagus to the stomach
- At the onset of this phase the upper esophageal sphincter relaxes to allow food to pass into the esophagus
- At the end of this phase the lower esophageal sphincter opens to allow food to pass into the stomach
- The length of time varies depending on the viscosity of the food but typically is completed within 20 seconds

Esophageal Phase of Swallow



Video of normal swallow

- Speed of oral phase
 - After bolus is prepared the transit time is 1 second
- Speed of pharyngeal phase
 - Transit time is 1 second



Common physiological problems during Oral Preparatory and Oral phase

- Oral Preparatory Phase
 - Poor oral motor control of bolus in oral cavity
 - Poor postural control to sustain safe eating
 - Problems with cognitive/perceptual function
- Oral Phase
 - Poor tongue control of bolus; limited intrinsic tongue muscle control
 - Extended oral transit time

Common physiological problems during Pharyngeal and Esophageal phase

- Pharyngeal Phase
 - Absent/delayed swallow reflex
 - Problems with laryngeal closure/elevation
 - Reduced pharyngeal peristaltic action
- Esophageal Phase
 - GERD along with sphincter dysfunction
 - Reduced esophageal peristaltic action

Videofluoroscopy – Abnormal Swallow

- 7 year old with history of pneumonia 2 - 3 times per year
- Look at transit during oral phase
- Look at transit during pharyngeal phase
- Pharyngeal residue after swallow

Videofluoroscopy – Abnormal Swallow

- Adult client
 - Assess oral transit
 - Assess oral residue
 - Assess pharyngeal transit
 - Assess pharyngeal residue

Incidence of Dysphagia

Bhattacharyya, 2014; Lawlor & Choi, 2020; Sato et al, 2013

- Incidence may be as high as 22% in those over 50 years of age
- Approximately 10 million Americans are evaluated each year with swallowing difficulties
- Swallowing difficulties negatively impact quality of life functioning
- Impaired swallowing can cause significant morbidity and mortality
- Parents report close to 50% of children experience episodes of dysphagia; most common for premature infants and children with neuromuscular disorders

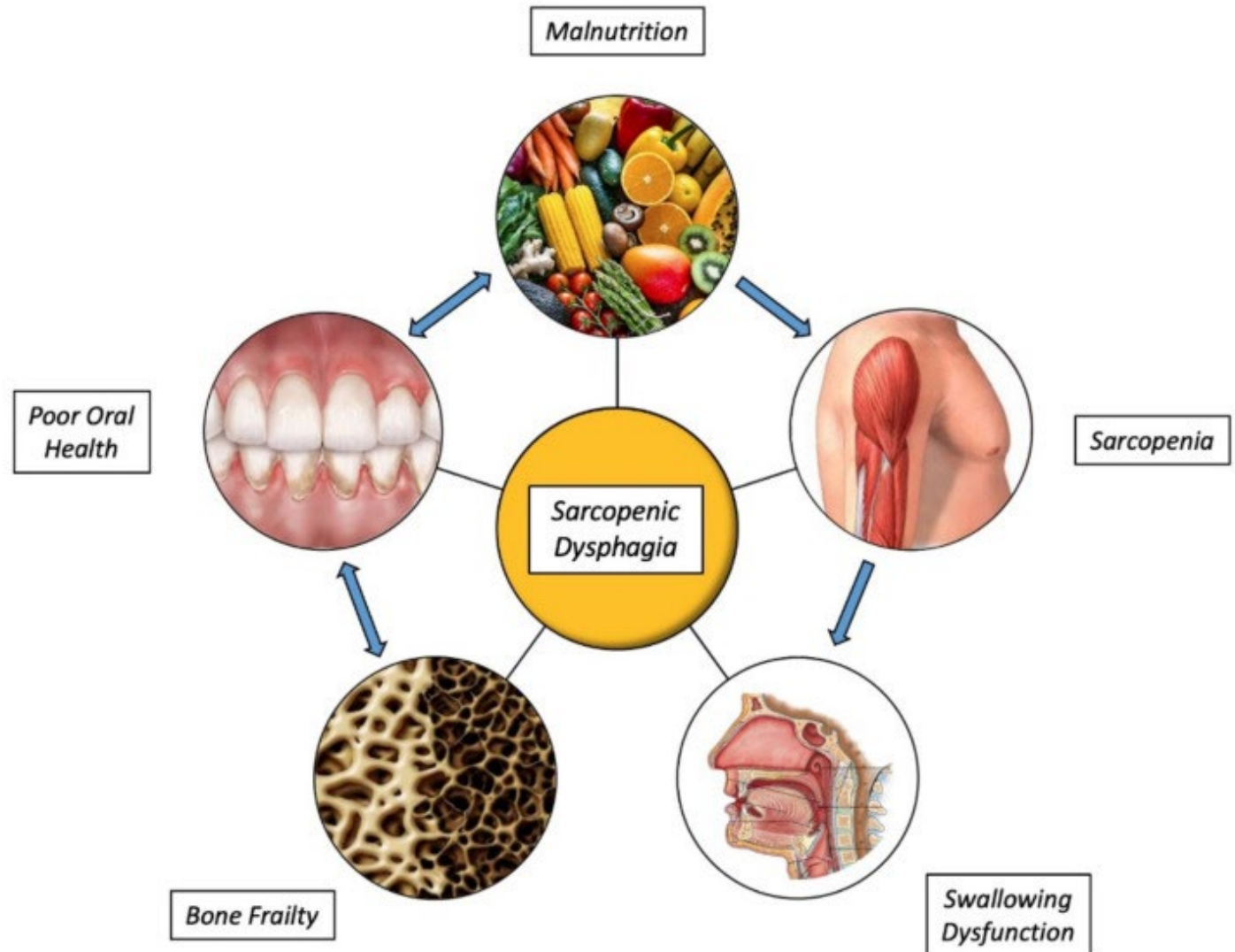
Dysphagia and normal aging

- Transit time increases with normal aging
- The retrusion (retraction of the tongue) does not appear to change in skill but diminished strength has been noted
 - Becker, et al, 2015
- Protrusion of tongue diminish with aging
- Pharyngeal transit time is increased
- Less laryngeal excursion with older adults
- Traveling esophageal velocity pressure is decreased with aging marking it more difficult to propel the bolus to the LES
 - Nishikubo et al, 2015
- Oral frailty is defined as the age-related functional decline of orofacial structures
 - Parisius et al, 2022

Sarcopenia and older adults

- Past publications addressing dysphagia in older adults focused on those residing in residential facilities
- More contemporary research has focused on dysphagia with community dwelling older adults
 - Christmas et al, 2019; Sakar et al, 2022; Yang et al, 2022
- Sarcopenia is documented with older adults and plays an important role in dysphagia during both the oral preparatory, oral and pharyngeal phases
 - de Sire et al, 2022; Sakar et al, 2022

Sarcopenia dysphagia de Sire et al, 2022



Sarcopenia dysphagia de Sire et al, 2022



Incidence of Dysphagia - Settings

- Dysphagia in different health care settings:
 - 61% of adults admitted to acute trauma centers
 - 41% of individuals admitted to rehab settings
 - 30%-75% of patients in nursing homes
 - 25%-30% of patients admitted to hospitals

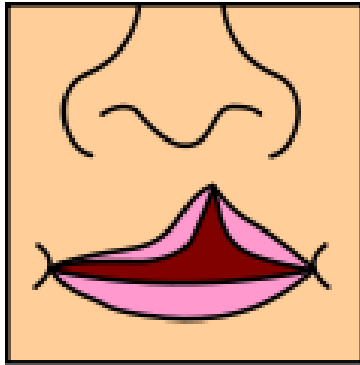
Anatomical Structures

- Anatomical problems and the impact on swallowing – Adult
- Decreased tongue mobility
- Surgical resections

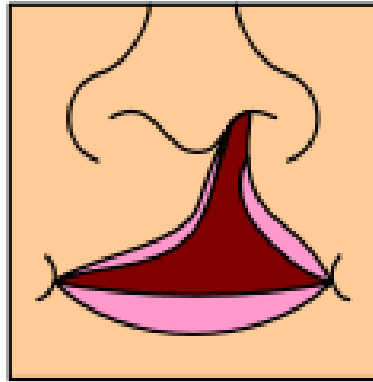
Anatomical Structures

- Anatomical problems and the impact on swallowing – Pediatric
 - Anatomical disorders of the oral cavity
 - Size of the tongue relative to the oral cavity
 - Cleft palate, submucosal cleft
 - Anatomical disorders of the jaw
 - Small jaw that compromises mastication
 - Mal-alignment that compromises mastication
 - Anatomical disorders of the esophagus
 - Obstructions to the esophageal tube
 - Esophageal fistulas and atresia

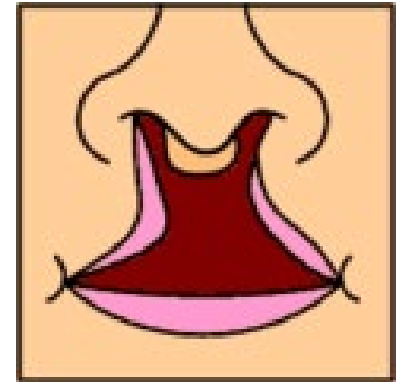
Cleft Lip and Palate



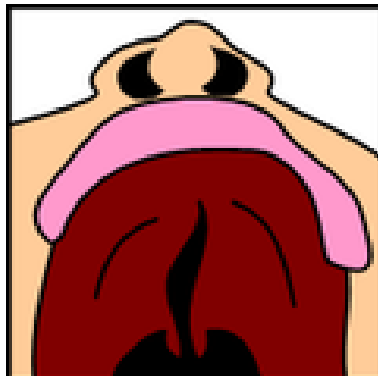
Unilateral Cleft
Lip - incomplete



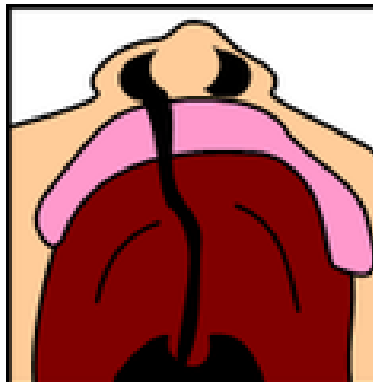
Unilateral Cleft
Lip - Complete



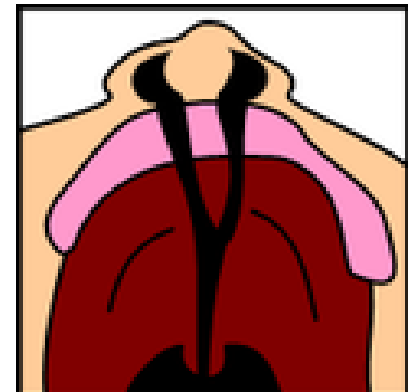
Bilateral Cleft of
the lip



Isolated Cleft of
the palate



Unilateral Cleft
lip & palate



Bilateral cleft lip &
Palate

Esophageal fistulas and atresia

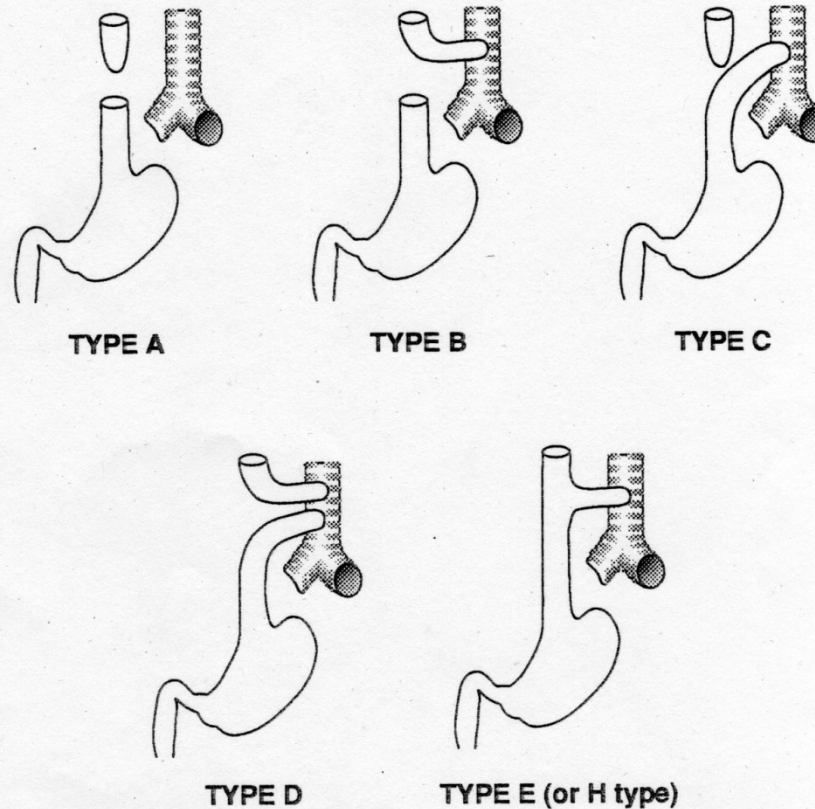
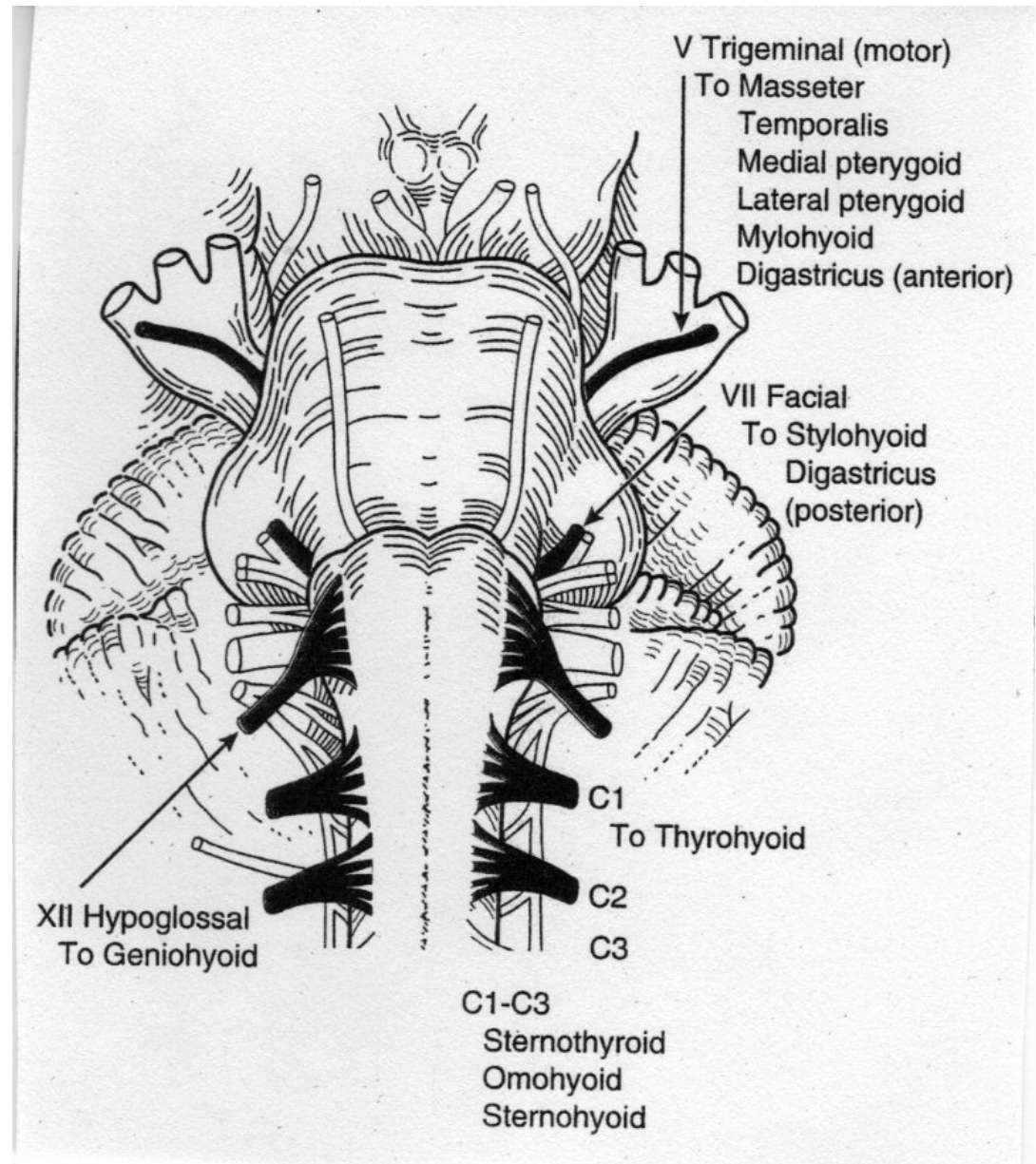


Figure 6-11 Types of tracheoesophageal fistulas and atresias.

Etiology of Dysphagia – Physiological Cranial Nerves

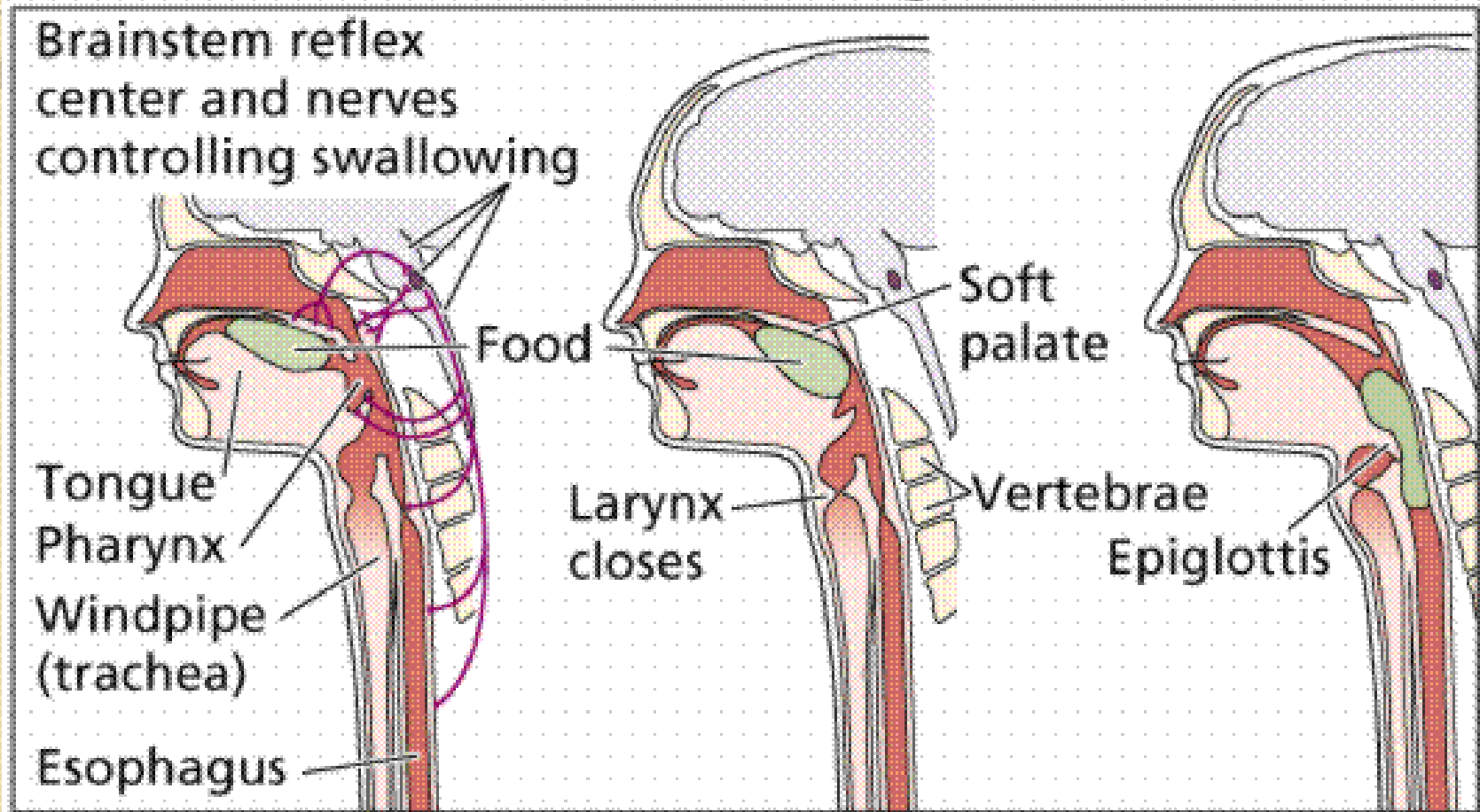
- Motor
 - CN V Trigeminal
 - CN VII Facial
 - CN IX Glossopharyngeal
 - CN X & XI Vagus & Accessory
 - CN X Vagus
 - CN XII Hypoglossal
- Sensory
 - CN VII Facial
 - CN IX Glossopharyngeal
 - CN X Vagus
- Reflexive
 - CN IX Glossopharyngeal
 - CN X Vagus

Brainstem and location of cranial nerves



Cranial Nerves and Swallowing

Swallowing



Central Pattern Generators

- Central pattern generators (CPG) are a neural network designed to produce a motor action without higher level CNS input
- Differentiated from reflexes that produce a specific response following specific sensory input; the CPG can occur without preliminary sensory input
- CPGs support the function of swallowing
- The CPG for respiration and swallowing interact

Case Presentation

- Child born 3 months premature
 - Gastroschisis: incomplete closure of the abdominal wall with protrusion of intestines & stomach through the hole
 - Mobius syndrome: cranial nerve involvement with bilateral facial paralysis
 - Arthrogryposis: congenital deformity of muscles and joints
- Lives with both parents and older brother (3 years old)

Case Illustration

- Hospitalized for first 2 months of life.
- Surgery to correct gastroschisis but fed through G-tube on continuous drip pump.
- Discharged to home with pump at 2 months CA (still 1 month prior to due date). Family lived in a small 2 bedroom apartment in a subsidized housing complex. Crib had to be placed in parents bedroom to accommodate electrical needs of the pump.
- Although other relatives were concerned about daughter, they did not offer active support for this family.

Small Group Discussion

- Neonatologist and gastroenterologist want this child transitioned to oral feeds ASAP!
- What phase of the swallow would be the start for your intervention and why?
- What strategies would you use?
- What evidence do you have for starting at this point of the swallowing process?

Dysphagia – Mr. J

- Mr. J is a 68 year old gentleman with moderately advanced Parkinson's Disease.
- He lives at home with his daughter and is ambulatory but with increasing motor impairment. He reports that he is more sedentary than in the past due to his concern with his unsteady balance.
- Mr. J has moderately impaired oral motor skills (strength and coordination) and impaired pharyngeal and esophageal function related to his progressing Parkinson's disease.
- Recently he has been experiencing greater difficulty eating (his current diet is pureed and mashed foods). He reports excessive time is required for oral transit of food and often he cannot swallow it or “get it down”.



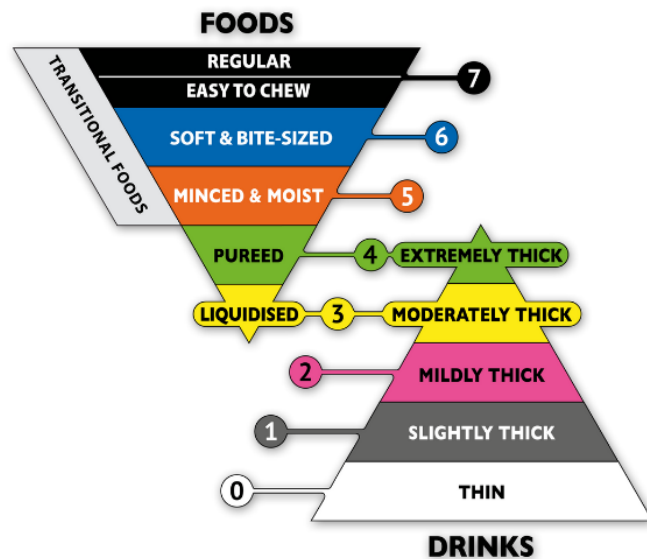
Case Illustration of Mr. J – Small Group Discussion

- What do you feel is contributing to his recent decline in swallow function?
- What phase/s of the swallow would you anticipate to be most compromised given this man's history and current complaints?
- What problems would you suspect most impact his ability to safely swallow?
- What areas might you target for intervention?
- What is your predicted outcome?
- What evidence would support this anticipated outcome?

Evidence to support intervention

- Bolus size can impact energy expenditure and the total number of chews to prepare the bolus
- For healthy women, as the size of the bolus increased there was increased energy to prepare the bolus
- Consider bolus size to conserve energy and alter food resistive properties
 - Goto et al, 2015
- Reduction in pressure of the upper esophageal sphincter was seen in older healthy adults
- Longer pharyngeal transit time noted in older adults
- Provide sips of water to support pharyngeal phase
 - Nishikubo et al, 2015

International Dysphagia Diet Standardization Initiative (IDDSI)



THE IDDSI FRAMEWORK

IDDSI Framework

- Level O:
 - Characteristics:
 - Flows like water
 - Fast Flow
 - Can drink through any type of nipple, straw, spout as appropriate for age and skills
 - Functionality: Able to manage liquids of all types
 - Testing: Test liquid flows through a 10 ml slip tip syringe completely within 10 seconds with no residue

IDDSI Framework

- Level I: Slightly thick
 - Characteristics:
 - Thicker than water
 - Requires more effort to drink compared to water
 - Flows through straw, syringe, teat/nipple
 - Similar thickness to commercially available anti-regurgitation infant formulas
 - Functionality: Predominantly used in pediatric population
- Testing: Test liquid flows through a 10 ml slip tip syringe leaving 1-4 ml in syringe after 10 seconds

IDDSI Framework

- Level 2: Mildly Thick
 - Characteristics:
 - Flows off spoon
 - Sippable, but slower than thin drinks
 - Effort required to drink this from a standard straw
 - Functionality: control of flow for safety issues if delays noted with oral and/or pharyngeal phase
 - Testing: Test liquid flows through a 10 ml slip tip syringe leaving 4-8 ml in syringe after 10 seconds

IDDSI Framework

- Level 3: Liquidized/Moderately Thick
 - Characteristics:
 - Drink using a cup
 - Effort required when using standard or large bore straw
 - Cannot be eaten with a fork
 - Can be eaten with a spoon
 - No oral preparation (chewing) needed and can be swallowed directly
 - Functionality: If tongue control cannot manage Level 2 liquid, move to Level 3; allows increased time for oral prep phase; does require tongue propulsion effort
 - Testing: Test liquid flows through a 10 ml slip tip syringe leaving >8 ml in syringe after 10 seconds; runny rice cereal, runny pureed fruit, sauces

IDDSI Framework

- Level 4: Pureed, Extremely Thick
 - Characteristics:
 - Eaten with a spoon but possible to use a fork
 - Cannot be sucked through a straw; Does not require chewing
 - Falls off the spoon in a single shape; holds shape on plate
 - No lumps, not sticky
 - Liquid MUST not separate from solid
 - Functionality: Poor tongue control; no need for biting or chewing; can be used with missing teeth or poorly fitting dentures
 - Testing: Fork test – press a fork into the substance and the time marks remain, no lumps; spoon tilt test – food should slide off a spoon, in a cohesive unit, when the spoon is tilted with no stickiness and very little residue on the spoon

IDDSI Framework

- Level 5: Minced & Moist
 - Characteristics:
 - Eaten with fork or spoon or chopsticks
 - Can be scooped and shaped; soft & moist with no separate thin liquid
 - Small lumps visible
 - Functionality: Biting not required but slight chewing needed, tongue force alone can break this texture into smaller sections
 - Testing: Fork test – press a fork into substance and substance easily comes through the tines; easily mashed; cohesive on a spoon; spoon test – must slide off the spoon with very little residue on the spoon, not sticky; mashed or minced meats/fish, mashed fruit, thick cereal with small lumps, soaked bread (NOT regular bread)

IDDSI Framework

- Level 6: Soft & Bite-sized (appropriate for oral cavity)
 - Characteristics:
 - Eaten with fork, spoon or chopsticks
 - Can be mashed with utensils
 - Chewing required before swallowing, but no biting required; soft and tender but no separate liquid
 - Functionality: tongue force and control required during oral prep and oral phase to move the bolus
 - Testing: Pressure from fork/spoon to “cut” food; when pressing utensil into food with thumb, thumb nail blanches due to resistance from food; tender cooked meat/fish, casserole/stew/, mashed fruit, steamed vegetables

IDDSI Framework

- Level: Transitional foods
 - Characteristics:
 - Foods that start as one texture and change into another texture with moisture or temperature
 - Functionality: biting not required and minimal chewing needed; tongue can break apart food
 - Testing: after moisture or temperature is applied, food cannot be reformed; ice cream, sorbet, waffle cone, gelatin, Pringles, Veggie Sticks, baby “puffs”

IDDSI Framework

- Level 7: Regular Diet
 - Characteristics:
 - Normal everyday foods of various textures
 - Includes dual consistency foods (mixed consistency)
 - Functionality: Need to bite and chew foods without tiring, need to form foods into cohesive bolus to be swallowed; ability to sort foods in mouth (bone shard from meat; extremely fibrous vegetable from soft – artichoke)
 - Testing: Any foods – no test required

Evidence to support intervention

- Use of carbonated thin liquids was compared to non-carbonated thin liquids for adults with neurogenic dysphagia
 - Use of carbonated thin liquids significantly decreased the penetration and aspiration upon videofluoroscopy
 - No significant change in oral transit or pharyngeal transit
 - Sdravou et al, 2012
- Adults with dysphagia due to deconditioning responded best to carbonated thin liquids
 - Shapira-Galitz et al, 2021

Use of carbonated liquids

- Investigation of length of swallowing following use of carbonated liquids for older adults without dysphagia
- Carbonated water stimulates the oral and pharyngeal mucosa and is a sensory stimulus.
- The pharyngeal phase was shortened resulting in less time for the bolus to remain in the pharyngeal region
 - Morishita et al, 2023
- Thickened carbonated liquids significantly reduced the penetration and aspiration for older adults with dysphagia
 - The subjective experience of clients was the thickened carbonated liquid was significantly easier to swallow compared to thin, thick and thin carbonated liquids
 - Morishita et al, 2022

Incidence of Dysphagia – Older Adult

(Bhattacharyya, 2014; Miller, 2013; Sura et al, 2012)

- Approximately 7%-10% of adults older than 50 years have dysphagia, although this number may be artificially low because many patients with this problem may never seek medical care. Of those over age 60, approximately 14% of individuals are affected by dysphagia

Incidence of Dysphagia – CVA

(Daniels et al, 2012; Kang et al, 2012; Kim et al, 2020; Takizawa et al., 2016)

- Studies on the prevalence of dysphagia range from 30%-70% in clients who have experienced stroke. Estimates vary because of the method of assessing swallowing function, the timing of swallowing assessment after stroke, and the number of and type of clients studied
- Although dysphagia improves in most clients post-stroke, many have persistent swallowing difficulties, with 10%-30% of individuals continuing to have dysphagia with aspiration
- Dysphagia has a significant impact on the quality of life for those who sustained a stroke (Kim et al, 2020)
- Bedside exercises improve swallowing function (Kang et al, 2012)

Incidence of dysphagia – Alzheimer's Disease

(Affoo et al, 2013; Espinosa-Val et al, 2020; Mira et al, 2022; Sato et al, 2014)

- Alzheimer's Disease

- With deterioration to the autonomic nervous system the coordination is often compromised during the oral preparatory, oral and pharyngeal stages of the swallow
- A systematic review of the literature revealed that dysphagia occurs in the early stages of AD
- Dysphagia increases in severity as AD progresses
- Thickened liquids eliminate thin-liquid aspiration in individuals with AD
- Appropriate head and neck posture improves oral phase
- Pneumonia accounts for 70% of causes of death
- Cerebrocortical atrophy negatively impacts initiation and modification of swallow force in response to bolus size and viscosity

Incidence of Dysphagia – Parkinson's Disease

(Suttrup & Warnecke, 2016; Takizawa et al., 2016; Wang et al. 2021)

- Clients with Parkinson's disease not only experience dysfunction of the various phases of swallowing, but they also have great difficulty in their ability to feed themselves
- Dysphagia is reported by 20%-40% of clients with idiopathic Parkinson's disease
- A longitudinal investigation noted that men with PD and cognitive impairments had greater risk of developing dysphagia; dysphagia was also associated with greater levels of anxiety
 - Wang et al, 2021
- Oral motor exercises improve swallowing function for clients with Parkinson's disease
- Thermal-tactile stimulation reduces the delay in initiation of the pharyngeal phase of the swallow

Incidence of Dysphagia – Huntington's Disease

(Heemskerk et al, 2011; Pizzorni et al, 2020)

- Dysphagia is a common symptom that may be associated with fatal complications
- Dysphagia hinders nutritional intake and places the patient at risk for aspiration
- Dysphagia is related to diminished control during the oral phase in almost all clients with HD as the disease progresses
 - Faster than typical oral transit phase
 - Impulsive behaviors
 - Poor postural control during oral preparatory and oral phase
- Dysphagia is also noted in the pharyngeal stage for many clients as the HD progresses
 - Poor epiglottis closure
 - Prolonged elevation of the larynx
 - Residue after initiation of pharyngeal phase

Incidence of Dysphagia – MS

(Ansari et al, 2020; Printza et al, 2020; Takakoli et al, 2023)

- Clients with multiple sclerosis (particularly those with brainstem involvement) are reported to have swallowing difficulties.
- Dysphagia may develop early or late in the disease's process and significantly impacts the quality of life for those with MS
- Over 30% of individuals with multiple sclerosis experience swallowing problems
- Problems most often seen in oral and pharyngeal phases, but problems noted during all phases of the swallow
 - Poor tongue control during oral transit
 - Poor coordination of musculature during pharyngeal phase
- Coordination of the suprahyoid muscles was compromised on electrophysiological studies as was the duration of pause for the cricopharyngeal muscles – extended time compromised the transition from the pharyngeal phase to esophageal phase
- Intervention that combines oral motor and pharyngeal exercises improved swallowing function; when NMES was added to conventional exercises additional gains were noted but use of NMES alone did not produce significant improvement

Incidence of Dysphagia – TBI

(Prum et al, 2022; Takizawa et al., 2016; Yan et al, 2021)

- Incidence of dysphagia in individuals with traumatic brain injury vary greatly depending on whether the population studied is comprised of clients with severe TBI, consecutive brain injury admissions, clients with acute TBI, or clients in the rehabilitation phase of recovery
- Most clients with a TBI have dysphagia during the first two weeks following injury and typically dysphagia resolves within five months of the injury
- To hasten the appropriate excursion of the hyoid bone and larynx during the swallowing process neuromuscular electrical stimulation (NMES), used on the suprahyoid muscles, was successful in fostering more appropriate swallowing process. This was combined with thermal-tactile stimulation to faucial arches to achieve results.
- A RCT was conducted and demonstrated that the use of oral motor exercises decreased episodes of aspiration for clients with TBI
- Sensory stimulation was used with clients with severe TBI and increased swallowing was noted with decreased aspiration

Incidence of Dysphagia – CP

(Acar et al 2022; Crary et al, 2022; Garcia Ron et al, 2023; Gonzalez-Rozo et al, 2022; Morgan et al, 2012)

- Feeding problems are seen in 38% - 57% of children diagnosed with cerebral palsy (CP) during the first year of life
- Children with more severe forms of CP have a much higher rate of dysphagia with swallowing problems seen in over 90% of clients
- Dysphagia identified in all phases of swallowing process – oral preparatory, oral, pharyngeal, and esophageal
- Dysphagia continues in many of these children throughout their lifetime and presents as a persistent compromise to nutritional status
- Even children with mild CP can display dysphagia and the severity of gross motor problems is associated with increased rate of dysphagia and drooling
- Use of NDT to foster better trunk control and posture improved feeding and swallowing skills in an RCT

Incidence of Dysphagia – Pre-term Infants

(Celik et al, 2023; Fucile et al, 2012; Hwang et al, 2010; Lawlor et al, 2020; Li et al, 2022; Morgan et al, 2012)

- Premature infants are typically dependent upon the use of G or NG tube feedings for nutritional support and have not developed the suck-swallow-breath coordination of a full-term infant
- Preterm infants: typical suck-swallow-breathe pattern is not developed until 37 weeks GA
- Bottle/breast feeding may be seen at 34-36 weeks gestational age, but swallow is poorly coordinated
- Dysphagia often persists beyond the time when the infant has reached full-term
- Diminished development of hunger-satiety with tube feedings since continuous feeds are most common
- An RCT used KT around the upper orbicularis oris and to support elevation of the hyoid bone with pre-term infants, improved oral reflexes and swallowing noted compared to control group

Incidence of dysphagia – Developmental Delay

(Hashimoto et al, 2014; Jackson et al, 2016; Morgan et al, 2012; Nordstrom et al, 2020; O'Neill & Richter, 2013)

- Oral preparatory deficits are frequent in children who have Down syndrome and the ability to effectively grind foods is compromised
- Oral phase deficits are very common and due to poor tongue control of bolus and poor oral transit time
- Poor tongue pressure noted during the oral phase to propel food posteriorly and due to poor tongue control and short, narrow palate
- Over 50% of children diagnosed with Down syndrome display pharyngeal dysphagia

Interventions: Positioning

- Positioning - 75% of eating intervention is positioning
 - Chin tuck - a forward head position compromises the suprahoid activity and places a person at risk for dysphagia (Tamai et al, 2022)
 - Head turn – unilateral problems (CVA) and turn head towards more involved side
 - Head tilt – unilateral problems (CVA) and tilt head away from more involved side
 - Pelvic position – neutral alignment, even weight bearing
 - Body positioning – symmetrical sitting position with head in neutral alignment

Modification to Volume, Rate and Placement of Food

- Variations in sensory
 - Offering ice chips or cold fluids between solids
- Pacing
 - Speed of presentation
 - Hunger/satiety paradigm
- Placement
 - Position of food within oral cavity
 - Food on the back of the bowl of the spoon
 - Food on a NUK toothbrush or on an infadent
- Flipped spoon
 - Placing spoon in mouth and then flipping over to deposit food on tongue



Infadent for oral stimulation and exercises



Oral and gum cleaner that
can also be used for oral
stimulation and exercises

Interventions – flipped spoon

- Flipped spoon technique was found to be effective in a pre-test/post-test design for children with developmental delays and oral preparatory/oral phases of the swallow
- Often used for children who pack foods in the cheeks and lack the tongue control to maneuver the bolus
- Collect the bolus onto the spoon
- Insert the spoon into the child's mouth
- Flip the spoon over, open bowl side on the tongue and deposit the food on the tongue while applying slight downward pressure on the middle of the tongue
- Maintain pressure on the tongue as you pull the spoon out of the mouth
 - Rivas et al, 2011; Volkert et al, 2011

Interventions – Side Placement of Food

(Ibanez et al, 2021; Rubio et al 2015; Taylor, 2020)

- The “flipped spoon” intervention has been used to diminish food refusals and packing of food in the lateral sulci by children
- Side placement of food on the lateral surface of the tongue and molars using a Nuk toothbrush or the back of the spoon was more effective to decrease food expulsions and refusals compared to the “flipped spoon” method
- Many children with feeding refusals also have oral motor difficulties in controlling the bolus during the oral and pharyngeal phases

Interventions

- Use of Cheek and Jaw support
 - Support provided by placing fingers on either side of the infant's cheeks
 - Provide slight pressure inward and towards the corners of the lips
 - Bottle/nipple presented in midline
 - Technique improved oral intake for pre-term infants
- Hwang et al, 2010

Interventions



Pre-term infants

(Fucile et al, 2012)

- Transition to oral feeds can be enhanced through oral and sensory interventions
- 75 pre-term infants (ave. 29 weeks GA)
- Randomly assigned to 3 intervention groups and 1 control
- Intervention groups:
 - Oral sensory input to the oral region
 - Tactile/kinesthetic stimulation to trunk and limbs
 - Combined use of both of the above interventions
- Outcomes:
 - Oral sensory group showed more advanced sucking skills with greater suction and amplitude than controls
 - All 3 interventions improved the respiratory support for the swallow-respiration sequence

Pre-term infants

(Fucile et al, 2012)

- Outcomes:
 - All 3 intervention groups transitioned to oral feeds faster than control by 9-10 days,
 - Oral and non-oral sensorimotor interventions (i.e. oral and tactile / kinesthetic) accelerated the transition from introduction of oral feeding to independent oral feeding and enhanced oral feeding skills.
 - Sensorimotor interventions (tactile / kinesthetic) had beneficial effects beyond the specific targeted system.
 - Combined (oral+tactile / kinesthetic) sensorimotor intervention had an additive/synergistic effect on oral feeding performance over single sensorimotor interventions

Extra-oral facilitation

- Vibration to suprahyoids
 - Provide stimulation to the muscles to elevate the larynx during the swallowing process
 - Uses the same musculature involved with VitalStim but uses finger tips instead of electrical stimulation
- Vitalstim
 - Electrical stimulation to the musculature to elevate the hyoid and larynx
 - Uses specialized electrodes
 - Gains noted in small studies, most often single subject design
- Oral motor exercises of lips, tongue & jaw (Kang et al, 2012)
 - 50 clients 6 mo post-CVA with dysphagia enrolled in an investigation
 - 25 in conventional tx of thermal-tactile stimulation, 25 in conventional tx plus specific daily exercises to lips, tongue and jaw
 - Each group seen daily for 2 mo (in Korea)
 - The group receiving thermal-tactile stim coupled with the oral motor exercises had significantly improved oral transit time but there was no difference between groups for the pharyngeal phase

Vibration to the Suprahyoids

- Specific vibration to the submental region improves the strength of those muscles
 - These muscles involved in the oropharyngeal phase of the swallow
 - Provide support for the tongue to control the bolus
 - Assist in the oral transit time for the bolus during the oral phase
 - Effective in improving swallow in single case presentations for clients with MS, TBI, and stroke
 - Ciritella et al., 2024; Kamarunas et al., 2022; Oh et al., 2025; Rosinczuk et al., 2025

Shaker technique

- The Shaker technique, also called the Head Lift, is indicated for clients who exhibit reduced superior and anterior movement of the hyolaryngeal complex. This results in residue in the pyriform sinuses, placing the client at risk to aspirate this material.
- RCT where one group had Shaker exercise and the other group had traditional pharyngeal exercises of elevating the larynx and tongue exercises (Logemann et al, 2009)
 - Only 9 clients in control and 5 in Shaker group completed both pre-test/post-test measures
 - Clients who used the Shaker method and had fewer episodes of post swallow aspiration than the group who used traditional exercises
 - Both groups improved in the UES opening

Shaker exercise



Chin Tuck Against Resistance (CTAR)

Exercise to strengthen the suprahyoids
Press down on the ball for 5 sec, relax and repeat 10 times



- CTAR found to more specifically target the suprahyoid muscles and foster laryngeal elevation compared to the Shaker exercise (Sze, et al. 2016)

Chin Tuck Against Resistance (CTAR)

- This exercise was introduced as an alternative to the Shaker exercise
- The systematic review completed by Liu et al, 2023 comparing results of studies using the Shaker exercise versus CTAR
- They concluded that the CTAR exercise is superior to Shaker exercise in improving swallowing safety for clients with dysphagia following a CVA

Effortful Swallow and Double Swallow Techniques

- Effortful Swallow Technique (EST): the client is asked to swallow with a hard force (extra effort by the client) as if gulping by pushing the tongue against the hard palate while squeezing the neck muscles (Park & Kim, 2016)
- Client has a sip of water or saliva, asked to “swallow hard” squeezing all throat muscles and repeat 10 times
 - Double blind RCT had clients with dysphagia due to a stroke perform EST 10 times, 3x/day for 4 weeks (Park et al, 2019)
 - Tongue strength improved significantly as did both the oral and pharyngeal phases of the swallow using the Videofluoroscopic Dysphagia Scale (VDS)
- Double Swallow: the client swallows twice in rapid succession

Mendelsohn Maneuver

- This exercise is done to improve swallowing. It helps to raise the larynx and open the esophagus when swallowing.
- Most often, these exercises should not be done with food in your mouth.
- Swallow your saliva several times and pay attention to your neck as you swallow.
- Feel your voice box, also called your Adam's apple, lift and lower as you swallow.
- Now, swallow and feel your voice box lift but do not let it drop. Hold it with your muscles for 2 seconds. Release and then repeat 10 times.

Mendelsohn Maneuver

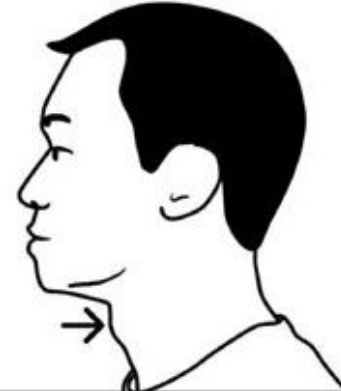


Mendelsohn Maneuver

1



2



3



EBP – Mendelson Maneuver

- Prospective cross-over study of 18 post CVA clients showed gains in extent of hyoid movement and UES opening and improvements in coordination of structural movements (McCullough & Kim, 2013)
- Results from other studies show increased hyoid movement and UES opening (McCullough et al., 2012)

Intervention – Masaka technique



Protrude your tongue from your mouth (stick out your tongue), hold your tongue between your teeth and then swallow

Repeat 10 times
Exercise to improve laryngeal elevation during swallow

Tactile Stimulation to the Tongue

- 45 children with various congenital anomalies and gastroenterologic dysfunctions
- All received artificial feedings
- All children had significant difficulties with configuration of the tongue to support the oral phase of the swallow
- All children were able to transition to oral feeds following 5-7 days of treatment
 - Lamm et al, 2005

Facilitation of masseter and pterygoids

- Gloved hand
- Index and middle finger
- Squeeze fingers laterally together
- Provide slight shaking as you withdraw fingers from the side of the cheek



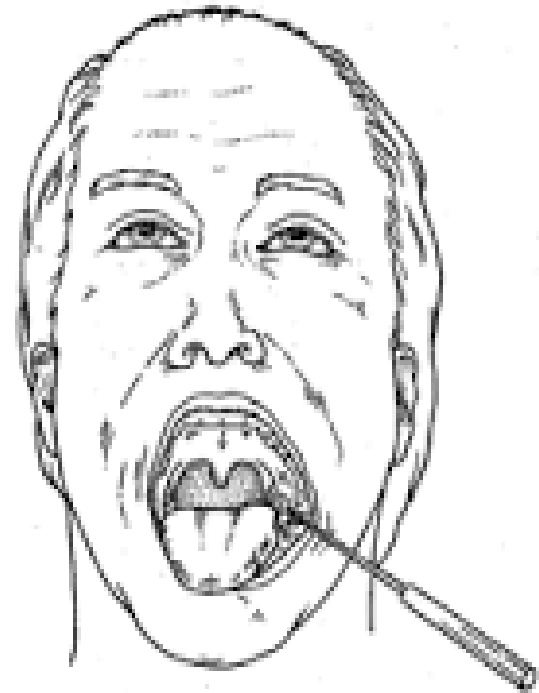
Clinical Assessment and Intervention during Phases of Swallow

- Thermal-tactile Stimulation
- *Purpose:* to increase the sensory awareness in the oral cavity prior to the swallow and to decrease the delay between the oral and pharyngeal swallow.
- *Technique:* 00 laryngeal mirror is used to stimulate the faucial arches 4 or more times in rapid succession followed by the command “swallow”.

Thermal-tactile Stimulation



Laryngeal Mirror



Intra-oral Facilitation

- Faucial arches
- Thermal-tactile stimulation (TTS)
 - (Park et al, 2010)
- Provide sensory stimulation to the anterior faucial arches to more rapidly trigger the pharyngeal phase of the swallow
- A long stainless steel device is dipped in ice water for at least 30 sec and then applied to the anterior faucial arches within 6 sec of removal from the ice water to retain the cold, process repeated 5 times
- Results for clients with CVA and PD demonstrated reduction in pharyngeal transit time
- The TTS did not reduce the oral transit time
- Focused on triggering the action controlled by the glossopharyngeal nerve
- Effortful swallow



Aspiration	Intervention Approaches
Aspiration before the swallow	Posture & positioning techniques Tactile – thermal stimulation Dietary alterations Carbonated liquids
Aspiration during the swallow - reduced protection of the airway	Chin tuck Chin tuck against resistance Mendelsohn Maneuver Dietary alterations & carbonated liquids Mealtime routines with clearing sips of water interspersed with solids Posture & positioning techniques
Aspiration after the swallow – residue in pharyngeal	Effortful swallow Double swallow Mendelsohn Maneuver Masako Maneuver



Clinical Assessment and Intervention Phases of Swallow – Small Group

- Identify a client (dx) who would have problems with the oral phase of the swallow
- Identify intervention methods that could be used to foster improved oral skills
- Interventions for Oral Phase
 - Sensory issues to detect the position of the bolus
 - Motor control of the tongue to propel the bolus
 - Physiological issues related to respiration support



Clinical Assessment and Intervention during Phases of Swallow

- Intervention strategies for the oral phase
 - Food consistencies
 - Rate of food presentation
 - Positioning
 - Motor facilitation for tongue
 - Oral motor exercises
 - Thermal stimulation to facilitate a swallow
 - Vibration to suprahyoids

Clinical Assessment and Intervention

Phases of Swallow – Small Group

- Identify a client (dx) who would have problems with the pharyngeal phase of the swallow
- Identify intervention methods that could be used to foster improved pharyngeal skills
- Pharyngeal phase
 - Physiological issues of closure of larynx by epiglottis
 - Poor force of peristaltic action of pharyngeal wall
 - Poor coordination of swallow and breathing

Intervention during Phases of Swallow

- Intervention strategies for the pharyngeal phase
 - Positioning
 - Thermal stimulation to facilitate initiation of swallow
 - Vibration to suprahyoids
 - Effortful swallow
 - To clear residual food, use alternating temperatures (ice chips contrasted with foods)
- (Leder et al. 2013; Nakayama et al. 2013; Park et al. 2012)

Intervention during Phases of Swallow

- *Oral motor Exercises*
- *Purpose:* to increase ROM, strength, coordination
- *Technique:* Use of quick stretch, 3 repetitions, to orbicularis oris, tongue, suprahyoids, masseter; also use of chewy foods or items to increase strength and control for muscles of mastication; ROM exercises; chewing on plastic straws

Intervention – tongue strengthening



Have client protrude tongue and push against tongue blade

Ask client to push as the client or therapist counts 10 seconds

Repeat 3 times twice a day
A toothbrush head can be substituted for the tongue blade if asking the client to perform this exercise at home

Intervention

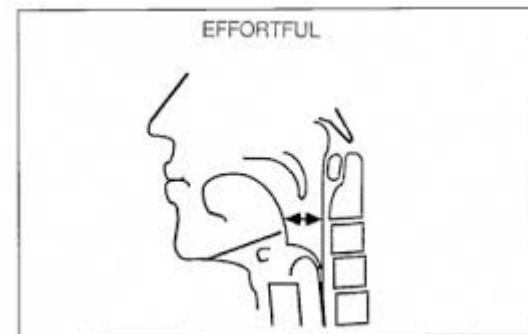
- Tongue exercises
 - Have client press tongue to roof of mouth and hold for 5 seconds, repeat 10 times
 - Use of an ice straw to foster lateralization
 - Ice straw to foster trough in tongue
- Repeated exercises can produce changes in corticomotor regions
 - Komoda et al, 2015
- Tongue exercises can improve oral phase of the swallow
 - Carnaby-Mann & Crary, 2010

Intervention during Phases of Swallow

Effortful Swallow

- *Purpose:* To improve tongue base retraction and reduce residue in the valleculae after the swallow.
- *Technique:* Ask the patient to “swallow normally” but to squeeze hard with the tongue and throat muscles throughout the swallow.

Combining this maneuver with the chin-down posture will aide in pushing the tongue base posteriorly and improving pharyngeal pressure and peristaltic strength.



Intervention during Phases of Swallow

- Neuromuscular electrical stimulation (NMES) with traditional swallowing therapy
- NMES with traditional swallowing therapy is significantly better than use of traditional swallowing therapy alone to improve coordination of swallowing for patients with acute/subacute stroke – RCT with over 25 clients in each group
 - NMES on suprahyoids
 - Traditional swallowing therapy included:
 - Thermal-tactile stim, tongue exercises, effortful swallow, Mendelsohn and Masako maneuver and Shaker exercises
 - Kim et al, 2014

Clinical Assessment and Intervention during Phases of Swallow

- Neuromuscular electrical stimulation (NMES) with traditional swallowing therapy
- RCT with over 25 in each group
 - NMES (VitalStim) on infrahyoids with effortful swallow
 - Control group had electrodes placed with insufficient stimulus to produce muscular action
 - All had oral motor exercises
 - Outcome measure – excursion of the hyoid bone during swallow as a measure of control and power
 - Park et al, 2016

Intervention during Phases of Swallow

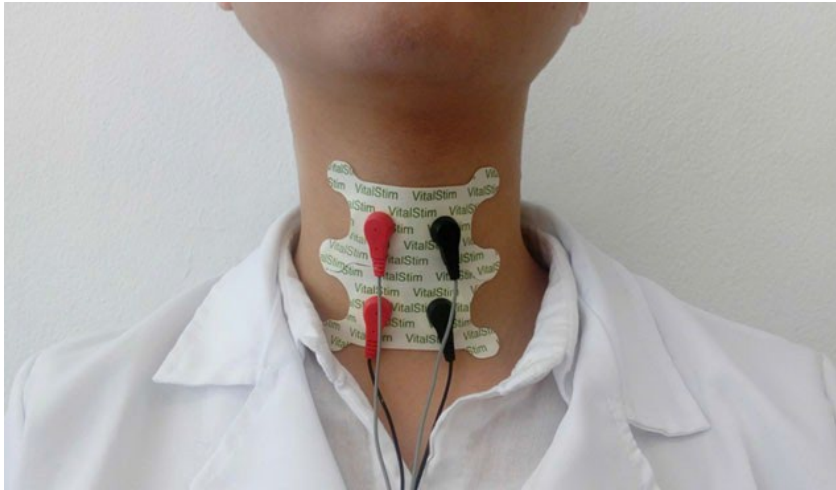


Fig. 2. Application of electrodes in the infrahyoid area targeting the sternohyoid muscles.

Electrodes were placed on both experimental and control group participants, the NMES was insufficient to produce muscular contraction for control group (placebo)

All participants had oral motor exercises using the effortful swallow exercise
Significant improvement in hyoid excursion noted in the experimental group

Intervention during Phases of Swallow

- *Vibration to suprahyoids*
- *Purpose:* to increase the motor control of suprahyoids to propel the bolus posterior and decrease the delay between the oral and pharyngeal swallow.
- *Technique:* place fingers on the suprahyoids and quickly vibrate for 2-3 seconds

Questions??

Thank you!

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OTAC 2025 Session 68 Evidence-Based Practice for Dysphagia
November 8, 2025, 3-hour session, Schultz-Krohn & Smith

References

- Acar G, Ejraei N, Turkdoğan D, Enver N, Öztürk G, Aktaş G. The Effects of Neurodevelopmental Therapy on Feeding and Swallowing Activities in Children with Cerebral Palsy. *Dysphagia*. 2022 Aug;37(4):800-811 doi: 10.1007/s00455-021-10329-w.
- Affoo, RH, Foley, N, Rosenbeck, J, Shoemaker, K, Martin, RE (2013). Swallowing dysfunction and autonomic nervous system dysfunction in Alzheimer's disease: A scoping review of the evidence. *Journal of the American Geriatrics Society*, 61, 2203-2213.
- Aghaz A, Alidad A, Hemmati E, Jadidi H, Ghelichi L. Prevalence of dysphagia in multiple sclerosis and its related factors: Systematic review and meta-analysis. *Iran J Neurol*. 2018 Oct 7;17(4):180-188. PMID: 31210903; PMCID: PMC6555886.
- Alamer A, Melese H, Nigussie F. Effectiveness of Neuromuscular Electrical Stimulation on Post-Stroke Dysphagia: A Systematic Review of Randomized Controlled Trials. *Clin Interv Aging*. 2020 Sep 3;15:1521-1531. doi: 10.2147/CIA.S262596. PMID: 32943855; PMCID: PMC7481288.
- Ansari NN, Tarameshlu M, Ghelichi L. Dysphagia In Multiple Sclerosis Patients: Diagnostic And Evaluation Strategies. *Degener Neurol Neuromuscul Dis*. 2020 Mar 26;10:15-28. doi: 10.2147/DNND.S198659. PMID: 32273788; PMCID: PMC7114936.
- Bahia, MM & Lowell, SY (2023) Hyolaryngeal movement during normal and effortful swallows determined during ultrasonography. *Journal of Speech, Language, and Hearing Research*, 66, 3856–3870.
https://doi.org/10.1044/2023_JSLHR-23-00088
- Bengisu, S., Demir, N. & Krespi, Y. Effectiveness of Conventional Dysphagia Therapy (CDT), Neuromuscular Electrical Stimulation (NMES), and Transcranial Direct Current Stimulation (tDCS) in Acute Post-Stroke Dysphagia: A Comparative Evaluation. *Dysphagia* (2023). <https://doi.org/10.1007/s00455-023-10595-w>
- Bhattacharyya, N (2014). The Prevalence of Dysphagia among Adults in the United States. *Otolaryngology–Head and Neck Surgery* 151(5) 765–769. DOI: 10.1177/0194599814549156 <http://otojournal.org>
- Carnaby GD, LaGorio L, Silliman S, Crary M. Exercise-based swallowing intervention (McNeill Dysphagia Therapy) with adjunctive NMES to treat dysphagia post-stroke: A double-blind placebo-controlled trial. *J Oral Rehabil*. 2020 Apr;47(4):501-510. doi: 10.1111/joor.12928. Epub 2020 Jan 19. PMID: 31880338; PMCID: PMC7067660.
- Çelik TÖ, Borman P, Tayman C, Kavakçı M, Çelebi F, Yaşar E. Effects of kinesiology taping on swallowing functions in newborns with swallowing difficulties: a randomized controlled pilot study. *Rev Assoc Med Bras (1992)*. 2023 Oct 9;69(10):e20230383. doi: 10.1590/1806-9282.20230383. PMID: 37820176.
- Chen AY, Frankowski R, Bishop-Leone J, Hebert T, Leyk S, Lewin J, et al. The development and validation of a dysphagia-specific quality-of-life questionnaire for patients with head and neck cancer: the MD Anderson dysphagia inventory. *Arch Otolaryngol Head Neck Surg*. 2001;127(7):870–876.
- Chen KC, Jeng Y, Wu WT, Wang TG, Han DS, Özçakar L, Chang KV. Sarcopenic Dysphagia: A Narrative Review from Diagnosis to Intervention. *Nutrients*. 2021 Nov 12;13(11):4043. doi: 10.3390/nu13114043. PMID: 34836299; PMCID: PMC8621579.2023
- Chen K, Xing L, Xu B, Li Y, Liu T, Zhang T, Shi H, Lu H, Zhou W, Hou J, Shi H, Qin D. Research progress in the risk factors and screening assessment of dysphagia in the elderly. *Front Med (Lausanne)*. 2022 Nov 7;9:1021763. doi: 10.3389/fmed.2022.1021763. PMID: 36419790; PMCID: PMC9676222.
- Chen SC, Huang BS, Chung CY, Lin CY, Fan KH, Chang JT, Wu SC. Effects of a swallowing exercise education program on dysphagia-specific health-related quality of life in oral cavity cancer patients post-treatment: a randomized controlled trial. *Support Care Cancer*. 2018 Aug;26(8):2919-2928. doi: 10.1007/s00520-018-4148-7. Epub 2018 Mar 15. PMID: 29546525.

Choy J, Pourkazemi F, Anderson C, Bogaardt H. Dosages of Swallowing Exercises Prescribed in Stroke Rehabilitation: A Medical Record Audit. *Dysphagia*. 2023 Apr;38(2):686-699. doi: 10.1007/s00455-022-10500-x. Epub 2022 Aug 11. PMID: 35951119; PMCID: PMC10006267.

Christmas C, Rogus-Pulia N. Swallowing Disorders in the Older Population. *J Am Geriatr Soc*. 2019 Dec;67(12):2643-2649. doi: 10.1111/jgs.16137. Epub 2019 Aug 20. PMID: 31430395; PMCID: PMC7102894.

Ciritella, C, Spina, S, Cinone, N, Giodano, MP, Facciorusso, S, & Santamato, A (2024) Focal muscle vibrations improve swallowing in persistent dysphagia after traumatic brain injury: A case report. *Turk J Phys Med Rehab* 70(2):274-278 DOI: 10.5606/tftrd.2023.11351

Clark, H.M., Shelton, N. Training Effects of the Effortful Swallow Under Three Exercise Conditions. *Dysphagia* **29**, 553–563 (2014). <https://doi.org/10.1007/s00455-014-9544-7>

Crary MA, Carnaby GD, Mathijs L, Maes S, Gelin G, Ortibus E, Rommel N. Spontaneous Swallowing Frequency, Dysphagia, and Drooling in Children With Cerebral Palsy. *Arch Phys Med Rehabil*. 2022 Mar;103(3):451-458. doi: 10.1016/j.apmr.2021.09.014. Epub 2021 Oct 26. PMID: 34715081.

Daniels, SK, Anderson, JA, Willson, PC (2012). Valid items for screening dysphagia risk in patients with stroke. *Stroke*, 43, 892-897.

de Sire A, Ferrillo M, Lippi L, Agostini F, de Sire R, Ferrara PE, Raguso G, Riso S, Roccuzzo A, Ronconi G, Invernizzi M, Migliario M. Sarcopenic Dysphagia, Malnutrition, and Oral Frailty in Elderly: A Comprehensive Review. *Nutrients*. 2022 Feb 25;14(5):982. doi: 10.3390/nu14050982. PMID: 35267957; PMCID: PMC8912303.

Espinosa-Val MC, Martín-Martínez A, Graupera M, Arias O, Elvira A, Cabré M, Palomera E, Bolívar-Prados M, Clavé P, Ortega O. Prevalence, Risk Factors, and Complications of Oropharyngeal Dysphagia in Older Patients with Dementia. *Nutrients*. 2020 Mar 24;12(3):863. doi: 10.3390/nu12030863. PMID: 32213845; PMCID: PMC7146553.

Flynn E, Smith CH, Walsh CD, Walshe M. Modifying the consistency of food and fluids for swallowing difficulties in dementia. *Cochrane Database Syst Rev*. 2018 Sep 24;9(9):CD011077. doi: 10.1002/14651858.CD011077.pub2. PMID: 30251253; PMCID: PMC6513397.

Frost J, Robinson HF, Hibberd J. A comparison of neuromuscular electrical stimulation and traditional therapy, versus traditional therapy in patients with longstanding dysphagia. *Curr Opin Otolaryngol Head Neck Surg*. 2018 Jun;26(3):167-173. doi: 10.1097/MOO.0000000000000454. PMID: 29553959.

Fucile, S, McFarland, DH, Gisel, EG, Lau, C (2012). Oral and nonoral sensorimotor interventions facilitate suck-swallow-respiration functions and their coordination in preterm infants. *Early Human Development*, 88, 345-350.

Fucile, S, Gisel, EG, MC Farland, DH, Lau, C (2011) Oral and non-oral sensorimotor interventions enhance oral feeding performance in preterm infants. *Developmental Medicine and Child Neurology*, DOI: 10.1111/j.1469-8749.2011.04023.x

García Ron A, González Toboso RM, Bote Gascón M, de Santos MT, Vecino R, Bodas Pinedo A. Nutritional status and prevalence of dysphagia in cerebral palsy: usefulness of the Eating and Drinking Ability Classification System scale and correlation with the degree of motor impairment according to the Gross Motor Function Classification System. *Neurologia (Engl Ed)*. 2023 Jan-Feb;38(1):35-40. doi: 10.1016/j.nrleng.2019.12.006. Epub 2021 Nov 23. PMID: 34836844.

George, R.G., Jagtap, M. Impact of Swallowing Impairment on Quality of Life of Individuals with Dysphagia. *Indian J Otolaryngol Head Neck Surg* **74** (Suppl 3), 5473–5477 (2022). <https://doi.org/10.1007/s12070-021-02798-0>

González-Rozo N, Pérez-Molina JJ, Quiñones-Pacheco YB, Flores-Fong LE, Rea-Rosas A, Cabrales-deAnda JL. Factors associated with oropharyngeal dysphagia diagnosed by videofluoroscopy in children with cerebral palsy. *Rev Gastroenterol Mex (Engl Ed)*. 2022 Jan-Mar;87(1):44-51. doi: 10.1016/j.rgmex.2020.09.004. Epub 2021 Oct 9. PMID: 34635447.

Goto T, Nakamich A, Watanabe M, Nagao K, Matsuyama M, Ichikawa (2015). Influence of food volume per mouthful on chewing and bolus properties T.Physiol Behav. 141:58-62. doi: 10.1016/j.physbeh.2015.01.007. Epub 2015 Jan 9.PMID: 25582518

Hashimoto, M, Igari, K, Hanawa, S, ...Saski, K (2014) Tongue pressure during swallowing in adults with Down Syndrome and its relationship with palatal morphology. *Dysphagia*, 29, 509-518.

Hazelwood, R.J., Armeson, K.E., Hill, E.G. *et al.* Relating Physiologic Swallowing Impairment, Functional Swallowing Ability, and Swallow-Specific Quality of Life. *Dysphagia* **38**, 1106–1116 (2023). <https://doi.org/10.1007/s00455-022-10532-3>

Heemskerk, A, Roos, RAC (2011) Dysphagia in Huntington's Disease: A Review. *Dysphagia* 26:62–66 DOI 10.1007/s00455-010-9302-4

Hwang, Y, Lin, C, Coster, WJ, Bigsby, R, Vergara, E (2010). Effectiveness of cheek and jaw support to improve feeding performance of pre-term infants. *American Journal of Occupational Therapy*, 64, 886-894.

International Dysphagia Diet Standardisation Initiative (IDDSI) (2017). <http://iddsi.org/about---us/sponsors/>

Ibañez VF, Peters KP, St Paul JA, Vollmer TR. Further evaluation of modified-bolus-placement methods during initial treatment of pediatric feeding disorders. *J Appl Behav Anal*. 2021 Jan;54(1):287-308. doi: 10.1002/jaba.748. Epub 2020 Aug 3. PMID: 32748439.

Jackson, A, Maybee, J, Wolter-Warmerdam, K, DeBoer, E, Hickey, F (2019). Associations between age, respiratory comorbidities, and dysphagia in infants with down syndrome. *Pediatr Pulmonol*. 2019 Nov;54(11):1853-1859. doi: 10.1002/ppul.24458.

Kaczmarek, E. (2020). Effects of aging on tongue movements during water swallowing. MGH Institute of Health Professions, ProQuest Dissertations Publishing, 28093048

Kamarunas, E, Mulheren, R, Wong, SM, Griffin, L & Ludlow, C (2022). The Feasibility of Home-Based Treatment Using Vibratory Stimulation in Chronic Severe Dysphagia. *American Journal of Speech-Language Pathology*, 31, 2539–2556 doi.org/10.1044/2022_AJSLP-22-00045

Kang, J, Park, R, Lee, S, Kim, J, Yoon, S, Jung, K (2012). The effect of bedside exercise program on stroke patients with dysphagia. *Annals of Rehabilitation Medicine*, 36, 512-520.

Kim, D., Park, H., Park, S., Kim, J. (2020). The impact of dysphagia on quality of life in stroke patients. *Medicine*, 99, <http://dx.doi.org/10.1097/MD.00000000000021795>

Komoda, Y, Iida, T, Kathari, M, Komiyama, O, Baad-Hansen, L, Kawara, M, Sessle, B, Svensson, P (2015). Repeated tongue lift movement induces neuroplasticity in corticomotor control of tongue and jaw muscles in humans. <http://dx.doi.org/10.1016/j.brainres.2015.09.016>

Krekeler BN, Davidson K, Kantarcigil C, Pearson W, Blair J, Martin-Harris B. Determining Swallowing Biomechanics Underlying Modified Barium Swallow Impairment Profile Scoring Using Computational Analysis of Swallowing Mechanics. *J Speech Lang Hear Res*. 2022 Oct 17;65(10):3798-3808. doi: 10.1044/2022_JSLHR-22-00047.

Krekeler BN, Rowe LM, Connor NP. Dose in Exercise-Based Dysphagia Therapies: A Scoping Review. *Dysphagia*. 2021 Feb;36(1):1-32. doi: 10.1007/s00455-020-10104-3. Epub 2020 Mar 5. PMID: 32140905; PMCID: PMC7483259.

Lanzoni G, Sembenini C, Gastaldo S, Leonardi L, Bentivoglio VP, Faggian G, Bosa L, Gaio P, Cananzi M. Esophageal Dysphagia in Children: State of the Art and Proposal for a Symptom-Based Diagnostic Approach. *Front Pediatr*. 2022 Jun 24;10:885308. doi: 10.3389/fped.2022.885308. PMID: 35813384; PMCID: PMC9263077.

- Lawlor CM, Choi S. Diagnosis and Management of Pediatric Dysphagia: A Review. *JAMA Otolaryngol Head Neck Surg.* 2020;146(2):183–191. doi:10.1001/jamaoto.2019.3622
- Li L, Liu L, Chen F, Huang L. Clinical effects of oral motor intervention combined with non-nutritive sucking on oral feeding in preterm infants with dysphagia. *J Pediatr (Rio J).* 2022 Nov-Dec;98(6):635-640. doi: 10.1016/j.jpeds.2022.02.005. Epub 2022 May 13. PMID: 35569569; PMCID: PMC9617285.
- Lin, Q; Lin, S; Ke, X; Jia, X; Huang, D. A Systematic Review and Meta-analysis on the Effectiveness of Transcranial Direct Current Stimulation on Swallowing Function of Poststroke Patients. *American Journal of Physical Medicine & Rehabilitation* 101(5):p 446-453, May 2022. | DOI: 10.1097/PHM.0000000000001845
- Liu J, Wang Q, Tian J, Zhou W, Gao Y, Chen X, Zhang W, Gao Y, Zhou L. Effects of chin tuck against resistance exercise on post-stroke dysphagia rehabilitation: A systematic review and meta-analysis. *Front Neurol.* 2023 Jan 9;13:1109140. doi: 10.3389/fneur.2022.1109140. PMID: 36698882; PMCID: PMC9868925.
- Marzouqah R, Huynh A, Chen JL, Boulos MI, Yunusova Y. The role of oral and pharyngeal motor exercises in post-stroke recovery: A scoping review. *Clin Rehabil.* 2023 May;37(5):620-635. doi: 10.1177/02692155221141395. Epub 2022 Nov 25. PMID: 36426582; PMCID: PMC10041576.
- Massey, R; Jedlicka, D. The Massey Bedside Swallowing Screen. *J of Neuroscience Nursing* 34(5):p 252-260, Oct. 2002.
- McCollough, G., Kamarunas, E., Mann, C., Schmidley, J., Robbins, J., & Crary, M. (2012). Effects of Mendelsohn maneuver on measures of swallowing duration post stroke. *Topics in Stroke Rehabilitation*, 19(3), 234-243.
- McCollough, G., & Kim, Y. (2013). Effects of the Mendelsohn maneuver on extent of hyoid movement and UES opening. *Dysphagia*, 28(4), 511-519
- Miller, N., & Patterson, J. (2014). Dysphagia: Implications for older adults. *Reviews in Clinical Gerontology*, 24(1), 41-57.
- Mira A, Gonçalves R, Rodrigues IT. Dysphagia in Alzheimer's disease: a systematic review. *Dement Neuropsychol.* 2022 Jul-Sep;16(3):261-269. doi: 10.1590/1980-5764-DN-2021-0073. Epub 2022 May 23. PMID: 36619845; PMCID: PMC9762388.
- Morgan AT, Dodrill P, Ward EC. (2012) Interventions for oropharyngeal dysphagia in children with neurological impairment. *Cochrane Database of Systematic Reviews*, Issue 10. Art. No.: CD009456. DOI: 10.1002/14651858.CD009456.pub2.
- Morishita M, Okubo M, Sekine T. Effects of Carbonated Thickened Drinks on Pharyngeal Swallowing with a Flexible Endoscopic Evaluation of Swallowing in Older Patients with Oropharyngeal Dysphagia. *Healthcare (Basel).* 2022 Sep 14;10(9):1769. doi: 10.3390/healthcare10091769. PMID: 36141382; PMCID: PMC9498686.
- Morishita M, Sota J, Kobayashi M. Effects of carbonated beverages on sustained swallowing behavior changes in older inpatients. *Physiol Behav.* 2023 Jun 1;265:114172. doi: 10.1016/j.physbeh.2023.114172. Epub 2023 Mar 24. PMID: 36965570.
- Moroco AE, Aaronson NL. Pediatric Dysphagia. *Pediatr Clin North Am.* 2022 Apr;69(2):349-361. doi: 10.1016/j.pcl.2021.12.005. PMID: 35337544.
- Nagano A, Maeda K, Shimizu A, Murotani K, Mori N. Effects of Carbonation on Swallowing: Systematic Review and Meta-Analysis. *Laryngoscope.* 2022 Oct;132(10):1924-1933. doi: 10.1002/lary.30019. Epub 2022 Jan 17. PMID: 35038167.
- Najeeb, H., Augenstein, K.J., Yee, J. *et al.* Predictors of Swallowing-Related Quality of Life in United States Veterans with Dysphagia. *Dysphagia* (2023). <https://doi.org/10.1007/s00455-023-10602-0>
- Nishikubo K, Mise K, Ameya M, Hirose K, Kobayashi T, Hyodo M. (2015). Quantitative evaluation of age-related alteration of swallowing function: Videofluoroscopic and manometric studies *Auris Nasus Larynx.* 42(2):134-8. doi: 10.1016/j.anl.2014.07.002. Epub 2014 Sep 6. PMID: 25199737

Nordstrøm M, Retterstøl K, Hope S, Kolset SO. Nutritional challenges in children and adolescents with Down syndrome. *Lancet Child Adolesc Health*. 2020 Jun;4(6):455-464. doi: 10.1016/S2352-4642(19)30400-6. PMID: 32450124.

O'Neil, K., Purdy, M., Falk, J. *et al*. The Dysphagia Outcome and Severity Scale. *Dysphagia* **14**, 139–145 (1999). <https://doi.org/10.1007/PL00009595>

O'Neill, AC, Richter, GT (2013). Pharyngeal dysphagia in children with Down syndrome. *Otolaryngology – Head and Neck Surgery*, 149, 146-150. DOI: 10.1177/0194599813483445

Oh, JC. Systematic Effortful Swallowing Exercise Without External Resistance Does Not Increase Swallowing-Related Muscle Strength in the Elderly. *Dysphagia* **36**, 465–473 (2021). <https://doi.org/10.1007/s00455-020-10163-6>

Oh, JC. (2025) Effects of tongue strength training and detraining on tongue pressures in healthy adults. *Dysphagia* 30, 315-330. DOI 10.1007/s00455-015-9601-x

Oh JC, Shin MS, Son MA, Kim HJ.(2025). Effect of Localized Muscle Vibration on Oral and Swallowing Pressure in Patients with Dysphagia Following Stroke. *Dysphagia*. Sep 9. doi: 10.1007/s00455-025-10883-7.

Parisius KGH, Wartewig E, Schoonmade LJ, Aarab G, Gobbens R, Lobbezoo F. Oral frailty dissected and conceptualized: A scoping review. *Arch Gerontol Geriatr*. 2022 May-Jun;100:104653. doi: 10.1016/j.archger.2022.104653.

Park, J., Dong-Hwan, O., Na-Kyoung, H., & Jung-Hoon, L. (2016). Effects of neuromuscular electrical stimulation in patients with Parkinson's disease and dysphagia: A randomized, single-blind, placebo-controlled trial. *Neuro Rehabilitation*, 42(4), 457-463

Park, J, Kim, Y, Oh, J, Lee, H (2012). Effortful swallow training combined with electrical stimulation in post-stroke dysphagia: A randomized controlled study. *Dysphagia*, 27, 521-527

Park HS, Oh DH, Yoon T, et al. Effect of effortful swallowing training on tongue strength and oropharyngeal swallowing function in stroke patients with dysphagia: a double-blind, randomized controlled trial. *Int J Lang Commun Disord* 2019; 54: 479–484.

Pizzorni N, Pirola F, Ciammola A, Schindler A. Management of dysphagia in Huntington's disease: a descriptive review. *Neurol Sci*. 2020 Jun;41(6):1405-1417. doi: 10.1007/s10072-020-04265-0.

Printza A, Triaridis S, Kalaitzi M, Nikolaidis I, Bakirtzis C, Constantinidis J, Grigoriadis N. Dysphagia Prevalence, Attitudes, and Related Quality of Life in Patients with Multiple Sclerosis. *Dysphagia*. 2020 Aug;35(4):677-684. doi: 10.1007/s00455-019-10075-0. Epub 2019 Nov 7. PMID: 31701212

Prum G, Mallart R, Beatrix M, Verin E. Swallowing activation using sensory stimulation in patients with severe disorders of consciousness. *J Rehabil Med Clin Commun*. 2022 Jun 13;5:2448. doi: 10.2340/jrmcc.v5.2448.

Rosinczuk, J, Regner, D, Mastej-Zaorska, B (2025). Evaluation of Neurological Therapy in a Patient with Ataxic-Spastic Dysarthria and Neurogenic Dysphagia in the Course of Multiple Sclerosis. *The Journal of Neurological and Neurosurgical Nursing*. 14(2):91–100 DOI: 10.15225/PNN.2025.14.2.6

Rubio, E. K., Borrero, C. S. W., and Taylor, T. (2015) Use of a Side Deposit to Increase Consumption in Children with Food Refusal. *Behav. Intervent.*, 30: 231–246. doi: [10.1002/bin.1404](https://doi.org/10.1002/bin.1404).

Sakai K, Nakayama E, Yoneoka D, Sakata N, Iijima K, Tanaka T, Hayashi K, Sakuma K, Hoshino E. Association of Oral Function and Dysphagia with Frailty and Sarcopenia in Community-Dwelling Older Adults: A Systematic Review and Meta-Analysis. *Cells*. 2022 Jul 14;11(14):2199. doi: 10.3390/cells11142199. .

Sato, E., Hirano, H., Watanabe, Y., Edahiro, A., Sato, K., Yamane, G., & Katakura, A. (2014). Detecting signs of dysphagia in patients with Alzheimer's disease with oral feeding in daily life. *Geriatrics & Gerontology International*, 14(3), 549-555.

Shapira-Galitz Y, Levy A, Madgar O, Shpant D, Zhang Y, Wang B, Wolf M, Drendel M. Effects of carbonation of liquids on penetration-aspiration and residue management. *Eur Arch Otorhinolaryngol*. 2021 Dec;278(12):4871-4881. doi: 10.1007/s00405-021-06987-z. Epub 2021 Jul 22. PMID: 34292401; PMCID: PMC8297430.

Smith, J. B.; Kamarunas, E.; O'Donough, C. The Influence of Side-Lying Position on Oropharyngeal Swallow Function in At-Risk Infants: An Exploratory Study. *Clinical Pediatrics*, [s. l.], v. 62, n. 9, p. 1087–1100, 2023. DOI 10.1177/00099228231159158.

Söyler AK, Kızıloğlu N, Serel Arslan S, Demir N, Gök M, Ertekin E, Düger T. (2025) Do We Know the Long-Term Effects of the Most Popular Traditional Swallow Maneuvers on the Submental Muscles? *J Oral Rehabil*. Apr;52(4):412-419. doi: 10.1111/joor.13862. Epub 2024 Sep 30. PMID: 39344429; PMCID: PMC11934837.

Suttrup, I., & Warnecke, T. (2016). Dysphagia in Parkinson's disease. *Dysphagia*, 31, 24-32.

Sze, W., Yoon, W., Escoffier, N., Liow, S. (2016). Evaluating the training effects of two swallowing rehabilitation therapies using surface electromyography – chin tuck against resistance (CTAR) and the Shaker exercise. *Dysphagia*, 31, 195-205.

Tamai, T, Hara, K, Nakagawa, K, Namiki, C, Yamaguchi, K, Yoshimi, K, Yanagida, R, Hasegawa, S, Nakane, A, Okumura, T, Ishii, M, Tohara, H. (2022). Strength and morphology of a suprahyoid muscle and their relationship to forward head posture in healthy older adults. *Geriatrics & Gerontology International*. , 2022, Vol.22(9), p.779-784 DOI: 10.1111/ggi.14457

Takizawa, C, Gemmell, E, Kenworthy, J, Speyer, R (2016). A Systematic Review of the Prevalence of Oropharyngeal Dysphagia in Stroke, Parkinson's Disease, Alzheimer's Disease, Head Injury, and Pneumonia. *Dysphagia* 31, 434–441. DOI <https://doi.org/10.1007/s00455-016-9695-9>

Tan, S.W., Wu, A., Cheng, L.J. *et al*. The Effectiveness of Transcranial Stimulation in Improving Swallowing Outcomes in Adults with Poststroke Dysphagia: A Systematic Review and Meta-analysis. *Dysphagia* 37, 1796–1813 (2022). <https://doi.org/10.1007/s00455-022-10424-6>

Taylor T. Side Deposit with Regular Texture Food for Clinical Cases In-Home. *J Pediatr Psychol*. 2020 May 1;45(4):399-410. doi: 10.1093/jpepsy/jsaa004. PMID: 32100032.

Thaduri, A., Kappari, S.R., Majumdar, K.S. *et al*. Long-term swallow outcomes and factors affecting swallowing dysfunction and quality of life among oral cancer patients: a prospective observational study. *Eur Arch Otorhinolaryngol* (2023). <https://doi.org/10.1007/s00405-023-08155-x>

Wang, L., Shi, A., Xue, H. *et al*. Efficacy of Transcranial Direct Current Stimulation Combined with Conventional Swallowing Rehabilitation Training on Post-stroke Dysphagia. *Dysphagia* (2023). <https://doi.org/10.1007/s00455-023-10581-2>

Wang, P., Wang, B., Chen, X. *et al*. Six-Year Follow-Up of Dysphagia in Patients with Parkinson's Disease. *Dysphagia* 37, 1271–1278 (2022). <https://doi.org/10.1007/s00455-021-10387-0>

Yan N, Jiang J, Liu H, Deng L, Hu Q, Sun J, Lv M. Evidence-based bundled care for patients with dysphagia after severe traumatic brain injury: a randomized controlled trial. *Am J Transl Res*. 2021 Jul 15;13(7):7819-7828. PMID: 34377259; PMCID: PMC8340219.

Yang RY, Yang AY, Chen YC, Lee SD, Lee SH, Chen JW. Association between Dysphagia and Frailty in Older Adults: A Systematic Review and Meta-Analysis. *Nutrients*. 2022 Apr 27;14(9):1812. doi: 10.3390/nu14091812. PMID: 35565784; PMCID: PMC9105461

Yang S, Park JW, Min K, ... Choi KH. Clinical Practice Guidelines for Oropharyngeal Dysphagia. *Ann Rehabil Med*. 2023 Jul;47(Suppl 1):S1-S26. doi: 10.5535/arm.23069. Epub 2023 Jul 30. PMID: 37501570; PMCID: PMC10405672.

Zhang YW, Dou ZL, Zhao F, Xie CQ, Shi J, Yang C, Wan GF, Wen HM, Chen PR, Tang ZM. Neuromuscular electrical stimulation improves swallowing initiation in patients with post-stroke dysphagia. *Front Neurosci*. 2022 Nov 14;16:1011824. doi: 10.3389/fnins.2022.1011824. PMID: 36452336; PMCID: PMC9704362.