Updates in post-stroke dysphagia rehab

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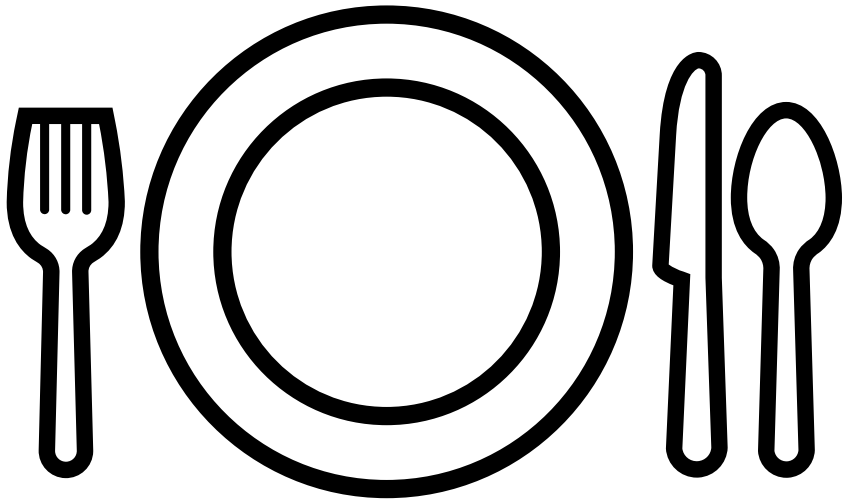
Disclosures

Invited speaker – thank you to the planning committee for having me!



Agenda

- Basics of normal swallowing
- Overview of post-stroke dysphagia
- Best practices for assessment
- Reflection on aspiration pneumonia risk factors
- Review evidence for treatment approaches in post-stroke dysphagia population

Normal swallowing

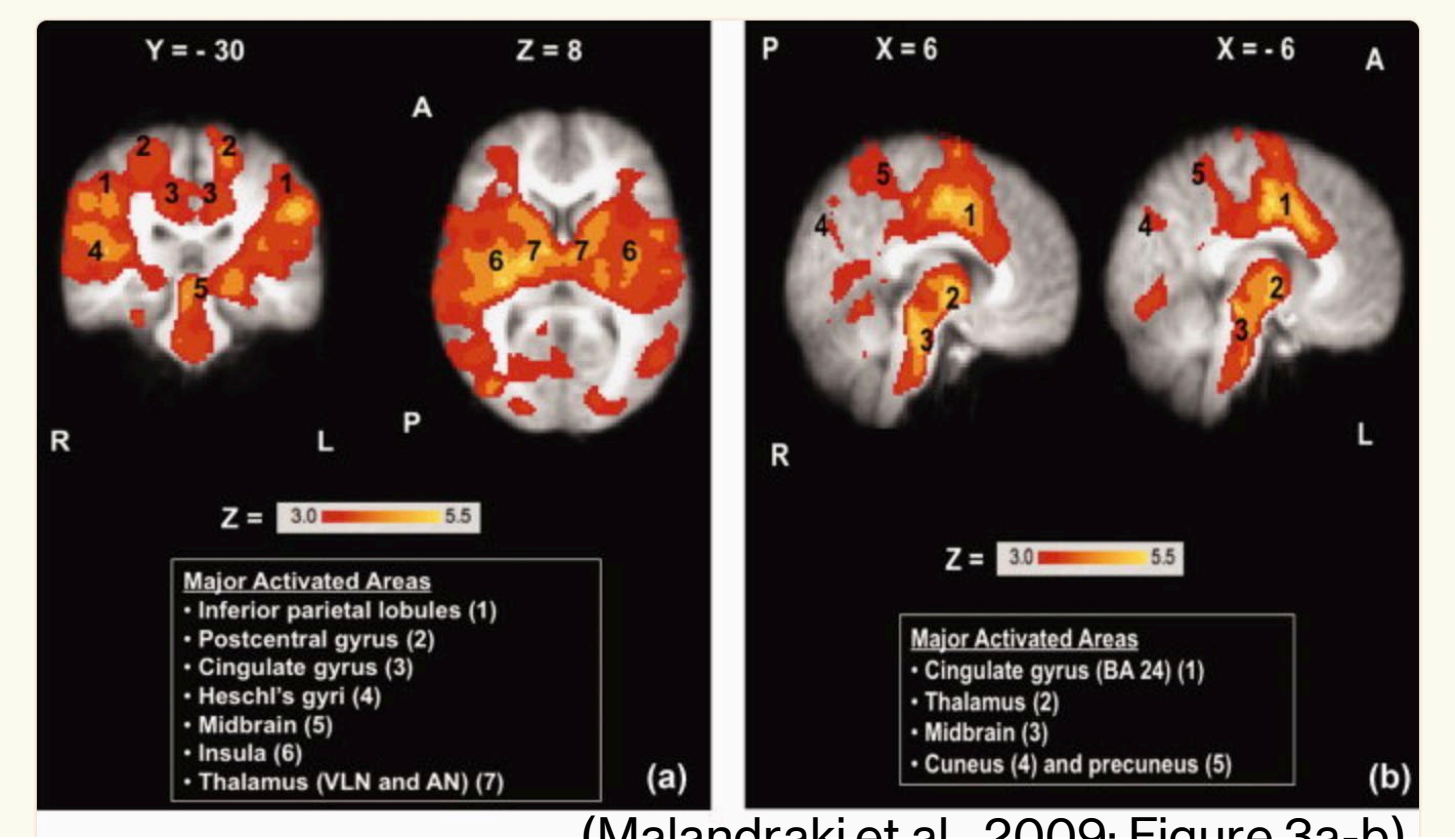
- Complex integration of sensorimotor information
- Part volitional– part reflexive (brainstem mediated)
  - Generally thought of as three phases: oral, pharyngeal, and esophageal
- Main swallowing events related to airway protection and bolus efficiency
- Normal pharyngeal swallow takes about 1 second for a drink of water (Matsuo & Palmer, 2008)

Watch video

Neural activation of swallowing fMRI (Malandraki et al., 2009)

3mL water swallow task in healthy young adults:

- **Cortical activations**
  - Insular cortex
  - Middle and superior frontal gyrus
  - Precentral gyrus
  - Post-central gyrus
  - Number of regions in temporal lobe
  - Superior and inferior parietal lobules
  - Cingulate gyrus
- **Subcortical activations:**
  - Portions of the thalamus and basal ganglia
  - Cerebellar regions



(Malandraki et al., 2009; Figure 3a-b)

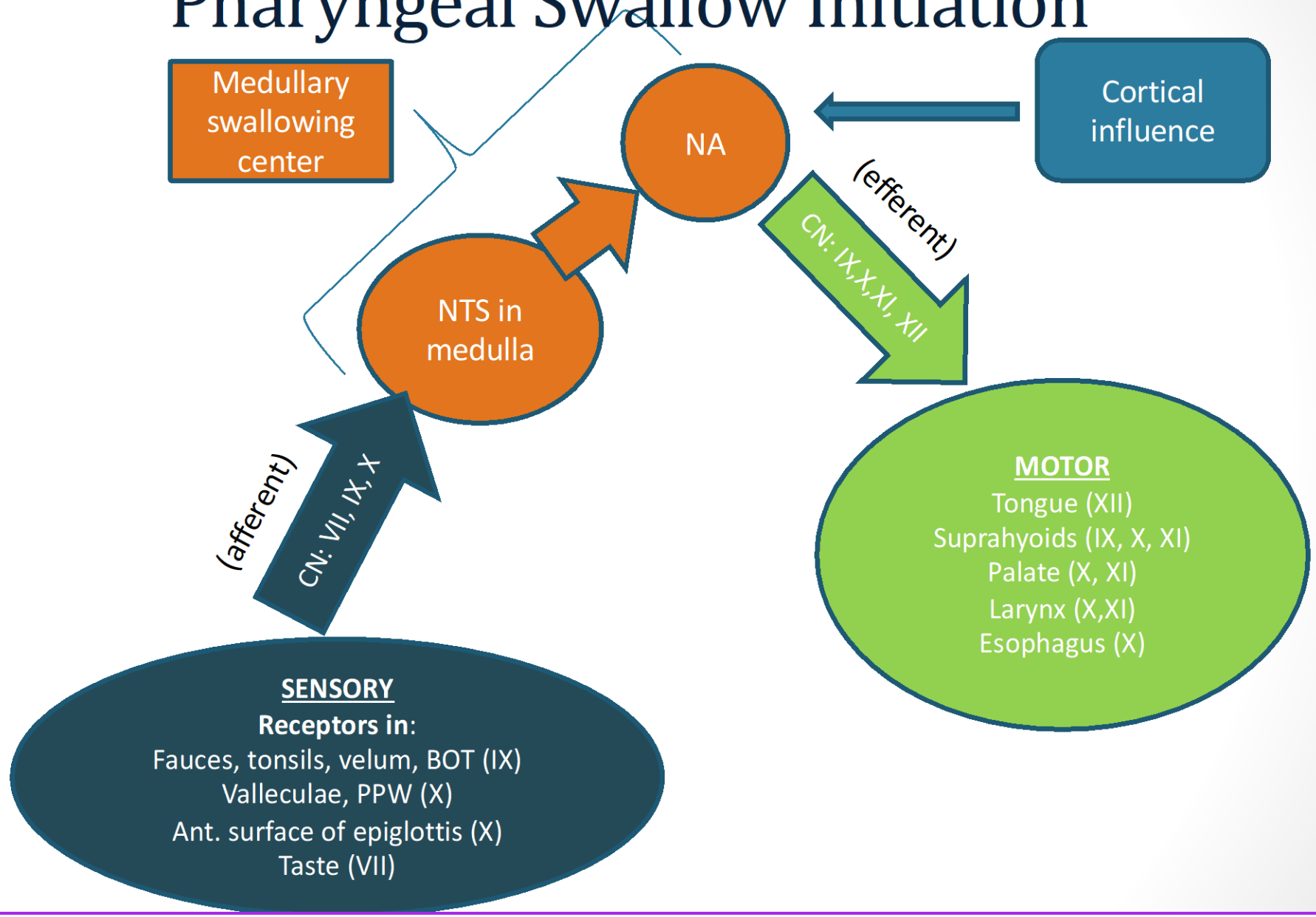
Role of the brainstem in mediating the pharyngeal swallow trigger

- Must have sensory input (taste, touch, temperature)
- Bolus stimulates afferent signals in oral cavity and pharynx and sends the info via CN VII, IX, and X* to the nucleus tractus solitarius (NTS) in the medulla
- When sensory info reaches the needed threshold the NTS signals motor nuclei in the nucleus ambiguous (NA) to initiate the swallow (IX, X**, XI)
  - Results in ***pharyngeal swallow response***
  - Most complex "*all-or-none*" response in CNS

*superior laryngeal internal branch

**recurrent and pharyngeal branches

Pharyngeal Swallow Initiation



Levels of nervous system and impact on swallowing

Basic Sensorimotor Functions Associated with Different Levels of the Nervous System

Level	Motor	Sensory
Cortical	Intent	Recognition
	Initiation	Awareness
	Programming	Motor tuning
	Execution	
Subcortical (basal ganglia)	Initiation	Motor tuning
	Refinement	Awareness
	Inhibition	Sensory conduit
Brainstem	Junction box:	Reflexes
	upper motor neuron/lower motor neuron	Sensory conduit
	Motor/sensory "centers":	
	Swallow	
	Respiration	
	Heart	
Cerebellum	Refinement	Refinement
	Inhibition	
Peripheral nerves	Lower motor neuron	Sensory conduit
	Drive movement	
Muscles and sensory receptors	Effect movement	Sensation reception

Groher & Crary (2021)

Overview of post-stroke dysphagia

Dysphagia affects approximately 55% of all acute stroke patients admitted to the hospital.

These folks are three times as likely to develop **pneumonia** as stroke survivors without dysphagia (regardless of dysphagia severity or presence of aspiration, Martino et al., 2005).

Higher **mortality** for stroke patients with dysphagia in first 90 days after stroke (Sharma et al., 2001).

Overview of post-stroke dysphagia cont.

- Swallowing motor functions bilaterally represented in the hemispheres so if dominant hemisphere is impaired- contralateral can be “backup” to facilitate recovery.
- Cortical (neural) plasticity may occur over time, increasing this effect.
- Bilateral strokes result in the most tenacious dysphagias.

(Michou et al., 2009; Hamdy et al., 1998; 2000)

Common swallowing impairments post-stroke

Hemispheric CVA

- Volitional motor control
  - Initiation difficulties
- Paresis/ paralysis
  - Transport difficulties
  - Reduced airway protection
- Sensory recognition
  - Impaired swallow initiation timing
  - Residue undetected
  - Aspiration
- Communication deficits

Brainstem CVA

- Delayed or absent pharyngeal response
  - Incomplete swallow
- Typically global weakness
- Reduced UES opening
- Brief swallow event
- General incoordination (including respiration)
- Watch video dysphagia post-brainstem CVA

Dysphagia-related quality of life

According to scoping review by Smith et al. (2022), multiple themes related to quality-of-life and dysphagia emerged from patient interviews:

- Burdensome recommendations
- Fatigue
- Increased time to eat
- Reduced desire to eat
- Frustration
- Humiliation
- Loss
- Feeling of incompetence
- Social isolation

Early detection of post-stroke dysphagia is crucial

- Early detection reduces pulmonary complications, length of hospital stay, and healthcare costs (Hinchey et al., 2005; Martino et al., 2000).
- A **swallowing screen** is defined by ASHA (n.d.) as "...a pass or fail procedure to identify individuals who require a comprehensive assessment of swallowing function or a referral for other professional and/or medical services."
- Evidence-based swallow screens:
  - Toronto Bedside Swallow Screen (TOR-BSST, Martino et al., 2008)
  - Yale Swallow Protocol (Leder & Suiter, 2014)

TOR-BSST (Martino et al., 2009)

- Sensitivity 91.3%
- Negative predictive values 93.3% in acute care and 89.5% in rehab settings
- Exclusion: not alert, cannot sit upright 90 degrees, not able to follow simple instructions
- Comprised of five items:
  - Baseline vocal quality
  - Tongue movement
  - 50mL water test
  - Cup sip
  - Final judgment of vocal quality

Yale Swallow Protocol (Suiter & Leder, 2008; 2014)

- Sensitivity: 96.5%
- Negative predictive value: 97.9%

Also provides structured guideline on what to do for pass/fail result in terms of diet.

- Exclusion: not alert, pre-existing dysphagia, head of bed restricted to <30 degrees, tracheostomy tube present, nil-per-os (NPO) for medical/surgical team
- Comprised of three components:
  - Brief **cognitive screen** (name, location, year, open mouth, stick out tongue, smile)
  - **Oral mechanism exam** (labial closure, lingual range of motion, facial symmetry)
  - **3-ounce water swallow challenge**
    - Drink entire 3 ounces slow and steady without stopping
      - Assess for interruption in sequential drinks, coughing or choking during or after

Clinical swallow examination with SLP (“bedside swallow”)

- **CSE components (Coyle, 2015)**
  - Chart review + interview
  - Self-report questionnaires (more common in post-acute)
  - Oral mechanism/cranial nerve examination
  - Speech/language/cognition assessment (brief)
  - Swallow trials (essentially another screen- not diagnostic)
    - Can be informal or standardized

CSE cont.

- Clinician gains important information about history, presentation, performance in naturalistic environment (impact of cognitive-linguistic status, behavior which may impact safety and adequacy of intake), and gain insight into patient and family goals and preferences.

- Clinician begins to make hypotheses about impairments and aspiration risk and assesses need/readiness for diagnostic instrumental exam.

Best clinical predictors of aspiration in post-stroke population

According to Daniels et al. (2000), identification of at least two of the following significantly predicts moderate-to-severe dysphagia and increased aspiration risk:

Predictor	Description
Dysphonia	Voice disturbance
Dysarthria	Motor speech disorder
Abnormal gag*	Either absent or weakened*
Abnormal volitional cough**	Weak, verbalized, or no response
Cough after swallow**	Immediately after to 1 minute after ingestion of water
Voice change after swallow	Alteration in vocal quality after ingestion of water

*Other studies show nearly 30% of younger adults and 40% of older adults may have unilateral or bilateral absent gag reflexes (Davies et al., 1995)
**Identified as independent predictors of aspiration on imaging (although huge range of reliability) in other studies

The “black box” problem

Image source: https://theconversation.com/curious-kids-is-x-ray-vision-possible-90393

- A patient reports food sticking in their throat, pain with swallowing, and appears to need multiple swallows per bite.
- SLP could make recommendations based on bedside only – softer foods, smaller bites, use a sip of liquid in between bites, remain upright after eating…but imaging is needed to actually visualize and diagnose the problem!

Oops!

Coyle et al. 2014 ASHA Convention

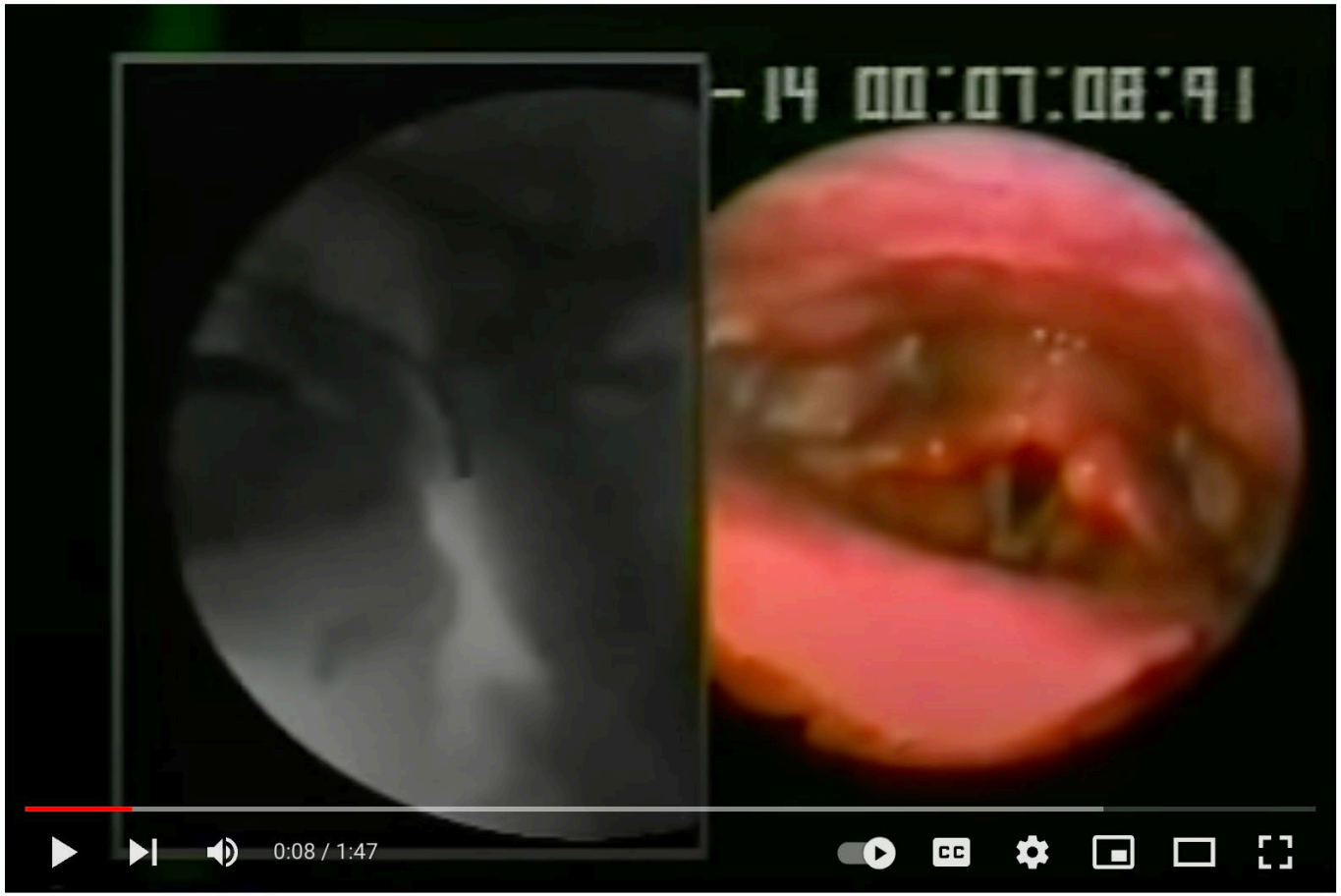
Dysphagia diagnostic tools

Instrumental options:

- **Videofluoroscopic swallowing study (VFSS)** aka modified barium swallow study (MBS) aka esophagram with SLP or cine video with SLP depending on where you are.
  - Option for well-researched standardized protocol- MBSImP (Martin-Harris, 2008)
- **Fiberoptic endoscopic evaluation of swallowing (FEES)**
  - Options for standardized protocols in the works.
- **Manometry**
  - Becoming more popular- usually in addition to and not in replace of VFSS or FEES
  - Pharyngeal and/or esophageal

VFSS vs. FEES

- VFSS:
  - Lips to stomach
  - Oral phase- posterior lingual propulsion
  - Aspiration during swallow
  - Esophageal screen- residue, reflux, structural or motility impairment (not diagnosing these as SLP but able to describe and recommend consideration of referral to GI)
- FEES
  - Pharyngeal phase only
  - Great exam of laryngeal function
  - Able to see location and extent of pharyngeal residue better
  - Portable options
  - Use in therapy to provide visual biofeedback



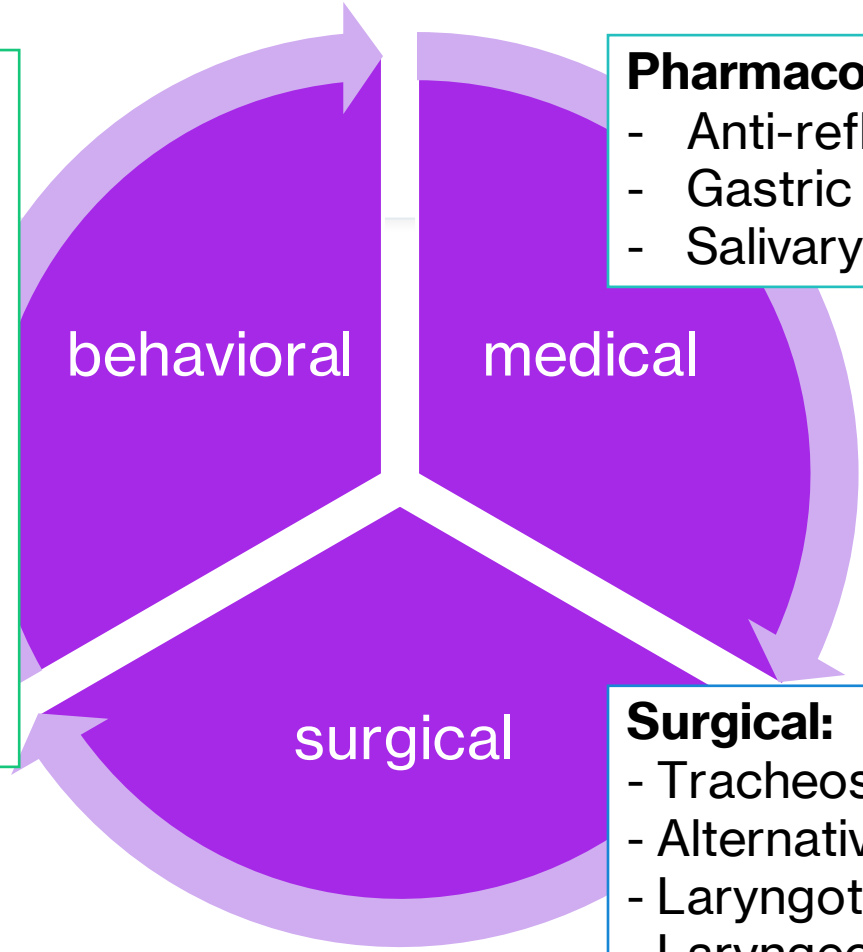
VFSS vs FEES Comparison Video with Susan Langmore Watch video

Dysphagia Treatment Options

Compensatory:
-Short-term adjustment

Rehabilitative
-Improvement in swallowing physiology that permits increased/expanded intake

Prevention
-Avoiding or minimizing negative outcomes, restrictions, progression



Pharmacologic:
- Anti-reflux
- Gastric motility
- Salivary management

Surgical:
- Tracheostomy
- Alternative nutrition
- Laryngotracheal separation
- Laryngectomy
- Thyroplasty
- Dilatation
- Myotomy
- Botox

Evaluating compensatory strategies for post-stroke dysphagia: common beliefs and practices with thickened liquids.

- Thickened liquids flow more slowly in the mouth than thin.
- Commonly **believed** to improve bolus control, sensory awareness, comfort, hydration, and swallow safety.
- Prescribing thickened liquids is a common treatment for thin liquid oropharyngeal dysphagia with the goal of reducing aspiration risk and minimizing aspiration pneumonia risk factors.

Chichero (2019); Pownall (2017); Howard et al. (2018), Nichinari et al (2019)

Common practice does not equal evidence-based practice!

The rationale for using thickened liquids is primary based on **common practice rather than the current evidence** (O'Keefe, 2018; Lippert et al., 2019).

There is **no conclusive evidence to support that thickened liquids reduce or prevent dysphagia-related complications** (Lim et al., 2016; Bock et al., 2016; Martin et al., 2018).

Thickened liquids can lead to **dehydration and reduced health-related quality of life** (Beck et al., 2018; Bolivar-Prados et al., 2019)

Why is using thickened liquids common?

- SLPs want to maximize health and prevent dysphagia-related complications (Murray et al., 2019).
- Natural to reach for “immediate” tool to try to help.
- Expectations from others to minimize coughing with drinking may play a role.
- Culture within practice, setting, region, etc.

Challenging these assumptions

- **Aspiration does not directly result in aspiration pneumonia- cluster of factors contribute to increase risk** (Langmore 2002, 1998).
  - Many patients with dysphagia who aspirate do not go on to develop pulmonary infections (Neil & Dean, 2019; Robbins et al., 2008; Carlaw et al., 2012; Meyer et al., 2017; Ashford, 2019).

Natural history of patients who aspirate (Bock et al., 2017)

- 564 patients (stroke, other neuro, surgery, trauma, NOS, esophageal), with unsensed airway penetration or aspiration on VFSS (Penetration Aspiration Scale score ≥ 5) followed for 54 months.
  - Three-year mortality was 39% (**dysphagia severity and diet recommendation from VFSS not predictive of mortality**)
  - Stroke group had longest time from VFSS to first pulmonary event (lowest risk) compared to other groups- dysphagia NOS and esophageal disorder group highest risk

Important- no stat sig association of recommendation for dietary modifications (e.g., thickened liquids, altered solids, NPO status with incidence of pulmonary events or survival rate over time.

Water versus thickened liquid

Aspiration of thickened liquids and foods are both significantly more likely to be associated with pneumonia than aspirating thin liquid (Langmore et al., 1998 and others).

Weighing individual patient factors that may contribute to oropharyngeal dysphagia aspiration pneumonia

Immune system function

Prevalence of dysphagia signs

Oral hygiene

If aspirating- frequency and acuity of aspiration onset, and amount and quantities of aspirate material.

(Campbell-Taylor, 2008; Coyle & Matthews, 2010; Son et al., 2017).

GRADE systematic review level summary

- A weak clinical recommendation AGAINST the use of thickened liquids in adults with oropharyngeal dysphagia.
- Most patients will probably not want to use thickened liquids and the benefits of the treatment probably do not outweigh their negative effects.
  - (Beck et al., 2018)

- ”In view of the low quality of evidence, any policies involving the implementation of thickened liquids should be subject to substantial scrutiny and debate and should include high-level engagement with patients.” (Guyatt et al., 2008)

Times when it may be appropriate- apply EBP to make individualized decision.

There are times when using thickened liquid MAY be appropriate- especially in acute care (e.g., aspirating large quantities consistently, already presence of pulmonary problem, weak cough, altered mental status, reduced level of alertness)- should be treated as “short term” strategy in conjunction with efforts to work away from it as quickly as possible.

Rehabilitative exercises: swallowing vs. non swallowing

Table I. Selected principles of neuroplasticity applied to exercises for dysphagia.

Neuroplasticity principle*	Swallowing exercises	Non-swallowing exercises
Use It or Lose It	✓	
Use It and Improve It	✓	
Specificity	✓	
Transference	✓	✓
Intensity	✓	✓

*Robbins et al. (2009).

Non-swallowing focus on strengthening muscle group- relies heavily on principle of transference to swallowing.

Post-stroke dysphagia: evidence for lingual resistance exercises

- Kim et al. (2016) completed a randomized controlled trial comparing **tongue-to-palate press** resistance training and treatment as usual compared to treatment as usual only.
  - Experimental group (n=18) did 30 reps, 5 times weekly x 4 weeks
  - Both groups had stat sig improvement in tongue strength and dysphagia severity- closer comparison showed tongue-press group slightly better in oral and pharyngeal ratings compared to control.
    - Evidence grade: A
- Robbins et al. (2007) cohort study (n=10)
  - 8-week lingual exercise program with **Iowa Oral Performance Instrument (IOPI)**
  - Alternated anterior then posterior regions of tongue against IOPI bulb
  - 10 reps, 3x a day, 3c per week
  - Tongue strength, swallowing pressure, and pharyngeal residue grade improved significantly – most gains within first 4 weeks
    - Evidence grade: B

Post-stroke dysphagia evidence for expiratory muscle strength training (EMST)

- Park et al., (2016) completed RCT comparing **EMST-150** sham
  - 5 reps x 5 sets x 5 days per week x 4 weeks
  - EMST-150 group had significant improvement in activation of suprahyoid muscles and improvements in liquids and semisolids
    - Control group improved with semisolids only
    - Both groups improved functional oral intake scores
      - Evidence grade: A

Post-stroke dysphagia evidence for neuromuscular electrical stimulation (NMES) paired with effortful swallows

- Park et al., (2016) completed an RCT comparing **NMES with effortful swallows** to effortful swallows and sham NMES (n=25 in each group)
  - 30 minutes per session x 5 days per week x 6 weeks (did not specify dose)
    - Said NMES created “grabbing” sensation to provide increased resistance to mechanism
    - Experimental group may sig gains in hyoid movement and dysphagia scores
      - Evidence grade: A

Post-stroke dysphagia evidence for chin-tuck against resistance (CTAR)

- Park et al., (2018) RCT comparing treatment as usual with addition of **CTAR** to treatment as usual only (n=12 each group)
  - Isometric (3 reps x 1 minute each) and isotonic (30 reps) during 30m sessions 5 days per week x 4 weeks
  - Both groups improved- greater effects in CTAR group for swallowing outcomes- increased hyolaryngeal elevation and less pharyngeal residue
    - Evidence grade: A

Fig. 1. Chin tuck against resistance training.

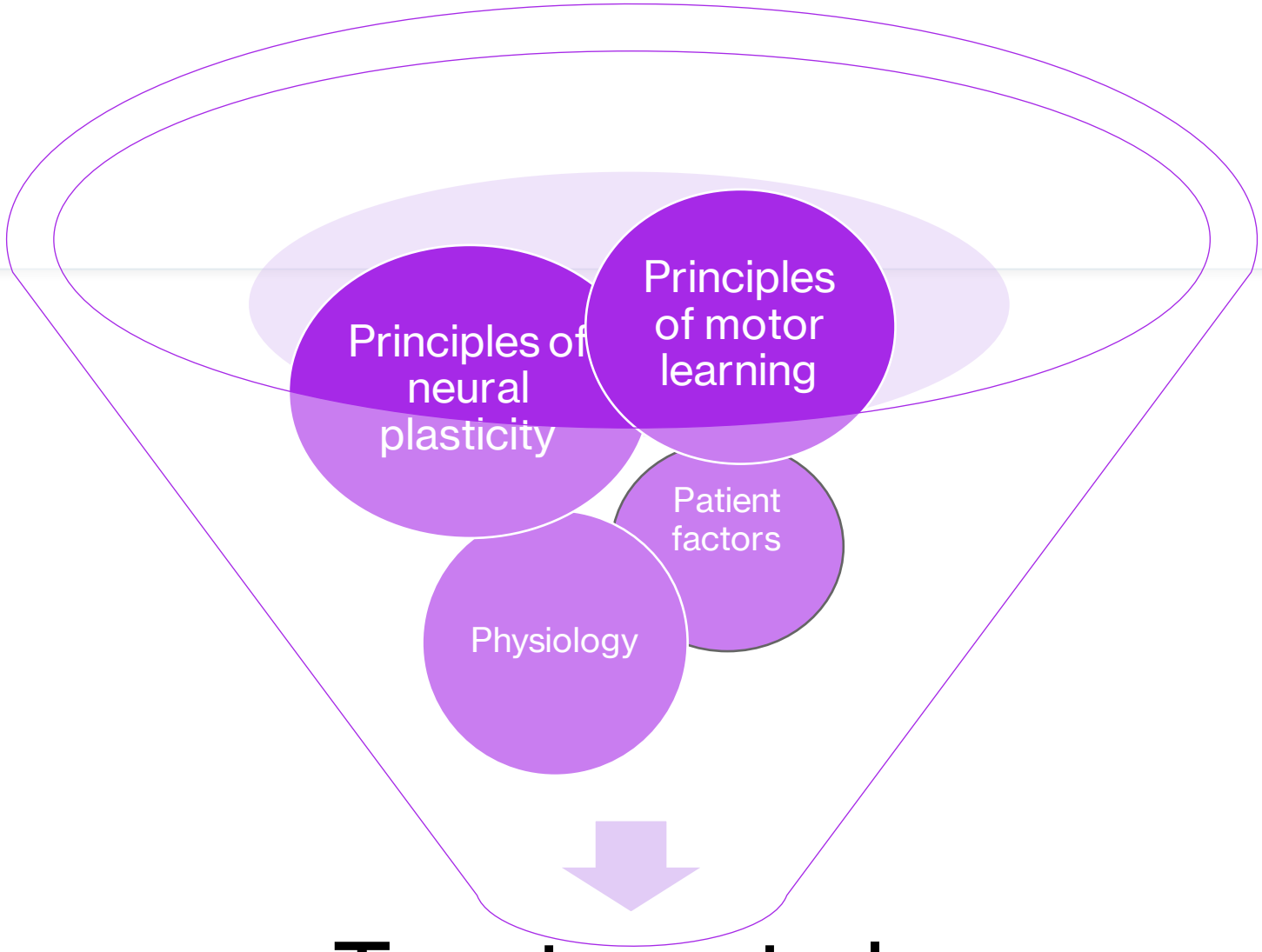
Post-stroke dysphagia evidence for Mendelsohn maneuver with sEMG

- McCullough et al. (2015) cohort study examining **Mendelsohn maneuver with sEMG** to no treatment – 2 weeks of each condition with a cross over design (n=18).
  - During treatment: 40 reps per session x 2 sessions daily
  - Significant improvement in measures of duration of hyoid elevation and excursion and duration of UES were seen. Beginning to see improvements in dysphagia severity.
    - Evidence grade: B

How much exercise is enough?

- Need to create muscle fatigue (intensity and repetitions matter)
- Need varied practice (e.g., variety/challenge in what is being swallowed.. If can only safely eat puree with meals need to challenge more solid foods in therapy)
- Feedback helps (e.g., visual feedback when possible with FEES/MBS, sEMG, practicing in mirror)
- Need resistance to exercise (e.g., effort, food)
- Should be working on foods that matter to patient (bring in from home, order from hospital kitchen, have family bring in)

Robbins et al. (2008)



Treatment plan

Final take away: Other predictors of aspiration pneumonia to consider- role for team mgmt

- Frail older adults age 60+ (ven der Maarel-Wierink et al., 2011 systematic review,)
  - **Age, male gender, lung diseases, dysphagia, diabetes mellitus, severe dementia, angiotensin 1-converting enzyme deletion/deletion genotype, bad oral health, malnutrition**, Parkinson's disease, use of antipsychotic drugs, proton pump inhibitors, angiotensin-converting enzyme inhibitors
- Nursing home residents (Langmore et al., 2002, case series n=189)
  - **Dependence on others for feeding and oral care**, **number of decayed teeth, tube feeding, polypharmacy, and smoking.**
  - Dysphagia an important risk factor but not sufficient on its own to case pneumonia- pioneered idea of "cluster" or risk factors

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Thank you!

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