TREATMENT FOR ORAL AND PHARYNGEAL DYSPHAGIA: WHAT PRINCIPLES AND EVIDENCE SUPPORT IT?

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Goals for this session

• Explain the anatomy and physiology of swallowing
• Discuss principles of neuroplasticity, motor learning and neuromuscular treatment related to dysphagia
• Differentiate postural, compensatory, bolus modifications, and rehabilitative techniques for oropharyngeal dysphagia
• Determine appropriate strategies for various oral and pharyngeal deficits
• Discuss evidence for dysphagia treatment, specific techniques and the limitations in current evidence

Swallowing in Adults

Safe Swallow
Food and liquid are swallowed in a correctly timed sequence without any entering the airway

Efficient Swallow
Food and liquid are cleared from the mouth and throat without any significant residue

Residue after a swallow can put patient at risk to aspirate

• Swallowing is a complex action
  • Requires highly coordinated movements
  • Sensory input
  • Motor output

Motor and Sensory

Disclosures

• Financial:
  • Received an honorarium for this presentation
  • Royalties from The Source for Dysphagia 4th Edition (Pro-Ed)
• Non-financial: Has presented and written on this topic previously
Sensory feedback

• Sensory feedback is important for learning a motor movement, predicting the accuracy of the movement and making corrections to the movement.

Role of sensory input

• In the **oral phases**:
  - Sensory feedback that there is food in the mouth that needs to be formed into a bolus.
  - Recognition of the sensory input from residue may help guide the person to clear the residue.

• In the **pharyngeal phase**: sensory input is critical
  - To the initiation of the swallow.
  - To cue the patient to clear residue.
  - To feel something in the airway and cough.

• The **esophageal phase** also depends on sensory input
  - Residue in the esophagus, the sensation triggers a secondary peristaltic wave.

Sensory input

• Beyond the scope of this course to fully cover the role of sensory input.

• Requires an understanding of the role of cranial and peripheral nerves.
  - And what damage to the upper and lower motor neurons does to sensory input as well as motor response.

Anatomy and Physiology

• Covering this would take 6-10 hours!
  - See ASHA web-based courses
    - Introduction to Anatomy & Physiology of Swallowing in Adults
    - Intermediate: Impact of Impaired Anatomy and Physiology on Swallowing in Adults
    - Cranial Nerve Examination for the SLP
    - And many more!

• I’ll intersperse some pertinent information throughout the course.

Why understand related principles?

• Swallowing involves series of highly coordinated, volitional and reflexive sensorimotor movements in mouth, larynx, and pharynx.

• Coordination between respiratory and swallowing functions in upper aerodigestive tract.

• To manage some a complex disorder, the SLP must understand underlying physiology and related principles.

Discuss principles of neuroplasticity, motor learning and neuromuscular treatment related to dysphagia.
Without the understanding, how does the SLP answer:

- Can the impaired physiology actually be changed?
- Is it possible an exercise could cause more harm than good?
- How frequently should an exercise be practiced?
- How many repetitions of the exercise are needed to obtain a benefit?
- Should the practice be spaced out or massed together?
- At what point in recovery will dysphagia intervention be most beneficial?

Neural plasticity

- Brain’s ability to change, to alter neuronal systems in response to changes in input
- Swallowing therapy intends to achieve a behavioral change (e.g. more efficient movement of the bolus), but also a change in underlying neural pathways

Do changes in pathways happen?

- “Swallow neural substrates can undergo plastic changes as a function of experience, and…
- These swallowing neuroplastic changes may be associated with modulated swallowing behavior”
  - Martin 2009 p. 219

Does it always happen?

- Changes in neural pathways may result in behavioral change
- Only sometimes does behavioral change indicate neural plasticity occur (Robbins et al 2008)

Ten principles of neural plasticity

- Overview
- Two good articles to read:
  - Robbins et al 2008 “Swallowing and Dysphagia Rehabilitation: Translating Principles of Neural Plasticity into Clinically Oriented Evidence”
  - Klein & Jones 2008 “Principles of Experience-Dependent Neural Plasticity: Implications for Rehabilitation After Brain Damage”

Use it or lose it

- If certain function is not used, behavioral response may degrade
  - A sport played in high school?
  - Dancing lessons?
  - Foreign language?
  - What does this imply for patients we make NPO?
Use it and improve it

• Function can be improved through use
  • Especially if the activity involves not just practicing, but practising designed to improve performance of the activity
  • Use of a coach for sports?
  • Instructor for dance or language lessons?
• What is implication for swallowing?
  • Just repetitive swallowing?
  • Or swallowing with instruction for improved performance?

Specificity

• Movement being trained should be close to the movement needed during the functional target task
  • Plasticity is related to specific skill being practiced
  • Practicing one skill will not necessarily result in change to a different area of the brain
  • Would practicing tap make a person a better ballet dancer?
  • Practicing a tennis forehand improve golf swing?

Repetition matters

• In order to change neural substrates, practice must be extensive and continue for a period of time
  • Anyone take piano lessons as a child?
  • How extensive does swallowing “exercise” need to be?
  • How many repetitions?
  • Over what length of time?
  • One of the criticisms of NMES… is it just the “repetition” that results in change?

Intensity matters

• In order to achieve neural change, activity must force the body beyond the typical level of activity in order to achieve neuromuscular adaptation (Pollock et al 1998)
  • No pain, no gain?
  • Body building… Light weights or heavy weights?
  • Swallowing: Burkhead (2007) suggests we should have patient work to point of fatigue rather than specific # reps or sets

Time matters

• Long periods of training and continuous training (rather than intermittent) may result in maximal neural change (Fisher & Sullivan 2001)
  • Two OP swallowing sessions/week?
  • Going to the gym for ten minutes a day? An hour a day?
  • Going for a few days and then skipping weeks?
  • Swallowing – at what point in recovery can patient benefit from long periods of continuous training?
    • Until that point, pair compensatory strategies with rehabilitative techniques patient can tolerate

Salience matters

• Movement being practiced has to be important, functional and related to the behavior being trained
  • A patient receiving PT for a knee injury may be more likely to practice quadriceps strengthening exercises if he understands it will help him climb stairs
  • Swallowing
    • Would swallowing exercises be more salient if practicing them led directly to being able to eat desired foods?
Age Matters

• Younger brain is more adaptive and plastic
  • Neural plasticity does occur across the lifespan
  • Though response decreased with age
    • (Kramer et al 2004; Sawaki et al 2003)
• Swallowing therapy – does this affect our prognosis?

Transference

• Plasticity in response to training one behavior can enhance acquisition of similar behaviors
  • Roller skating and roller blading ... and ice skating?
• Would training tongue lateralization to clear the sulci enhance acquisition of tongue lateralization to place food on chewing surface

Interference

• Plasticity within a given neural structure can impede that structure from other more beneficial plasticity
• Skiing vs. snowboarding: facing straight ahead vs. sideways; moving legs vs. moving whole body
• A patient might learn a maladaptive compensation which could impede them using the same neural circuitry to learn appropriate behavior
  • Garcia et al 2004

Interference example (Garcia et al)

• Patient changed mechanics of swallow
• Interfered with typical bolus flow
• Used abnormal tongue base seal with bolus still in oral cavity
• Resulted in nasal backflow
• Authors stressed importance of carefully monitoring behaviors taught
• They observed this on repeat VFSS, and could not tell clinically

Applying these principles to our treatment planning

• As you read a research article and determine if you will use that technique with a certain patient....
  • Consider the principles of neuroplasticity
• Some principles apply to any exercise you choose
  • Repetition matters
  • Time matters
  • Age matters
• Other principles may not be applied with a particular technique
  • Salience
  • Intensity matters

Motor control and motor learning

• Humbert & German 2013
  • “New Directions for Understanding Neural Control in Swallowing” Dysphagia 28 (1) 1-10
Top-down, Bottom-up

- Swallowing involves top down (cortical control) and bottom-up (peripheral input) processing
  - Chewing and unexpectedly encounter something hard
  - Sip of coffee much hotter than expected

Continuum

- Swallowing movements occur on a continuum of volitional to reflexive

Feed-back and feed-forward

- Motor learning involves feed-back and feed-forward control loops as the individual adapts motor movements

Evidence for dysphagia treatment and treatment techniques

Evidence-based Practice

- "Evidence-based medicine is the integration of best research evidence with clinical expertise and patient values."

EBP is client/patient/family centered

- A clinician’s task is to interpret best current evidence from systematic research in relation to an individual client/patient, including that individual’s preferences, environment, culture, and values regarding health and well-being.
- Because EBP is a continuing process, it is a dynamic integration of ever-evolving clinical expertise and external evidence in day-to-day practice.
What is the BIG challenge for the clinician?

- Clinical expertise?
- Taking client values into account?
- Reading and interpreting best current evidence, which changes on an almost daily basis!

Key steps in the EBP Process

- Framing the clinical question
- Finding the evidence
- Assessing the evidence
- Making the clinical decision

Framing the clinical question

<table>
<thead>
<tr>
<th>Population</th>
<th>Intervention</th>
<th>Comparison</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients to undergo RBT of neck</td>
<td>Prophylactic swallow exercises</td>
<td>No exercise during XRT</td>
<td>Return to Full PO</td>
</tr>
<tr>
<td>Patients after stroke</td>
<td>Use of EMG with Mendelsohn</td>
<td>Mendelsohn without EMG</td>
<td>Improved hyolaryngeal elevation on VFSS</td>
</tr>
</tbody>
</table>

Finding the evidence

- Systematic reviews
- Individual studies
- More on that as we go through the course

Systematic review: evidence base for dysphagia treatment

- ASHA’s National Center for Evidence-Based Practice in Communication Disorders (N-CEP) published a three part systematic review of oropharyngeal dysphagia treatments
  - Part I – Background and methodology
  - Part II – Impact of dysphagia treatment on normal swallow function
  - Part III – Impact of dysphagia treatment on populations with neurological disorders
  - Part IV – Impact of dysphagia treatments on post-cancer treatment

Systematic review: some conclusions:

- Many studies are completed on individuals with a normal swallow
- Makes it difficult to translate findings to individuals with swallowing deficits
- Some techniques (e.g. effortful swallow) have been studied much more than others
- Many studies are in exploratory stages, and are not efficacy studies
- When a study is completed on one population (e.g. stroke), the results cannot necessarily be generalized to another population (e.g. Neuro-degenerative)
- The studies vary in subjects and methods of analyses and “have been conducted more for pre-experimental exploration rather than for substance, direction, and advancement of science” (p. 203)
Speyer systematic review (2010)

- The conclusions found in the literature on the effects of swallowing therapy are strongly dependent on the selected evaluation protocol (e.g., number of swallowing trials, bolus volume and consistency) as well as the outcome parameters (e.g., incidence of pneumonia, temporal or spatial videofluoroscopic parameters, dysphagia-related quality of life).

Speyer cont’d

- Great diversity in type of therapy
- Great diversity in duration of therapy
- Many studies claim short term effects
- Little to no evidence exists on the long-term benefits of therapy
- Heterogeneity of study design
- In general, positive outcomes are reported
- Conclusions of most studies cannot be generalized

Nice “state of the art” article

Individual studies

- MEDLINE
  - Largest online bibliographic database of health related studies
  - Published does not always = scientific quality
  - May not publish studies with negative findings
  - I’ve included information from individual studies throughout the course

Assessing the evidence

- Level of evidence
- Study quality

Making the clinical decision

- Relevance of the findings to your clinical question
- If there is a “guideline”, is it consensus-based?
  - Evidence-based?
- Who wrote and published the guidelines?
What’s a clinician to do?
ASHA Guidelines

• As new guidelines are developed, they will need to be evidence-based
  • The document will be more robust
  • It will take years to develop
• Limitations to EBP framework
  • “The question of whether EBP has positive effects on clinical care itself should be studied empirically”
    • Cohen, Stavri & Hersh, 2004; Sackett et al, 1996, 2000
  • Systematic reviews often do not yield solid empirical evidence
    • Steele, 2006

EBP takes so long... is there an alternative?

• Alternative is a theory-driven approach to care (Sidani and Braden, 1998)
  • Explicit identification of theory underlying the intervention
  • Should specify the nature of intervention, nature of expected effects, process mediating expected effects, and conditions under which the mediating processes occur

Theoretical soundness

• Should this treatment be beneficial
  • Is this treatment beneficial (Evidence-based)
• Judging theoretical soundness can work if the clinician understands the nature of the targeted impairment and the therapeutic mechanism of the selected technique
  • Clark 2003

Use what you know to evaluate treatment strategies

Consider important questions:
• Can the impaired physiology be changed?
• Could the exercise do more harm than good?
• How frequently should the exercise be done?
• How many repetitions of each exercise will be needed?
• Should practice be spaced or massed?
• At what point in the continuum of care should which types of strategies be used?

Rosenbek... “lack of evidence does not necessarily mean a treatment technique does not work”

Treatment strategies
Categorizing treatment strategies

- **COMPENSATORY**
  - **Postural**
  - Techniques to increase control of bolus
  - Diet/bolus modifications
    - How food is presented
  - In patients after surgery for H&N Cancer, compensations may include:
    - Prosthetics

- **REHABILITATIVE**

**Compensatory**

- Compensate for lost or impaired function
- Not intended to improve impaired anatomy or physiology
- Achieve a more functional, safe or efficient swallow
- Physical therapy example: Brace to prevent foot drop
- Examples: External pressure to the cheek or placing bolus on strong side

**Compensatory: Postural**

- Used to re-direct bolus flow in oral, but mostly pharyngeal phases
- Physical therapy example: after a back injury, person has pain with sitting. Using a roll behind lower back may eliminate pain
- E.g. head turn, head tilt

**Compensatory: Increase control of bolus**

- Could be postural
  - Chin down
- Other techniques to exert cortical control
  - Three-second prep

**Compensatory: Bolus modifications**

- Texture changes
- Temperature changes
- Viscosity changes
- Sensory changes (e.g. sour, carbonation)
- Size of bolus

- How the bolus is presented:
  - Utensil
  - Midline/side
  - Self-feeding

**IDDSI.org**

**IDDSI Framework**
Rehabilitative

• Designed to alter (and in some cases have been demonstrated to) the physiology of the swallow
  • i.e. result in long-lasting behavioral changes (and maybe changes in neural pathways)
• Should target the underlying impaired physiology identified during assessment
• Require individual to actively participate and in most cases to follow complex directions

Rehabilitative: PT

• Physical therapy example:
  • They use the term restorative
  • Activity-based therapeutic exercise to re-educate and strengthen damaged muscle
  • Thermotherapy to promote healing

Rehabilitative + Compensatory

• Some strategies thought to be rehabilitative (i.e. result in lasting change in physiology) can also be used in a compensatory way (e.g. used to improve safety or efficiency of each swallow during a meal)
  • Mendelsohn maneuver

Combining type of strategies

• Which strategy at what point in continuum of care?
• How well will individual be able to utilize different types of strategies?
• Are certain types of strategies more effective in certain settings (e.g. available caregivers to implement?)
• Physical therapy example: Using crutches to get around while attending physical therapy for treatment of muscular injury

Case example- combining strategies

• 75 year old male with acute CVA
  • Oral and pharyngeal dysphagia
  • Difficulty following commands
  • Postural: head rotation
  • Compensatory: support to lips
  • Bolus modifications: pureed, nectar thick
  • No rehabilitative strategies at this time

CVA case example

• As patient recovers, and repeat instrumental studies are completed:
  • Remove postural and compensatory strategies
  • Adjust bolus modifications
  • Add in specific rehabilitative strategies
Case example – combining strategies

• 87 year old SNF resident with early to mid stage dementia
• Difficulty chewing solids
• No pharyngeal deficits
• Compensatory: reminder sign for second swallow and sip of liquid
• No postural, bolus modifications or rehabilitative

Dementia case example

• As dementia progresses...
• Individual no longer able to respond to cues for the compensations
• Managed only with bolus modifications

Determine appropriate strategies for various oral and pharyngeal deficits

Discuss evidence for dysphagia treatment, specific techniques and the limitations in current evidence

A Strategy May Address More Than One Impairment In Physiology

• Super-supraglottic
  • Airway closure
  • Timing of closure
  • Movement
• Effortful swallow
  • Movement
  • Timing
  • Duration
  • Bolus flow
  • Pressures
• You should understand why a specific technique is being used

Oral phase treatment

For More information about:
Refer to:


Neuromuscular treatments for speech and swallowing

• Limited empirical evidence to support use of NMTs
• Clinicians may also lack the foundational information needed to judge the theoretical soundness of unstudied treatment strategies.
Clark and NMTs

- Much of the work on neuromuscular treatment is derived from work of physical therapists
- Large muscles in the limbs
- Differ from muscle fiber types in small muscles of lips, tongue, cheek, soft palate
- Beyond scope of this course to review all of the information

Impaired Anatomy/Physiology Of Lips: Impact On Swallowing

<table>
<thead>
<tr>
<th>What physiologic problem might you observe if impairments in lips or lip muscles?</th>
<th>What signs or symptoms might it cause?</th>
</tr>
</thead>
</table>
| Inability to compress lips | Can’t close on spoon  
Can’t drink from straw  
Loses liquid anteriorly when drinking from cup  
Can’t keep bolus in mouth |

Lips: Techniques

- Intended to be rehabilitative:
  - Lips around lifesaver  
  - Lip strength training using Oral Screen  
  - Pucker and retract  
  - Puff cheeks  
  - Resistance straws  
  - Ora-Light
- Postural:
  - Chin up  
- Bolus modifications:
  - Thicker materials if losing bolus anteriorly
- Intended to be compensatory:
  - External support to lips

Lip screen device

- Improved lip strength and swallowing capacity in patients with stroke after training with device  
  - Hagg and Anniko (2008)

High Resistance Straws

- TheraSip™  
- Visual feedback  
- Little ability to modify pressure  
- No change in lip or cheek strength following 4 weeks training with high resistance straws  
- Healthy adults—training with high resistance straws improved only effortful sips and did not improve sipping strength  
  - Shelton (2011)
Objectively measuring change in lip strength

- Iowa Oral Performance Instrument (IOPI)

Impaired Anatomy/Physiology Of Jaw: Impact On Swallowing

<table>
<thead>
<tr>
<th>What physiologic problem might you observe if impairments in jaw or jaw muscles?</th>
<th>What signs or symptoms might it cause?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of graded jaw movement</td>
<td>Opening and closing the jaw the precise amount needed for biting, closing on spoon, cup straw</td>
</tr>
<tr>
<td>Lack of jaw stability</td>
<td>Inability to open and close in coordinated way</td>
</tr>
<tr>
<td>Lack of diagonal movements</td>
<td>Up and down munching instead of rotary chewing</td>
</tr>
</tbody>
</table>

Jaw: Techniques

- Intended to be rehabilitative:
  - Open and close against resistance
- Used as compensation:
  - Hand under jaw for support
- Postural:
  - None in adults

Chewing gum

- Healthy adults no benefit from high resistance chewing gum
  - Found immediate decrease in chewing efficiency (Tzakis et al 1989)
- Healthy adults had increase in functional capacity of masticatory muscles and strength after chewing extra hard gum (Kiliardis et al 1995)

Impaired Physiology Of Cheeks: Impact On Swallowing

<table>
<thead>
<tr>
<th>What physiologic problem might you observe if impairments in cheeks</th>
<th>What signs it might cause?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inability to tighten the cheeks</td>
<td>Reduced ability to suck from straw</td>
</tr>
<tr>
<td>Food and liquid residue in buccal cavities</td>
<td>Poor tone in cheek can result in biting the cheek</td>
</tr>
</tbody>
</table>

Cheeks: Techniques

- Intended to be rehabilitative:
  - Pucker/retract lips
- Compensatory:
  - External pressure to cheeks
  - Place bolus on stronger side
  - Clean buccal cavity with tongue or finger
  - Rinse and clear
- Postural:
  - Head tilt
- Bolus modifications:
  - Foods that maintain cohesive bolus
Cheek strength with IOPI

- Healthy adults – no change in cheek strength after 9 weeks of training with IOPI
  - Clark et al 2009

**Impaired Anatomy/Physiology Of Soft Palate: Impact On Swallowing**

<table>
<thead>
<tr>
<th>What physiologic problem might you observe if impairments in soft palate or muscles of soft palate?</th>
<th>What signs or symptoms might it cause?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Difficulty keeping soft palate against back of tongue during eating</td>
<td>Premature loss of bolus over back of tongue</td>
</tr>
<tr>
<td>Inability to close off nasopharynx during swallowing</td>
<td>Food or liquid gets into the nasopharynx</td>
</tr>
<tr>
<td>Inability to get tight seal for nasopharynx</td>
<td>Difficulty generating pressure to drive the bolus</td>
</tr>
</tbody>
</table>

**Soft palate: Techniques**

- This slide is intentionally left blank
- However... Compensations with prostheses.....

**Impaired Physiology of Tongue: Impact on Oral Phase(s) Swallow**

<table>
<thead>
<tr>
<th>What physiologic problem might you observe if there are impairments in tongue or tongue muscles?</th>
<th>What symptoms might it cause?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inability to protrude and retract tongue</td>
<td>Can’t move bolus back in oral cavity</td>
</tr>
<tr>
<td>Inability to cup, flatten, lateralize the tongue</td>
<td>Reduced ability to form and manipulate bolus Can’t clear residue</td>
</tr>
</tbody>
</table>

In the oral phases, we are concerned with the body of the tongue and back of the tongue (base will come later in pharyngeal phase).

**And now.... The tongue**

- More attention being given to the tongue
- Tongue movement is the initiator for pharyngeal phase
- Better understanding of the inter-connectedness of the oral and pharyngeal phases
- Good review – “Rationale for Strength and Skill Goals in Tongue Resistance Training: A Review” Steele, Bailey, Molfenter, Yeates in SIG 13 Perspectives June 1, 2009

**The tongue: Techniques**

- Intended to be rehabilitative
  - Press tongue (tip, blade, sides, back) against tongue depressor to increase strength
  - Sweep tongue tip from front to back along hard palate
  - Lateralize tongue tip
  - Graduated straws
  - Ora-Light
- Effortful swallow
  - In healthy volunteers, effortful swallow increased tongue pressure
  - Fukuoka, et al 2013

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Devices with no measurement capacity and no research

- No research published on use of Ora_Light
- Abilex
- No feedback and no ability to modify

The tongue: Techniques

- Compensatory:
  - Bolus placement
  - Tongue or finger sweep
  - Multiple swallows
  - Sensory input to tongue
  - Liquid mix or wash
- Postural:
  - Chin up
- Bolus modifications:
  - Cohesive bolus
  - Increased texture
  - Sensory changes

Resistance Exercise: Healthy

- **8 weeks** tongue-pressure resistance exercise
- Increased tongue pressures in healthy & aging adults
  Lazarus, et al, 2003; Robbins et al, 2005

Tongue strength exercises in healthy elderly

- Tongue strength exercises using IOPI
- Trained at **100% of maximum**
- Resulted in increased strength
- Did not measure any swallow function

Improved bolus control

- Three adults with dysphagia
- Tongue-pressure training was beneficial for improving both instrumental and functional aspects of swallowing.
- Used IOPI

Need more than subjective measure of strength

- Inexperienced and experienced raters judge tongue strength differently
- Correlations to specific functional aspects of the oral swallow differed between the rater groups
  - Clark et al 2003
Devices to measure strength

• IOPI
• SwallowSTRONG

New device to measure strength

• Tongueometer
  • www.tongueometer.com
  • No published research yet
  • Affordable, at-home device designed to measure and increase tongue strength and endurance.

Linguinal exercises in stroke

(Robbins, et al 2007)

• 8-week isometric linguinal exercise program with IOPI
• 10 stroke patients (acute and chronic)

  • All subjects significantly increased isometric and swallowing pressures
  • Airway invasion reduced for liquids
  • Two subjects increased lingual volume

  • So is there an effect on swallowing?

  *http://www.iopi.info/index.php?option=com_content&view=article&id=64&Itemid=71

Resistance Exercise: Swallowing

• Robbins et al (2007) started to take the next step

  • Pen-Asp Scale (Rosenbek et al, 1996)
    • Attempted to measure vallecular & pyriform residue
      • Lower pressures → increased oropharyngeal residue & more likely to aspirate
      • Challenges:
        • Difficult with consistency of measures
        • not all spaces are created equally

The Next Steps for Research: Swallowing Physiology?

• Other possibilities:
  ▫ Oral control
  ▫ Pharyngeal residue
  ▫ Back of tongue propulsion of bolus
  ▫ Hyoid per VFS (preliminary; Steele, 2010)
    • Closely timed with tongue pressure events
    • Anterior max pressures → elevation
    • Posterior max pressures → excursion
  ▫ Others?
  ▫ Base of tongue: role in initiation of the pharyngeal response?

Model for pharyngeal swallow

- Safe swallow (airway protection)
- Efficient swallow (bolus clearance)
- Hyolaryngeal excursion
- Tongue base
- Pharyngeal walls
- True & false folds & arytenoids
- Epiglottis
- Hyolarynx
- Back of tongue
- Movements
- Timing

- Cannot move on its own
Let’s talk about penetration

Remember that penetration and aspiration occur on a continuum... they both involve material entering the airway.

Penetration can occur unless the epiglottis AND the arytenoids have BOTH done their job – sealing off the entrance to the airway.

Penetration can be normal

- Prevalence of penetration 11.4% in normal adults
- More common with liquid bolus
  - Allen et al 2010
- Older adults (mean 78) demonstrated penetration on 15% of swallows
  - Milk, water, barium no difference
  - 5 or 10 ml
  - Butler et al 2009
Thermal-tactile stimulation

- Improved triggering of swallowing reflex
- Single subject withdrawal design. Failed to reveal that two weeks of thermal stimulation worked
- Rosenbek et al. (1996) - TS did reduce duration of stage transition and total swallow transition
- Regan et al. (2010) - TTS had immediate effects (pharyngeal transit time, total transit time, pharyngeal delay time). Pts with IPD

- We still don’t know:
  - How frequently and with what intensity
  - For which patients
  - Does it eliminate aspiration
  - Does it matter if mirror is cold
  - Is location important

Mechanical, Cold, Gustatory and Combined Stimulation

- Study broke the components down
- Normal healthy adults
- Each of the three components were presented and compared to no stimulation
- Used a different methodology: slowly introduced liquid bolus until patient felt capable of swallowing
- Support explanation of temporary facilitative effect of this stimulus combination on swallow-specific activity
- Raised more questions than it answered

Gustatory: Sour

- Kaatzke-McDonald et al. 1996
- Logemann et al. 1995

Gustatory (Sour) (Pelletier, 2002)

- 11 SNF residents
- 10 aspirated water (1 penetrator)
- Citric acid (2.7%) improved swallowing safety compared to water
- Eliminated aspiration in 8/10

Gustatory (Sour) (Pelletier, 2002)

- Taste stimuli increased the # of spontaneous swallows observed within 1 minute after initial swallow compared to water
- Gustatory stimuli might facilitate swallowing in some patients with neurogenic dysphagia
- Best response in patients without dementia
Lemon glycerin swabs  
Trenter-Roth 1986

- When used for oral hygiene, considered ineffective
- Lemon reduces oral pH to 2.4 (below the normal 6.7)
- Acid conditions can irritate the mouth, cause pain and decalcify teeth and increase risk of dental caries
- Glycerin dehydrates the oral tissues

Sucrose, salt and sour effects on movement and timing

- Moderate sucrose, high salt and high citric acid elicited significantly higher lingual swallowing pressures compared to pressures generated with water
- Mediated by Trigeminal Nerve
- Pelletier and Dhanaraj (2006)
- Stronger muscle contractions also observed in other studies
- May impact timing and better bolus clearance

Carbonation

- During VFSS carbonated liquid reduced penetration/aspiration and pharyngeal transit time
  - Less pharyngeal retention
  - Bulow et al 2003
- Carbonated thickened liquids decreased penetration and aspiration on 5 ml boluses during instrumental exam
- No change in oral or pharyngeal transit times
  - Sdravou et al 2012

Carbonation

- Discrete and continuous sips of carbonated beverages in patients with neurogenic dysphagia
  - Reduction in pen-asp scores
  - Not all patients improved
  - Not all changes were clinically significant
  - Turkington, 2017
- Are all of these sensory techniques just compensatory?
- Work only on that bolus?

Prepping the system

- Three second prep
- Three-step swallow (Langmore)
- Suck-swallow with added sensory input (Neurosensory stim)
- No research
- Do these techniques “make sense?”
- Cued vs. non-cued swallows

Cued vs. non-cued swallows

Healthy older adults
- Bolus was at a deeper location at swallow onset in the non-cued condition
- Also characterized by longer durations for all timing measures
  - Daro et al 2007

Healthy young
- Pharyngeal transit times and pharyngeal response time were both significantly longer in the cued condition
- Bolus advancement to more distal locations in the pharynx at the time of swallow onset is seen more frequently in non-cued conditions.
  - Nagy et al 2013
Supraglottic and super-supraglottic and timing

- Found to have impact on timing in healthy adults:
  - Earlier and longer laryngeal closure
  - Higher position of hyoid bone at swallow onset
  - Bulow et al 1999
  - Earlier and longer PES opening
  - Ohmae et al 1996
  - Longer duration of hyolaryngeal complex movement
  - Ohmae et al 1996

Mendelsohn and timing

- Mendelsohn found to have impact on timing in a single subject
  - Lazarus et al 1993

Effortful swallow changes timing

- Healthy individuals
- Longer duration of:
  - Hyoid maximum anterior excursion
  - Laryngeal vestibule
  - Duration of the upper esophageal sphincter opening
  - Hind et al 2001

Effortful Swallow

- Performance on the effortful swallow tends to be highly variable
- Therefore, it is recommended that clinicians use submental sEMG biofeedback during the effortful swallow to improve reliability and effectiveness in performing the exercise.
  - Slovarp et al 2016

Movement/Back of Tongue

Safety

Rehabilitative Techniques

<table>
<thead>
<tr>
<th>Impairment</th>
<th>What you might see (sign)</th>
<th>Treatment Techniques</th>
</tr>
</thead>
</table>
| Decreased back of tongue control | Aspiration before the swallow | - Produce 5 g/  
- Pressure on tongue blade |

No evidence to support use of these techniques

Reduced back of tongue control
Timing or Movement

Compensatory Strategies

<table>
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<tr>
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<tbody>
<tr>
<td>Delay/mistiming</td>
<td>Aspiration before the swallow</td>
<td>Chin down, Control bolus size, Thickened liquids, Super-supraglottic (also R), Mendelsohn (also R), Mendelsohn increase cortical control, would it impact timing?</td>
</tr>
<tr>
<td>Decreased back of tongue control</td>
<td></td>
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</tbody>
</table>

Compensatory strategies don’t depend as much on the physiology

Chin down – do we all agree on what that is?

- Survey with five pictures with variety of head and neck positions
- 23% of Japanese and 58% of US SLPs made a distinction between chin down and chin tuck
- This may explain varying results of published studies on effects of chin down
  - Okada et al 2006

Chin down – the good & bad

**Good**
- Posterior shift of AP structures
- Narrowed laryngeal entrance
- Narrowed distance from epiglottis to pharyngeal wall and entrance
- Widened angle of epiglottis
  - Welch et al 1993

**Not so good**
- Dementia w/ or w/o Parkinson’s
- 77% reduction in vallecular area
- 76% of those with reduction aspirated
  - Kunduk et al

Chin down

- 8 healthy volunteers
- Reduced laryngohyoid distance
- Reduced hyoid-mandibular distance
- Weaker pharyngeal contractions
  - Bulow et al 1999

- Reduced distance b/t thyroid and hyoid
- And b/t mandible and hyoid
- Small study with 8 patients
  - Bulow et al 2001

Efficacy: chin down (Lewin et al 2001)

- 21 esophagectomy patients
  - Associated with potential trauma to recurrent laryngeal nerve
  - Who had impaired elevation and anterior movement of hyolaryngeal complex with aspiration during swallow in 100% cases……
- Aspiration was eliminated in 81% of aspirators with the chin tuck maneuver
  - Lewin et al 2001

Thickening – lessons from Protocol 201

- Honey thick liquids most effective in immediately eliminating aspiration
- Patients didn’t like it
- Patients who aspirated on all conditions, and were randomized to honey, got more pneumonia
- More patients assigned to thickened liquids (than chin down) had dehydration, UTI and fever
A word on thickening and carbonation

• Thickening carbonated liquids decreased effect of both starch and gum-based thickening agents
• Rendered thickened carbonated liquid thinner than a non-thickened carbonated liquid
  • Bulow et al 2003

Mendelsohn Maneuver

• Use of maneuver increased the duration of the anterior-superior excursion of the larynx and hyoid and delayed sphincter closure by maintaining traction on anterior sphincter wall (Kahrilas, et al 1991)
• Improved extent of UES and bolus head velocity (Logemann & Kahrilas, 1990)

Mendelsohn with sEMG

• SEMG biofeedback
  • Chronic dysphagia secondary to brainstem stroke
  • Physiologic change in swallowing as measured by severity ratings on VFSS
  • 8 of 10 able to return to full oral intake with elimination of G-tube
  • Average of 5.3 months
  • Huckabee & Cannito, 1999
  • Bryant, 1991
  • Crary, 1995

sEMG

• Patients with Stroke and Head/Neck Cancer
• Reduced hyolaryngeal elevation, reduced pharyngoesophageal segment opening & residue
  • Daily 50 minute sessions and portable biofeedback to practice at home
  • Average # sessions 12/stroke and 9/head & neck
  • 87% of patients increased functional oral intake by at least one scale score on FOIS
  • Stroke had more functional gains
  • Crary, et al 2004

Movement/Hyolaryngeal Elevation Rehabilitation Techniques

<table>
<thead>
<tr>
<th>Impairment</th>
<th>What you might see (sign)</th>
<th>Treatment Techniques</th>
</tr>
</thead>
</table>
| Reduced superior movement of HLE                | Aspiration of the swallow from pyriform sinuses               | • Mendelsohn
|                                                  |                                                                | • sEMG
|                                                  |                                                                | • Effortful Pitch Glide
|                                                  |                                                                | • Supragsagittal
|                                                  |                                                                | • Effortful swallow
| Reduced anterior movement of HLE                 | Aspiration of other pharyngeal residue due to reduced opening of PFS | • Head Lift
|                                                  |                                                                | • EMST
|                                                  |                                                                | • CTAR
|                                                  |                                                                | • Decline
|                                                  |                                                                | • Head Extension

Safety
Judging Elevation By Palpation

- Palpation by clinicians was sensitive only to differences in anterior hyoid movement (not superior movement)  
  - CSE compared to VFSS
- Peak anterior hyoid position was significantly lower in patients judged to have reduced HE compared to those judged to have functional HE  
  - Brates et al 2019

Super-supraglottic and elevation

- Higher position of hyoid bone at swallow onset  
  - Bulow et al 1999
- Longer duration of hyolaryngeal complex movements in healthy volunteers  
  - Ohmae et al 1996

Effortful Swallow and Elevation

- Increases extent and duration of laryngeal elevation  
  - Jang, et al 2025

EMST

- The EMST device is a calibrated instrument consisting of a mouthpiece with a one-way spring-loaded valve and it is referred to as an expiratory pressure threshold trainer.  
  - (Baker et al., 2005)
- The valve blocks airflow produced by the user until a sufficient “threshold” pressure is produced to overcome the force.
  
  www.aspireproducts.org

EMST with SEMG of submental muscles

- Patterns of activation in the submental muscles while training on EMST had longer duration of activation with higher amplitude compared to swallowing  
  - Increases motor unit recruitment  
  - Wheeler et al 2007

EMST compared to other techniques

- 25 healthy male subjects  
  - Compared normal swallow, effortful swallow, Mendelsohn and EMST
  - Videofluorographic measurements and SEMG
- The target threshold was defined as 75% of each participant’s MEP.  
EMST compared to other techniques

- Compared to normal swallow, Mendelsohn and Effortful swallow, there was less hyoid displacement with EMST
- EMST achieved higher maximum and average submental sEMG activity versus normal swallowing

Specificity

With the Mendelsohn maneuver and effortful swallow, the load imposed was volitional.
- That is, the submental muscle activity found to increase on sEMG resulted from the intention of the participant to “squeeze” those muscles, or to “swallow hard.”
- Conversely, the load imposed by EMST results from an externally imposed threshold that must be overcome in order to break the spring-loaded valve and allow air to flow through the device.

EMST

- EMST has potential to induce strength gains in the submental muscles secondary to the externally imposed load.
- Expiratory muscle strength training (EMST) increases motor unit recruitment of the submental muscle complex.

Head Lift

- In healthy elderly there was an increase in:
  - magnitude of anterior excursion of the larynx
  - maximum A-P diameter
  - cross-sectional area of UES
  - Decrease in hypopharyngeal intrabolus pressure (decrease in pharyngeal outflow resistance)
  - Strengthens suprahyoid muscles
    - Shaker et al 1997

Isometric: 60 seconds
Isotonic: 30 reps

Head Lift

- 27 patients (hemispheric CVA, brainstem CVA, pharyngeal radiation)
- Six weeks of exercise vs. sham
- Improvement in:
  - UES opening
    - Anterior laryngeal excursion
    - Post-deglutitive aspiration resolved
  - Returned to PO
    - Shaker et al 2002

14 healthy elderly and 14 healthy young revealed:
- AP deglutitive UES opening and hyoid bone and thyroid cartilage anterior excursion are reduced in the elderly
- Associated with higher intra-bolus pressure
- Suggests higher pharyngeal resistance
  - Kern et al 1999
Head lift (Shaker) compared to traditional

- In addition to strengthening suprahyoid muscles...
- Augments thyrohyoid muscle shortening
- 11 patients with UES dysfunction
- Compared traditional therapy to Shaker
  - Mepsar et al 2000

Traditional:
- Super-supraglottic
- Mendelsohn
- Tongue base
- Yawning
- Gargle
- Tongue pull back

Shaker vs. Traditional

Shaker

- Reduced post swallow aspiration to greater degree

Traditional

- Superior hyoid and laryngeal movement
- Improved range of movement in structures of pharynx

Both: Significant increase in width of UES opening on paste

Head Lift Systematic Review

- Nine studies were included in the review
- Effects of the head lift exercise were an increase in the anterior excursion of the larynx and in the anteroposterior diameter of the upper oesophageal sphincter opening, and the elimination of dysphagic symptoms.

The data on the functional results are, however, promising for dysphagia interventions

Recline

- Healthy young adults do not have significant swallow duration or amplitude gains
- Such gains not needed in healthy adults
- Significant lingual strength gains were seen
- More research needed
  - Mishra et al 2015

Head Extension Swallowing Exercise (HESE)

- 8-week HESE protocol significantly improved suprahyoid muscle activity during effortful swallowing as well as the isometric tongue pressures.
- The HESE appears effective in exercising and strengthening the suprahyoid muscles and tongue muscles in healthy participants

Chin Tuck Against Resistance: CTAR

- Increase in submental muscle activity with use of CTAR in healthy adults
  - Isometric and isotonic
- Greater maximum sEMG values during CTAR isokinetic and isometric than during equivalent Shaker
- Greater mean sEMG values for CTAR isometric than Shaker isometric
  - Yoon et al 2014
Falsetto/Effortful Pitch Glide

- Falsetto - hypothesis that elevation for falsetto will facilitate elevation for swallow
- Effortful Pitch Glide – Healthy Adults
- Saw similarity in movements with EPG and swallow
  - Anterior hyoid
  - Hyolaryngeal approximation
  - Laryngeal elevation
  - Lateral pharyngeal wall medialization
- Only superior hyoid movement was greater during swallowing
  - (Miloro et al. 2014)

Movement/Hyolaryngeal Elevation

**Compensatory Strategies**

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<td>Aspiration after the swallow from pyriform sinuses</td>
<td>Liquid wash</td>
</tr>
<tr>
<td>Reduced anterior movement of HLE</td>
<td>Aspiration of other pharyngeal residue due to reduced opening of PES</td>
<td>Multiple swallows</td>
</tr>
</tbody>
</table>

Head rotation

- 320 detector row CT revealed increased volume, length and cross-sectional area of the pyriform sinuses in healthy volunteers
  - Nakayama et al. DRS 2010
- So the posture does increase the size of the pyriform sinuses (at least in healthy volunteers)

Thick liquids and timing

- Healthy Young
- Increased velocities and higher peak velocities with nectar thick compared to thin
- Hyoid moved faster and further
- Perhaps this is why thickened liquids contribute to improved airway protection
- Facilitating more timely laryngeal vestibule closure
  - Naga et al. 2015

Head rotation

- Head rotation to the damaged side twists the pharynx and closes the damaged side so that food flows down the more normal side
  - Logemann, Kahrilas, Kobara & Vakil, 1989
- Used when there is a unilateral pharyngeal wall impairment or unilateral vocal fold weakness

Head rotation (and other postural changes)

- Head rotation was one of the postural changes studied in 32 patients s/p head and neck CA surgery
- Each posture eliminated aspiration in at least 50% of patients
  - Logemann et al. 1994

- Effect of Bolus Viscosity on the Safety and Efficacy of Swallowing and the Kinematics of the Swallow Response in Patients with Oropharyngeal Dysphagia
- 33 articles
- Increasing bolus viscosity:
  - Increased safety of swallowing
  - Increased amounts of oral and/or pharyngeal residue which may result in post-swallow airway invasion
  - Reduced palatability correlates with increased risk of dehydration and decreased QOL

### Safety

#### Movement/Epiglottis (with HLE)

**Rehabilitative Techniques**

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<td>Epiglottis does not move to horizontal (The epiglottis does NOT move on its own. This is due to reduced HLE)</td>
<td>Penetration into upper laryngeal vestibule</td>
<td>- Maybe nothing as some penetration is normal</td>
</tr>
<tr>
<td>Aspiration during the swallow</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Mendelsohn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Chin down</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Effortful Swallow</td>
</tr>
</tbody>
</table>

**Tip:** The epiglottis cannot be "paralyzed".

### How Does the Epiglottis Help Protect the Airway?

- A cartilage cannot move unless pulled by muscles or acted upon by other forces
- Muscular forces pull the thyroid cartilage up and forward
- This causes the epiglottis to tip to a horizontal position
- Then it fully inverts to cover the entrance to the airway from the pressure of the bolus (which is being pushed by the tongue base and pharyngeal walls)
- This backward pressure by the tongue base helps to shield the entrance to the laryngeal vestibule

### Effortful Swallow and Pen/Asp

- Effortful swallow reduced the depth of penetration into the airway (as did chin tuck)
- Did not reduce the number of misdirected swallows
- Small study with 8 patients
  - Bulow et al 2001

### Compensatory Strategies

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</tr>
<tr>
<td></td>
<td></td>
<td>- Chin down</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Thinned liquids</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Mendelsohn (also R)</td>
</tr>
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<td></td>
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<td>- Mendelsohn (also R)</td>
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### Movement/True & False Folds & Arytenoids

#### Rehabilitative Techniques

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</tr>
</thead>
<tbody>
<tr>
<td>If arytenoids don’t fully tip forward to meet</td>
<td>Penetration into upper laryngeal</td>
<td>• Mediate nothing in severe penetration cases (sore)</td>
</tr>
<tr>
<td>arytenoids</td>
<td>epiglottis</td>
<td>• Super-supraglottic swallow</td>
</tr>
<tr>
<td>If arytenoids and folds don’t fully close</td>
<td>Aspiration during the swallow</td>
<td>• Supraglottic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Super-supraglottic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Breath hold/valsalva</td>
</tr>
</tbody>
</table>

#### Airway Closure

- Arytenoids close
- Arytenoids tip forward to touch base of epiglottis
  - Aryepiglottic folds move toward midline
- The epiglottis tips to horizontal with movement of the hyoid and larynx
- The whole complex of hyoid and thyroid move up and forward to get out of the way of the bolus
- True and false folds close under the arytenoids, after the arytenoids have sealed off the glottis

#### Safety

- **Laryngeal closure: Valsalva, Supraglottic and Supersupraglottic**
  - Some subjects close glottis during breath hold, and others did not
    - Mendelsohn & Martin, 1993
  - Arytenoid approximation and true vocal fold closure were produced consistently by the majority of subjects on all breath hold maneuvers, but false vocal fold approximation and anterior arytenoid tilting accomplished by majority of subjects only during effortful breath-hold conditions
    - (Martin, et al 1993)

- **Breath-hold**
  - Effortful breath hold instruction most effective method to obtain TVC closure
  - Inhale/easy breath hold least effective
  - Instructions for supraglottic to take a deep breath and then hold may be counter-productive
    - Brady et al 2002
  - Instruction to “take a breath, bear down, and hold it” achieves closure of TVF and FVF in most subjects
  - No evidence of carry-over to swallowing
  - Does not using instructions for super-supraglottic to get closure
    - Donzell & Brady 2004

- **Caution: Supraglottic and super-supraglottic**
  - Prolonged voluntary closure of glottis may create Valsalva maneuver, which has been associated with sudden cardiac death and cardiac arrhythmias
  - Subjects: recent stroke, dysphagia and/or CAD
  - 86% demonstrated abnormal cardiac findings (supraventricular tachycardia, premature atrial and ventricular contractions)
  - SG and SSG contraindicated for patients with history of stroke or CAD
    - (Chaudhuri et al 2002)
Movement/True & False Folds & Arytenoids

Compensatory Strategies

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<td>If arytenoids don’t fully tip forward to meet epiglottis</td>
<td>• Penetration into upper laryngeal vestibule • Aspiration during the swallow</td>
<td>• Maybe noticing a sore penetration or swelling</td>
</tr>
<tr>
<td>If arytenoids and folds don’t fully close</td>
<td>• Aspiration during the swallow</td>
<td>• Centriloculate size • Head rotation • Chin down • Thickened liquids • Supraglottic (also R) • Super-supraglottic (R)</td>
</tr>
</tbody>
</table>

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Efficiency

Movement/Hyolaryngeal Elevation

Rehabilitative Techniques

And the epiglottis moving with it

Impairment | What you might see (sign) | Treatment Techniques |
---|---|---|
Reduced superior movement of HLE | • Pyriform sinus residue • Vallecular residue if epiglottis doesn’t invert | • Mendelsohn • With EMG • Effortful swallow/Esophageal glottis |
Reduced anterior movement of HLE | • Pyriform sinus residue • Residue at posterior commissure | • Head Lift • EMET • CTAR • Recline • Head Extension |

We’ve already discussed these in the Safety section

Hyolaryngeal Elevation And Bolus Clearance

Pressure on bolus

• If epiglottis does not invert to horizontal, bolus more likely to stick in valleculae
  
With epiglottis at horizontal, bolus can more easily move on through the pharynx

Pressure from BOT and pharyngeal walls pushes the bolus through

Head turn + chin down

• Subjects with vallecular residue
  
  The head-turn-plus-chin-down maneuver achieved significant reductions in residue for thin and nectar-thick fluids, suggesting that this maneuver can be effective in reducing persistent vallecular residue with these consistencies.
  
  • Nagy et al 2016

We’ve already discussed these in the Safety section

Efficiency

Movement/Hyolaryngeal Elevation

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<td>Liquid wash • Multiple swallows • Bolus size • Head rotation • Head sticky • Thickened liquids • Mendelsohn (also R)</td>
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We’ve already discussed these in the Safety section

Efficiency

Movement/Tongue Base

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<tbody>
<tr>
<td>Reduced posterior movement of the tongue base</td>
<td>• Vallecular residue • Residue on tongue base • Residue on pharyngeal wall</td>
<td>• Tongue retraction • Effortful swallow • Vowel, Glide • Supraglottic</td>
</tr>
</tbody>
</table>

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Effortful Swallow
How instructions are given may make a difference

• “Swallow as hard as you can”
  • Healthy women
    • Huckabee & Steele 2006
  • “Concentrate on pushing the tongue against the hard palate”

This group demonstrated more pressure with the tongue and in upper pharynx

Effortful swallow and esophagus

• Healthy adults
  • Effortful swallowing resulted in increased peristaltic amplitudes within the distal smooth muscle region of esophagus

Efficacy: Three techniques on Maximum Posterior Movement of Tongue Base

• Pull-back (tongue retraction): “Pull the back of your tongue to the back of your mouth and hold for a second”
  • Yawn: “Pull your tongue back during a yawn and hold for a second”
  • Gargle: “Pull your tongue back during a gargle and hold for a second”

• Subjects were consecutively referred patients
  • (Yeas, et al 2000)

Efficacy: Three techniques on Maximum Posterior Movement of Tongue Base

• Gargle task most successful in eliciting more tongue base retraction for the group of subjects (although not in every subject)
  • Number of repeat swallows on each bolus correlated significantly with approximate % of residue in valleculae

Adding Resistance To Tongue Pull Back

• The unassisted TPB may not be any more helpful than typical swallowing:
  • Adding resistance to the TPB by holding the tongue with gauze is feasible and a reasonable consideration when a nonspecific swallowing exercise is needed for improving tongue-base retraction;
  • BUT... Resisted TPB not significantly different than effortful swallow
    • Slovarp et al 2016

Efficiency

Movement/Pharyngeal Walls

Rehabilitative Techniques

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<td>Reduced movement of pharyngeal walls</td>
<td>• Vallecular residue</td>
<td>• Yawn, Gargle</td>
</tr>
<tr>
<td></td>
<td>• Residue on tongue base</td>
<td>• Tongue Hold (Mirabile)</td>
</tr>
<tr>
<td></td>
<td>• Residue on pharyngeal walls</td>
<td>• Effortful swallow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Mendelsohn</td>
</tr>
</tbody>
</table>

Intensity: Specificity
Tongue hold (Masako)

• Patients with H&N CA who had undergone tongue resection
• Noted increased anterior bulging of PPW 3 months after surgery
• More bulging with greater tongue resection
• Suggested PPW could compensate
• Therefore, exercise designed to work the pharyngeal constrictors
  + Fuji et al 1995

Fujiu et al 1995

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Tongue hold (Masako)

• 10 healthy adults
• Increased PPW bulging at mid and inferior levels of second cervical vertebra
  + Fuji & Logemann, 1996

Fuji & Logemann, 1996

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Tongue hold (Masako)

• Do NOT use with food
• The move impairs some of the natural movements of swallowing (inhibits tongue base retraction)
• Three negative findings:
  + Increased pharyngeal residue, particularly in valleculae
  + Shortened duration of airway closure
  + Increased pharyngeal delay time in triggering the pharyngeal swallow
• Three negative findings:
  + Increased pharyngeal residue, particularly in valleculae
  + Shortened duration of airway closure
  + Increased pharyngeal delay time in triggering the pharyngeal swallow
• This might impede bolus flow through the pharynx
  + Doeltgen et al 2009, 2011

More evidence that tongue hold is rehabilitative only

• 20 healthy participants
• Tongue hold swallows created significantly lower pressures in upper pharynx than non-effortful saliva swallows
• The increased anterior bulge cannot compensate for decreased pressure generation at level of upper pharynx
• This might impede bolus flow through the pharynx
  + Doeltgen et al 2009, 2011

Doeltgen et al 2009, 2011

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THS in normal subjects

• Tongue hold does not improve swallowing function in normal subjects
• 20 minutes(240 reps/session) for 5 days/week for 4 weeks
  + Oh et al 2012
• Healthy subjects showed significantly higher suprahyoid and infrahyoid muscle activities during normal swallowing as measured by surface electromyography (sEMG) during swallowing
  + Woo et al 2014

Oh et al 2012

Woo et al 2014

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Tongue Hold Swallow –Amount of Load on Tongue

• Could Tongue Hold also address tongue pressures?
• Healthy adults
• As the amount of tongue protrusion increased, pressure generation patterns became irregular
• THS may place different amounts of load on tongue muscles by adjusting degree of tongue protrusion
  + Fuji-Yamashita et al 2014

Fuji-Yamashita et al 2014

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Tongue Hold and Suprahyoid Muscles

• Change in suprahyoids related to amount of protrusion
• Many elderly showed an increased activation of the suprahyoid muscles during THS, while others showed the opposite.
• Therefore, it is necessary to perform the exercise at a tongue protrusion length that can maximize the effect of the exercise by confirming the degree of suprahyoid muscle activation of each subject during THS.

Mendelsohn for bolus clearance

• Healthy volunteers
• Mendelsohn resulted in increases in both pharyngeal peak contraction and contraction duration
• So... if true in patients, might result in improved propulsion of bolus

Efficiency

Movement/Tongue Base & Pharyngeal Walls

Compensatory Strategies

<table>
<thead>
<tr>
<th>Impairment</th>
<th>What you might see (sign)</th>
<th>Compensatory Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced posterior movement of the tongue base</td>
<td>Vallecular residue</td>
<td>Chin down to widen Vallecular</td>
</tr>
<tr>
<td>Reduced movement of pharyngeal walls</td>
<td>Residue on tongue base</td>
<td>Multiple swallows</td>
</tr>
<tr>
<td></td>
<td>Residue on pharyngeal walls</td>
<td>Effortful Swallow (also R)</td>
</tr>
</tbody>
</table>

ASHA

• Practice Portal
• SIG 13 Perspectives
• Dysphagia Competency Verification Tool

Other Resources

• Dysphagia Research Society
• Special Interest Group 13
• (AB-SSD) American Board of Swallowing and Swallowing Disorders: www.swallowingdisorders.org

QUESTIONS?
• Contact me: nancyswigert1066@gmail.com