TREATMENT FOR (ORAL AND) PHARYNGEAL DYSPHAGIA; WHAT PRINCIPLES AND EVIDENCE SUPPORT IT?

Nancy B. Swigert, M.A., CCC-SLP, BCS-S
BAPTIST HEALTH LEXINGTON
NSWIGERT@BHSI.COM

Goals for this session

• Discuss principles of neuroplasticity, motor learning and neuromuscular treatment related to dysphagia
• Differentiate postural, compensatory and rehabilitative techniques for pharyngeal dysphagia
• State the role outcomes data play in planning treatment
• Determine appropriate strategies for various oral and pharyngeal deficits
• Discuss evidence for some specific techniques and the limitations in current evidence

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

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

Disclosures

• Financial:
  — Received an honorarium for this presentation
  — Royalties from The Source for Dysphagia (Linguisystems)
• Non-financial: Presented on this topic
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”
  — Kleim & 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 practicing designed to improve performance of the activity
  • Use of a coach for sports?
  • Instructor for dance or language lessons?
• What implication for swallowing?
  — Just repetitive swallowing?
  — Or swallowing with instruction for improved performance?

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?
• Would practicing bringing spoon to lips result in improved cup to lips? (and a change in different areas of the brain)
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)
- 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?

Salience matters

- Movement being practiced has to be important, functional and related to the behavior being trained
- Basketball player at the foul line... what’s more important to practice....
  - Bouncing the ball before shooting?
  - The movement of the shoulders and wrist during the shot?
- Swallowing –If goal is to improve ability to move bolus posteriorly would practicing tongue lateralization be salient?

Salience ... specificity

- Specificity- movement being trained should be close to the movement needed during the functional target task
- E.g. Training on isotonic endurance task did not increase endurance on an isometric endurance task (Clark 2012)
  - Isotonic
  - Isometric

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)
    - Whew!!
- Swallowing therapy – does this affect our prognosis?
Transference

- Plasticity in response to training one behavior can enhance acquisition of similar behaviors
  - Roller skating and rollerblading... 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
  - LazGarcia 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

Motor control and motor learning

- Humbert & German 2013
- “New Directions for Understanding Neural Control in Swallowing” Dysphagia 28 (1) 1-10

Sensory feedback

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

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 reflexive to volitional

Feed-back and feed-forward

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

Neuromuscular treatments for speech and swallowing

- Heather Clark
- 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

So why understand how muscles function?

- May think you are working on one muscle when you are really working on another (that is perhaps on top of the one you are hoping to target)
- You might be providing a treatment that is not beneficial to the type of muscle you are targeting
  - E.g. strength training may not be indicated for a particular disease

Evidence-based practice

- ASHA has placed an emphasis on EBP
- Multiple documents exist to provide information to the clinician
- **EBP Documents and Reports**
  - 2006 Work Plan: Focused Initiative on Evidence-Based Practice
  - Position Statement: Evidence-Based Practice in Communication Disorders
  - Report of the Evidence-Based Practice Coordinating Committee
  - Research and Scientific Affairs Committee Statement
- Excerpts to follow
Evidence-based Practice

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

The goal of EBP is the integration of:

- (a) clinical expertise, (b) best current evidence, and (c) client values to provide high-quality services reflecting the interests, values, needs, and choices of the individuals we serve

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.

Goal of EBP

- Providing optimal clinical service to that client/patient on an individual basis.
- 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 about the evidence base for dysphagia?

- ASHA's National Center for Evidence-Based Practice in Communication Disorders (N-CEP) published 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

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
Some conclusions

• When a study is completed on one population (e.g. stroke), the results cannot necessarily be generalized to another population (e.g. Neurodegenerative).
• 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. 201).

Speyer 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

Speyer cont’d

• In general, positive outcomes are reported
• Conclusions of most studies cannot be generalized

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, Stodd & Harth, 2004; Sackett et al, 1996, 2000)
  – Systematic reviews often do not yield solid empirical evidence (Simm, 2008)

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 vs.
• 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?

Use what you know...

• 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”

Less rigorous guidance documents exist

• Division 13, Swallowing and Swallowing Disorders is developing FAQ
  – Short (2-4 pages)
  – Written by panel of experts
  – Evidence included as available
  – Current topics:
    • NPO until dysphagia screen
    • Alternative Nutrition and Hydration in Dysphagia
    • Decision-Making about Dysphagia Management for Patients Nearing the End of Life

ASHA Practice Portal

http://www.asha.org/practice-portal/

Outcomes data

• Functional Outcomes
• Variety of rating scales exist to measure changes:
  – Ability to eat
  – Health Status
  – Patient/Caregiver Satisfaction
  – Quality of Life
Outcomes tools dysphagia

• Functional Oral Intake Scale (FOIS)
  • Crary et al 2005
• Dysphagia Outcome and Severity Scale (DOSS)
  – O’Neil 1999

Patient-reported outcomes (PRO) tools

• "any report of the status of a patient's health condition that comes directly from the patient, without interpretation of the patient's response by a clinician or anyone else." (FDA 2010)
• PRO tools measure what patients are able to do and how they feel by asking questions.

PRO

• SWAL-QOL, a 44-item tool that assesses ten quality-of-life concepts, and
• SWAL-CARE, a 15-item tool that assesses quality of care and patient satisfaction.
  – McHorney et al 2002
• EAT-10 -Eating Assessment Tool is a self-administered, symptom-specific outcome instrument for dysphagia
  – Belafsky et al 2008

PRO

• MD Anderson Dysphagia Inventory
• MDADI is a 20-item five-point Likert questionnaire that assesses dysphagia in three domains (functional, emotional, physical)
  – Chen et al 2001

ASHA NOMS (Outcomes)

• Swallowing is one of the areas represented by 7-point scale called a Functional Communication Measure
• NOMS growing in recognition by governmental agencies

What kind of questions can outcomes data answer?

• How often should treatment be given to achieve maximum gain?
• How long should the treatment sessions be?
• Is treatment more effective when provided 1:1 or in a group?
More specifically the data could provide info to answer each question:

• For a particular diagnostic category
• At different points in continuum of care
• For individuals of different ages
• For individuals with different severity levels of dysphagia

Categorizing treatment strategies

• Compensatory
  – Sensory overlaps compensatory, diet and rehabilitative
  – Postural
    – Diet/bolus modifications
  – 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

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

Bolus modifications

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

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

• 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

Let’s move to treatment

• Framework
• Techniques
• Efficacy (when we have it 😊)
• Application

Without knowledge of underlying physiology

• You might select the wrong treatment techniques for the problem
• A sign/symptom may have more than one possible physiologic cause
• You might select a treatment technique or method which doesn’t even make sense for the problem (e.g. treating a delay when the problem is reduced laryngeal elevation)

Attending to physiology helps determine what to treat

<table>
<thead>
<tr>
<th>Sign/symptom</th>
<th>Functional short term goal</th>
<th>Different physiologic causes</th>
<th>Reworded functional short term goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient has residue in the pyriforms after the swallow</td>
<td>Patient will reduce the amount of residue in the pyriform sinuses to reduce the risk of food falling into the airway</td>
<td>Reduced laryngeal elevation</td>
<td>Patient will increase laryngeal elevation to reduce the amount of food remaining in the pyriforms which could fall into the airway</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Reduced anterior movement of hyolaryngeal complex</td>
<td>Patient will increase anterior movement of hyolaryngeal complex to reduce the amount of food remaining in the pyriforms which could fall into the airway</td>
</tr>
</tbody>
</table>

How would you reword goals if no rehabilitative techniques are selected (i.e. no improvement is expected)?

• Patient will compensate for decreased laryngeal elevation to reduce the amount of food remaining in the pyriform sinuses that falls into the airway after the swallow.
• Patient will compensate for decreased closure at the entrance to the airway to keep food from entering the top of the larynx and falling into the airway after the swallow.

Oral phase treatment – that’s another seminar!

For More information about:
Refer to:

- Strength Training Exercise Principles

- Neuromuscular Treatment Exercise Principles
The tongue as the transition between oral and pharyngeal

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

Lingual exercises in stroke
(Robbins, et al 2007)
- 8-week isometric lingual exercise program with IOPI
- 10 stroke patients (acute and chronic)

Lingual exercises
- 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?

Resistance Exercise: Swallowing
- Robbins et al (2007) started to take the next step
  - Pen-Asp Scale (Rosenbek et al, 1996)
    - Mean reportedly improved across groups
    - Attempted to measure vallecular & pyriform residue
      - Lower pressures → increased oropharyngeal residue & more likely to aspirate
      - Challenges:
        - difficulties with consistency of measures
        - not all spaces are created equally
The Next Steps: Swallowing Physiology?

- Other possibilities:
  - Oral control
  - Pharyngeal residue
  - 2’ weak 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?

Categorizing strategies for pharyngeal phase

- AIRWAY CLOSURE
  - Delay
  - Mistiming of initiation
  - Movement impairments
    - Poor back of tongue control
    - Reduced closure at folds
    - Reduced closure at entrance to airway
    - Reduced hyolaryngeal excursion

Categorizing strategies for pharyngeal phase

- BOLUS CLEARANCE
  - Reduced hyolaryngeal excursion
  - Reduced tongue base
  - Reduced pharyngeal wall movement

Focus on pharyngeal

- What is the sign?
- What is the physiologic cause?
- What treatment techniques are indicated?
- What evidence do we have for the technique?
  - Some listed as “rehabilitative” may only have evidence to support a compensatory effect

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

Selecting treatment objectives

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment Techniques (R?)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration before the swallow</td>
<td>Decreased back of tongue</td>
<td>k.g. Pressure on tongue blade</td>
</tr>
<tr>
<td>Delayed swallow</td>
<td>Thermal slim</td>
<td>Sour, carbonation</td>
</tr>
<tr>
<td></td>
<td>Prep: 3-second</td>
<td>Neurosensory stim</td>
</tr>
<tr>
<td></td>
<td>Supra and super-supra, Mendelsohn</td>
<td></td>
</tr>
</tbody>
</table>
Efficacy of Mechanical, Cold, Gustatory and Combined Stimulation

- Study broke the components down
- Normal healthy adults
- Only when all three components were presented was there statistically quicker average activity 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
  - Sciortino, et al 2003

Efficacy: 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

Lemon glycerin swabs

- 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

Carbonation

- Carbonated thickened liquids decreased penetration and aspiration on 5 ml boluses during instrumental exam
  - Sdravou et al 2012

Efficacy: 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

Effects of sour on tongue movements

- 16 healthy adults
- Tongue movement data for tongue body and dorsum
- Water, high intensity sour (2.7% citric acid), moderate intensity sour, moderate sweet, sweet-sour
- High intensity sour stimulus elicited significantly larger amplitude and higher peak velocity forward and backward tongue body movements than other stimuli
- Suggests Trigeminal irritation may be required to influence bolus transmit times during swallowing

Nancy Swigert, M.A., CCC-SLP, BCS-S

2016

85

87

89

91
Prepping the system

- Three second prep
- Suck-swallow with added sensory input ((Neurosensory stim))
- Three-step swallow (Langmore)

Added benefits on timing

- Supraglottic and super-supraglottic originally intended to improve closure
- Found to have impact on timing in healthy adults:
  - Earlier and longer laryngeal closure
  - Higher position of hyoid bone at swallow onset
  - Longer PES opening
  - Longer duration of hyolaryngeal complex movement (Logemann et al 1997)

Added benefits on timing

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

Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment Techniques (c,d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration before the swallow</td>
<td>Decreased back of tongue Delayed swallow</td>
<td>Chin down (c) Control bolus size (c) Thickened liquids (d)*</td>
</tr>
</tbody>
</table>

Thickening – lessons from Protocol 201

- Honey thick liquids most effective in immediately eliminating aspiration
  - Patients didn’t like it
- Patients who aspirated on all, 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
Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment technique (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration during the swallow</td>
<td>Decreased closure of larynx</td>
<td>Supraglottic</td>
</tr>
<tr>
<td></td>
<td>Mistiming of laryngeal elevation/closure</td>
<td>Supero-supraglottic</td>
</tr>
<tr>
<td></td>
<td>Shortened duration of closure</td>
<td>Breath hold (Valsalva)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Vowel initiate words</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supraglottic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mendelsohn</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Effortful swallow</td>
</tr>
</tbody>
</table>

Efficacy studies - particular approach

- Laryngeal closure: Valsalva, Supraglottic and Supersupraglottic
  - Normal subjects produced earlier cricopharyngeal opening, prolonged pharyngeal swallow, some degree of laryngeal valving before swallow, and change in extent of vertical laryngeal position before the swallow
  - Changes more successful and maintained longer with SSG than SG
  - Breath-holding maneuvers alter not only airway conditions before swallow but also temporal relationships and biomechanical events during (Ohmae, et al 1996)

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)

Efficacy studies: Breath-hold (Brady, 2002)

- Effortful breath hold instruction most effective method to obtain TVC closure
- Inhale/easy breath hold least effective
- Easy breath hold better than inhale/easy
- Instructions for supraglottic to take a deep breath and then hold may be counter-productive

Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment Technique (c,d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration during the swallow</td>
<td>Decreased closure</td>
<td>Head rotation(C)</td>
</tr>
<tr>
<td></td>
<td>Mistiming of laryngeal elevation/closure</td>
<td>Chin down (C)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thick liquids (d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bolus size (d)</td>
</tr>
</tbody>
</table>
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

Chin down – the good & bad
- 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
- 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

Efficacy: chin down (Lewin et al 2001)
- However... in 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.......

Efficacy: chin down (Lewin et al 2001)
- Aspiration was eliminated in 81% of aspirators with the chin tuck maneuver

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
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

- 320 detector row CT revealed increased volume, length and cross-sectional area of the pyriform sinuses in healthy volunteers
  -- Nakayama et al DRS 2010

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

Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment techniques (R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration after from pyriform sinus residue</td>
<td>Decreased laryngeal elevation</td>
<td>Mendelsohn With SEMG Falsetto/Effortful pitch glide</td>
</tr>
<tr>
<td>Decreased anterior movement of hyolaryngeal complex</td>
<td>Head lift/CTAR</td>
<td>Mendelsohn</td>
</tr>
</tbody>
</table>

Efficacy- particular treatment method

- 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)

Efficacy of specific method

- Mendelsohn with SEMG
  - Changes in swallow physiology
  - Improved coordination, longer duration, and increased effort
  - Sustained oral and pharyngeal postures inhibited some of the transient movements noted as part of incomplete swallow (e.g. lingual pumping, repetitive pharyngeal contraction) (Crary, 1995)
Efficacy of specific treatment techniques

• 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

EMST

www.aspireproducts.org

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

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 normal swallow, Mendelsohn and Effortful swallow, there was less hyoid displacement with EMST
  – Speaks to specificity of the task
• EMST achieved higher maximum and average submental sEMG activity versus normal swallowing.

SEMG of submental muscles with EMST

• 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

SEMG biofeedback

– Stroke and Head/Neck Cancer patients
– 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

Nancy Swigert, M.A., CCC-SLP, BCS-S
2016 115

Nancy Swigert, M.A., CCC-SLP, BCS-S
2016 116

Nancy Swigert, M.A., CCC-SLP, BCS-S
2016 117

Nancy Swigert, M.A., CCC-SLP, BCS-S
2016 118

Nancy Swigert, M.A., CCC-SLP, BCS-S
2016 119

Nancy Swigert, M.A., CCC-SLP, BCS-S
2016 120
EMST

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.

Efficacy of specific treatment technique

- Head Lift
  - Health elderly: 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

Efficacy: head lift

- 14 healthy elderly and 14 healthy young
- 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

Efficacy: Head lift (patients)

- In addition to strengthening suprahyoid muscles...
- Augments thyrohyoid muscle shortening
- 11 patients with UES dysfunction
- Compared traditional therapy to Shaker
  - Mepani et al 2009

Efficacy: Head lift (Shaker et al 2002)

- 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 compared to traditional

- Pre and post MBS
- Traditional: Super-supraglottic; Mendelsohn; Tongue base; yawning; gargle; tongue pull back

Shaker vs. traditional

- Shaker: reduced post swallow aspiration to greater degree than traditional
- Traditional: superior hyoid and laryngeal better (uses greater muscle effort than Shaker)
- Both: significant increase in width of UES opening on paste
- Aspiration after: Shaker
- Reduced range of movement in structures of pharynx: traditional therapy

CTAR

- Increase in submental muscle activity with use of CTAR in healthy adults
  - Yoon et al 2014

Head lift – effect on voice?

- 21 subjects
- Dysphonia Severity Index scores improved in 10 of the 21 participants after 6 weeks of exercise

Falsetto/Effortful Pitch Glide

- Falsetto- hypothesis that elevation for falsetto will facilitate elevation for swallow
- Effortful Pitch Glide (Miloro et al 2014) – 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

Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration after from pyriform sinus residue</td>
<td>Decreased laryngeal elevation</td>
<td>Liquid wash (c)</td>
</tr>
<tr>
<td></td>
<td>Decreased anterior movement of hyolaryngeal complex</td>
<td>Multiple swallows (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bolus size (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Head rotation (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid sticky (d)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thickened liquids (d)</td>
</tr>
</tbody>
</table>
Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration after from penetration into laryngeal vestibule</td>
<td>Decreased laryngeal elevation</td>
<td>Mendelsohn</td>
</tr>
<tr>
<td>Decreased arytenoid tipping</td>
<td>Super-supraglottic</td>
<td></td>
</tr>
<tr>
<td>Slow or mistimed closure of larynx</td>
<td>Mendelsohn</td>
<td></td>
</tr>
<tr>
<td>Supraglottic</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Efficacy: Three techniques on Maximum Posterior Movement of Tongue Base (Wei, et al 2000)

- 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)

Efficacy: tongue hold (Masako)

- CA patients with tongue resection
- Noted increased anterior bulging of PPW 3 months after surgery
- More bulging with greater tongue resection
- Suggested PPW could compensate
  - Fuji et al 1995
Efficacy: Tongue hold (Masako)

- 10 normal adults
- Increased PPW bulging at mid and inferior levels of second cervical vertebra
  - Fujii & Logemann, 1996

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

More evidence that tongue hold is rehabilitative only (Doeltgen et al 2007)

- 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

Effortful swallow: unintended consequences

- 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 MBS, and could not tell clinically

Effortful swallow and esophagus

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

Selecting treatment techniques

<table>
<thead>
<tr>
<th>Sign</th>
<th>Physiology</th>
<th>Treatment techniques (c,d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration after from vallecular residue/pharyngeal wall</td>
<td>Decreased tongue base movement</td>
<td>Bolus size (c)</td>
</tr>
<tr>
<td></td>
<td>Decreased pharyngeal wall movement</td>
<td>Stay seated up (c)</td>
</tr>
<tr>
<td></td>
<td>Decreased laryngeal elevation</td>
<td>Multiple swallow (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Liquid wash (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Head rotation (c)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Avoid sticky (d)</td>
</tr>
</tbody>
</table>
Let’s wrap up

• Questions and answers?
• What else would you like to touch base on:
  – NMES?
  – End of Life?
  – Developing protocols?