Evidenced Based Practice in Dysphagia

Houston We Have a Problem
“HOUSTON, WE HAVE A PROBLEM”
THE ALARM WILL SOUND, EVENTUALLY

Rosenbeck 1995

“In 1969 an alarm sounded throughout the aphasiology community when the efficacy of aphasia treatment was challenged in a Medical World News article. Part of that article's message was that aphasic patients arrive at the hospital not walking and not talking and walk out not talking. The future of aphasia treatment was described as "bleak." Alarmed and challenged, the aphasiology community began collecting efficacy data. No such alarm has yet sounded in dysphagia.”
“The assessment and management of patients in long term care who have oropharyngeal dysphagia has developed into an apparently complex and distinct field of practice. It is unfortunate that it lacks an evidence base, the efficacy of treatment is not established, and many clinicians are unfamiliar with appropriate and effective interventions because of a lack of training. Some commonly used interventions are not only ineffective but potentially hazardous. Physicians must become more familiar with the assessment process and appropriate management.”
“Various protocols and algorithms have appeared, said to be essential to the treatment of the person with swallowing impairment. It is unfortunate that there is no evidence to support the suggested need for such management.”
“It appears that a set of procedures and expectations has developed in advance of the evidence required to support it.”
“It is important to keep in mind that the majority of stroke patients recover the ability to swallow post insult. It may be that claims to success in the treatment paradigms with these patients have been and continue to be influenced by this phenomenon of rapid, spontaneous recovery.”
“The most common misperception about swallowing treatment is that the primary purpose of intervention is to identify aspiration and that aspiration can and must be prevented. The overwhelming emphasis on the supposed negative effects of aspiration seems to have developed from the early literature on swallowing disorders in which it was repeatedly stated that all aspiration was probably lethal. These early publications relied on the seminal work of Bartlett, Cameron, and others who were writing of the hazards of aspiration of stomach contents including vomitus...”
“Some of the frequently used **test items** have no bearing on the ability to swallow. One example is examining tongue movements outside the mouth. These are voluntary movements and as such are cortically controlled and distinct from the brain stem–modulated function involved in swallowing. Tongue movements inside the mouth are important and revealed through speech abnormalities.”
“Comparing agreement between a diagnostic test such as the clinical “bedside” examination and the modified barium swallow (MBS) is not appropriate to establish the efficacy of either. Two relatively poor tests may perfectly agree with each other, and high correlations between them do not mean that the sensitivities and specificities of them are similar. The AHCPR report was plain in determining that there was no absolute “gold standard” for assessment of oral pharyngeal dysphagia.”
“Mixing mashed potatoes with barium does not indicate whether or not the patient can swallow mashed potatoes, only whether he or she can swallow potatoes mixed with barium. The mixture bears no resemblance to potatoes alone on any measure of viscosity, rheology, shear, mouth feel, or any other standard. Several studies have compared fluids used in VFSS with the liquids normally served to patients and found no comparison.”
THE PROBLEM WITH SWALLOWING

Applying treatment rationale to another discipline

The physical therapist evaluates the patient at bedside measuring ROM, strength, balance, and functional tasks and determines the patient is a high fall risk.

The PT provides treatment by listening to the patient from another room, while listening for signs and symptoms of falling and providing verbal feedback.

After 4 weeks of treatment the PT goes back into the room to obtain measurements to document changes. The therapist then adjusts the plan as indicated.

Would you consider this physical therapist to be highly skilled?
The scope of dysphagia rehabilitation methods has been changing.

Research has moved away from the use of behavioral compensations and maneuvers toward a greater emphasis on exercised-based therapy that emphasizes consistent, active muscle movement. Examples include:

- Lingual resistance exercises (IOPI/MOST)
- Expiratory Muscle Strength Training (EMST)
- McNeill Dysphagia Therapy Program (MDTP)
WHAT IS “USUAL CARE” IN DYSPHAGIA REHABILITATION: A SURVEY OF USA
DYSPHAGIA PRACTICE PATTERNS
CARNABY 2013

• Data from new therapies suggests a stronger emphasis on exercise yields positive results that are superior to older “management” techniques of compensations and maneuvers.

• Although there is evidence supporting these active exercise approaches, it is unclear how many practicing SLPs are utilizing these techniques.

• Given this recent change in treatment emphasis, it is important to determine if practicing SLPs are incorporating “best practice” into their treatment approaches.
WHAT IS “USUAL CARE” IN DYSPHAGIA REHABILITATION: A SURVEY OF USA DYSPHAGIA PRACTICE PATTERNS
CARNABY 2013

• This study used a web-based survey method to target SLPs who treat adults with dysphagia in a variety of clinical settings throughout the US

• The ASHA’s Special Interest Group 13 was used as the sampling frame because it provided a representative study population of experienced dysphagia clinicians.
WHAT IS “USUAL CARE” IN DYSPHAGIA REHABILITATION: A SURVEY OF USA DYSPHAGIA PRACTICE PATTERNS
CARNABY 2013

254 surveys were analyzed

• Assessment information:
  • 55% SLPs reported using either self-developed assessment/outcome measures
  • 44% used facility-developed measures
  • 37% reported using published peer reviewed tools
  • 29% reported that they used only published tools with statistically confirmed validity
Therapy techniques used were derived from:

- 92% postgraduate CEU courses
- 70% learned from colleagues
- 44% self-developed
- 20% from professional journal articles
WHAT IS “USUAL CARE” IN DYSPHAGIA REHABILITATION: A SURVEY OF USA DYSPHAGIA PRACTICE PATTERNS
CARNABY 2013

• 47 different techniques were recommended

• 3.9% were based on physiologic abnormality identified from data provided

• 96 different combinations were recommended with no single combination exactly repeated

• 58% did not match the patient's specific dysphagic symptoms

• 13% of interventions were exercise based
WHAT IS “USUAL CARE” IN DYSPHAGIA REHABILITATION: A SURVEY OF USA DYSPHAGIA PRACTICE PATTERNS
CARNABY 2013

• 72% of SLPs believed the patient improved more than 50% of the time (improving diet)

• 19% of SLPs reported return to full oral diet without restrictions as a typical outcome of therapy

• Common causes for not regaining pre-injury diet:
  • Progression of premorbid disease
  • Cognition
“Teachability is the capacity to recognize limitation while actively seeking guidance, advice and information to fill those gaps...They are prepared to admit ignorance, but will simultaneously accept responsibility to discover more information.”
“...effective evidence based treatment, does not develop in a vacuum, but rather within a community that is constantly growing in response to the needs of our patients and families.”
“Being teachable is a choice. It involves acknowledging three concepts in your life and your practice:

- Recognize and admit your limitations.
- Create pathways for learning.
- Surround yourself with credible people who can share their knowledge with you.”
• Rogers, K. Even ‘experts” can learn more. The ASHA Leader. December 2016;32-33.
NORMAL SWALLOWING (ADULTS)
TEMPORAL MEASURES

Does anybody know? Does anybody really care?
Normal or Abnormal?
Swallow reaction time (the time between the head of the bolus passing the ramus of the mandible and the first burst of hyoid movement) of 895 milliseconds

Answer: Abnormal

Normal swallow reaction time: -220 to 540 milliseconds
A NORMAL SWALLOW
TEMPORAL MEASURES

Normal or Abnormal?
Duration of laryngeal vestibule closure (the time between the first frame of laryngeal vestibule closure and the first frame of laryngeal vestibule opening) of 1065 milliseconds

Answer: Normal

Normal Range: 310 to 1070 ms
A NORMAL SWALLOW
TEMPORAL MEASURES

Normal or Abnormal?
Duration to laryngeal vestibule closure to hyoid burst (the time between the hyoid burst and the first frame of laryngeal vestibule closure) of 199 milliseconds

Answer: Normal

Normal Range: 198 to 363 ms
A NORMAL SWALLOW
TEMPORAL MEASURES

Duration to maximum hyoid bone elevation (the time between the hyoid burst and the maximum superior/anterior displacement of the hyoid bone)

Range 137 to 291 msec

Sluggish, rather than decreased hyolaryngeal movements during swallowing, are a remarkable feature of post-stroke dysphagia

*Swallowing Kinematics and Factors Associated with Laryngeal Penetration and Aspiration in Stroke Survivors with Dysphagia*  Seo 2016
A NORMAL SWALLOW
TEMPORAL MEASURES

Duration from hyoid burst to opening of upper esophageal sphincter opening (the time between the hyoid burst and the first frame of UES opening)

Normal range 46 to 191 msec
Duration of UES opening (the time between the first frame when the UES opens and the first frame of UES closure)

Normal Range: 210 to 670 ms
A NORMAL SWALLOW
TEMPORAL MEASURES

Pharyngeal transit time (the time between the head of the bolus passing the ramus of the mandible and the first frame at which the tail of the bolus passes the UES)

Normal Range: 350 to 1190 msec
KINEMATICS
A NORMAL SWALLOW

- 20% of elderly, non-dysphagic patients present with post swallow residue in the pharynx.

- 39% of non-dysphagic patients do not trigger a swallow until the head of the bolus reaches the pyriform sinuses.
A NORMAL SWALLOW
RANGE OF MOTION

What is normal?

Anterior hyoid displacement: 7.6 mm to 18.0 mm
Superior hyoid displacement: 5.8 mm to 25 mm
Anterior laryngeal displacement: 3.4 to 8.2 mm
Superior laryngeal displacement: 21.1 mm to 33.9 mm
THE RELATIONSHIP BETWEEN RESIDUE AND ASPIRATION ON THE SUBSEQUENT SWALLOW: AN APPLICATION OF THE NORMALIZED RESIDUE RATIO SCALE STEELE 2013

• The presence of residue after the swallow is a presumed risk for aspiration. Previous studies have failed to sufficiently control timing relationships and/or use precise measurement techniques.
• Pre-swallow vallecular residue, but not pterygoid sinus residue, is significantly associated with impaired swallowing safety on the subsequent clearing swallow in a sample of patients who recruit multiple swallows to clear thin-liquid boluses.
• In our opinion, residue ratios fail to adequately characterize the clinical implications and potential severity of residue.
NORMAL PENETRATION
THIN

Daggett 2006
NORMAL PENETRATION
THICKER FOODS (PUDDING)

Daggett 2006
A NORMAL SWALLOW: AGE RELATED CHANGES  LAZARUS 2017

- Reduced hyolaryngeal movement
- Reduced pharyngeal contraction
- Reduced width and duration of UES opening
- Reduced pharyngeal pressures
- Increased pharyngeal residue
- Reduced sensation in the pharynx and larynx
- Changes in taste and taste acuity
COMPLICATIONS OF DYSPHAGIA
COMPLICATIONS OF DYSPHAGIA

• Dehydration and malnutrition
  • Poor recovery from surgery, injury, illness, and wounds
  • Decreased participation in therapy
  • Increased incidence of pressure ulcers
  • Increased rates of infection
  • Weight loss and muscle wasting
• Choking
• Depression and decreased quality of life
• Substantially higher costs of care
• Higher mortality rates
COMPLICATIONS OF DYSPHAGIA

• Aspiration Pneumonia Research

  • VF and FEES did not significantly predict aspiration pneumonia. Specifically, “Documented aspiration of food or liquid on an instrumental swallow study were not predictors of pneumonia.” ‘Only’ 38% of those who aspirated developed pneumonia.

  • Therefore, dysphagia by itself does not appear to cause aspiration pneumonia. “Dysphagia and aspiration are necessary but not sufficient conditions for development of pneumonia.”

    Langmore, 1998
ASPIRATION PNEUMONIA

1998 Langmore Study

- Patients followed for 4 years after aspirating on instrumental study.
- Instrumental studies did not predict aspiration pneumonia.
- Only’ 38% of those who aspirated developed pneumonia.
- Aspiration does not appear to cause aspiration pneumonia.
- “Dysphagia and aspiration are necessary but not sufficient conditions for development of pneumonia.”
ASPIRATION PNEUMONIA

Study of 515 patients with dementia and/or Parkinson’s Disease

- 11% (52) of patients developed pneumonia in 3 months
  - 9.8% using compensatory chin tuck (chin down)
  - 8.4% with nectar thick liquids
  - 15.0% with honey thick liquids

Robbins 2008
## COMPLICATIONS OF DYSPHAGIA

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Chin Tuck</th>
<th>Thickened Liquid</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dehydration</td>
<td>2%</td>
<td>6%</td>
</tr>
<tr>
<td>UTI</td>
<td>3%</td>
<td>6%</td>
</tr>
<tr>
<td>Fever</td>
<td>2%</td>
<td>4%</td>
</tr>
</tbody>
</table>

Robbins 2008
PRANDIAL ASPIRATION AND PNEUMONIA IN AN ELDERLY POPULATION FOLLOWED OVER 3 YEARS  FEINBERG 1996

- Study followed 152 patients for 3 years
  - 50 non aspirators,
  - 51 minor aspirators,
  - 51 major aspirators
    - 21 PEGS
    - 6 NGT

Our results indicate that there is not a simple and obvious relation between prandial liquid aspiration and pneumonia. Artificial feeding does not seem to be a satisfactory solution for preventing pneumonia in elderly aspirators.
PRANDIAL ASPIRATION AND PNEUMONIA IN AN ELDERLY POPULATION FOLLOWED OVER 3 YEARS FEINBERG 1996

<table>
<thead>
<tr>
<th>Status</th>
<th>Months</th>
<th>Pneumonia Episodes</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Aspiration</td>
<td>1173</td>
<td>7</td>
<td>0.6%</td>
</tr>
<tr>
<td>Minor Aspiration</td>
<td>1493</td>
<td>13</td>
<td>0.9%</td>
</tr>
<tr>
<td>Major Aspiration/Oral feeding</td>
<td>1116</td>
<td>14</td>
<td>1.3%</td>
</tr>
<tr>
<td>Major Aspiration/Artificial Feeding</td>
<td>498</td>
<td>22</td>
<td>4.4%</td>
</tr>
<tr>
<td>Total</td>
<td>4280</td>
<td>56</td>
<td>1.3%</td>
</tr>
</tbody>
</table>
## Mortality Rates

<table>
<thead>
<tr>
<th>Final Status</th>
<th>Deaths</th>
<th>PNA in pts who expired</th>
<th>PNA considered cause of death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non aspirators</td>
<td>7 (19%)</td>
<td>5 (71%)</td>
<td>2 (43%) (NS)</td>
</tr>
<tr>
<td>Minor aspirators</td>
<td>9 (24%)</td>
<td>7 (78%)</td>
<td>3 (33%) (NS)</td>
</tr>
<tr>
<td>Major aspirators Oral feeding</td>
<td>21 (45%)</td>
<td>10 (48%)</td>
<td>7 (33%) (NS)</td>
</tr>
<tr>
<td>Major aspirators Artificial feeding</td>
<td>26 (87%)</td>
<td>15 (58%)</td>
<td>14 (54%)</td>
</tr>
<tr>
<td>Total</td>
<td>63 (41%)</td>
<td>37 (59%)</td>
<td>27 (43%)</td>
</tr>
</tbody>
</table>
Conclusion:

- Results indicate that there is not a simple and obvious relation between aspiration and pneumonia.
- Artificial feeding does not seem to be a satisfactory solution for preventing pneumonia in elderly aspirators.
Aspiration Pneumonia

- Severely Impaired Health
- High Incidence of Aspiration Swallows
- Poor Oral Health Status
PNEUMONIA “RISK” PREDICTOR
Ashford 2016

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Immune System Status</th>
<th>Oral Health Status</th>
<th>Laryngeal Valve Integrity</th>
<th>Predicted Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scenario 1</td>
<td>Normal</td>
<td>Good</td>
<td>No Aspiration</td>
<td>No Pneumonia</td>
</tr>
<tr>
<td>Scenario 2</td>
<td>Normal</td>
<td>Good</td>
<td>Aspiration</td>
<td>No Pneumonia</td>
</tr>
<tr>
<td>Scenario 3</td>
<td>Normal</td>
<td>Very Poor</td>
<td>No Aspiration</td>
<td>No Pneumonia</td>
</tr>
<tr>
<td>Scenario 4</td>
<td>Normal</td>
<td>Very Poor</td>
<td>Aspiration</td>
<td>No Pneumonia</td>
</tr>
<tr>
<td>Scenario 5</td>
<td>Elevated</td>
<td>Good</td>
<td>No Aspiration</td>
<td>No Pneumonia</td>
</tr>
<tr>
<td>Scenario 6</td>
<td>Elevated</td>
<td>Very Poor</td>
<td>No Aspiration</td>
<td>No Pneumonia</td>
</tr>
<tr>
<td>Scenario 7</td>
<td>Elevated</td>
<td>Very Poor</td>
<td>Aspiration</td>
<td>Pneumonia</td>
</tr>
</tbody>
</table>
“Where do eating and drinking set within life’s activities?

• Very few people think first of the nutrition and hydration needs of a body when they think of eating and drinking.

• We think of sharing coffee and a chat with a neighbor, of celebrating a holiday gathering, remembrance of a person or place now far away.”
“Thanksgiving dinner of a roast vegetable stew with brown rice followed by fresh fruit would be far better for us than a greasy, roast bird with mashed vegetables with cream, spiced sugary pies and beer... but would it be Thanksgiving?

We think of the activity associated with the food often before we think of the food, and certainly before we think of how we will swallow each morsel.”
“Perhaps the goal is not so much recovery of the mechanics of the swallow, but rather the golden ticket that such ability would bring? *If I can eat again I can go to the game with my friends and family – I can recover a life lost to me.*”
“We, the speech-language pathology profession, and others involved in the care of people with swallowing have reduced a complex, highly meaningful psychosocial activity to a purely biomechanical action. And this may be where we are failing our patients. We have their best interests in mind of course: we feel that we are being beneficent (doing good) and non-maleficent (not doing harm). We attend to research evidence and we may even continue our learning and undertake assessment to become a specialist in swallowing disorders.”
“I fear that in our drive to know more and more about the intricacies of the swallow we have somehow lost sight of the bigger picture, the purpose of eating and drinking. For many patients improvement in their swallow abilities will be measured in the activities that they can participate in again, the return to a life taken from them. To ensure this, we swallow experts have to take a step back and find out what eating and drinking meant to a person and their family. Then to frame the rehabilitation of the swallow within that meaningful experience as much as to attend to the biomechanics.”
REFERENCES


Ashford, J. ASHA 2016


Leslie, P. “Worship the Dog, Not the Larynx

REFERENCES


COMPENSATION, ADAPTATION AND REHABILITATION
CURRENT DYSPHAGIA THERAPY

Overuse of diet changes and compensatory strategies because:

- Lack of ability to identify pathophysiology of the swallow
- The history of dysphagia intervention
- Clinical supervisors taught it
- Emotional response of the therapist to aspiration
- Lack of standardized clinical swallow assessment
- Concern for patient safety
- Routine therapy approaches
- Lack of dysphagia therapy knowledge
- Lack of technology
COMENSATORY TECHNIQUES
COMPENSATORY TECHNIQUES

- Chin Tuck
- Chin Elevation
- Head Rotation to Weaker Side
- Head Tilt to Stronger Side
- Side lying
- Supraglottic Swallow
- Super-Supraglottic Swallow
- Diet Modification
- Smaller Bites
- Alternating Bites/Sips
Collectively, evidence indicates that the chin tuck changes the anatomic relationships between structures involved in swallowing before the swallow and narrows the width of the airway entrance before the swallow.

Therefore, the potential of the chin tuck to mechanistically treat certain aspects of swallowing disorders is established and investigation into its efficacious value warranted.

Wheeler-Hegland 2009
CHIN DOWN/CHIN TUCK

- Chin-down posture has no remarkable effect except on horizontal hyoid movement.

- Chin tuck facilitates airway protection and enhances tongue base retraction but possibly reduces UES opening.

Leigh 2015
CHIN DOWN/CHIN TUCK

• The effectiveness of chin tuck is related to the overall degree of dysphagia, the more severe the dysphagia, the less effective the maneuver. Saconato 2016

• Chin down position improved airway protection in patients with impaired swallowing safety during cup drinking with thin liquid barium in the upright position. The chin down maneuver did not lead to improved airway protection with teaspoon-sized thin liquid bolus volumes. Clinicians should not recommend the chin down maneuver without first ruling out detrimental effects and seeing evidence of its benefit in videofluoroscopy. Fraser 2012
HEAD TURN

• Videofluoroscopic studies of swallowing in the normal subjects revealed that head rotation to either side increased upper esophageal sphincter opening diameter by an average of 2mm without affecting the period of UES opening or the oropharyngeal transit time.

• We conclude that head rotation can improve swallowing in patients with unilateral oropharyngeal dysphagia. Two potentially beneficial effects were observed:
  • functional exclusion of the relatively flaccid, weakened pharyngeal wall, and
  • reduced UES tone

Logemann 1989
HEAD TURN

• The pharyngeal pressure and time parameter analysis using HRM determined the availability of head rotation as a compensatory technique for safe swallowing. (Kim 2015)
HEAD TURN

When compared with a neutral head position, rotating the head to the left or right

- increased pharyngeal contraction pressure at the level of the valleculae and pyriform sinuses on the side of rotation
- decreased UES resting pressure on the side opposite
- rotation, increased duration from peak pharyngeal pressure in the pyriform sinuses to the end of UES relaxation,
- increased UES anterior-posterior opening diameter

“Studies have laid a foundation for use of the head rotation as a compensatory mechanism for dysphagia characterized by unilateral weakness or possibly by increased tone and resistance to opening at the UES.”

Wheeler-Hegland 2009
SIDE LYING

- The existing rational for use of the side-lying technique is that lying down will hold residual bolus material to the pharyngeal walls instead of allowing it to drop into the airway, which may more readily occur as a result of gravity in an upright position.
- Logemann recommends the use of side lying when pharyngeal contraction is reduced such that residue is observed throughout the pharynx.
- The physiological basis of this posture bears no support from exploratory research. (Wheeler-Hegland 2009)
SUPRAGLOTTIC SWALLOW

• Use of supraglottic maneuver during swallowing resulted in minimal change in the timing or extent of tongue base movement. Therefore the patient continued to have significant pharyngeal /vallecular reside after the sallow and to aspirate (Langmore 1998)

• Overall, results of the physiological study of the supraglottic swallow indicate that it does close the vocal folds earlier in the swallow while concurrently prolonging hyolaryngeal excursion. The original purpose of the technique to treat dysphagia accompanied by reduced or late vocal fold closure is supported by physiological findings. (Wheeler-Hegland 2009)
SUPER SUPRAGLOTTIC SWALLOW

- Increases UES relaxation pressure
- Increased duration of hyoid excursion and laryngeal movement
- Decreased time between UES opening and onset of hyoid movement and BOT movement time between UES opening and the onset of vocal fold adduction and laryngeal closure (indicating
- These airway-protective mechanisms happened earlier in
- the swallow sequence).
- Actual displacement decreased for the hyoid bone and increased for the larynx
- The width of UES opening increase.

Wheeler-Hegland 2009
Results show that these two swallowing maneuvers, which are known primarily as techniques to protect the airway, also function to strengthen the tongue pressure produced by the contact between the tongue and the hard palate during swallowing and this effect is more pronounced during the super supraglottic swallow.

Fujiwara 2014
ADAPTATIONS
ADAPTATIONS

• Diet Changes
• Water Free Protocol
• Meal Size
• No Straws
• Feeding Tubes
• Total beverage intake was not significantly different between the water free group and the thickened liquids only group.
• There was no significant difference in beverage intake between participants based on any of demographic.
• Collectively, 71% of participants were classified as dehydrated at entry to the study. Participants in the water protocol group displayed a trend of improvement in hydration status over the 2 weeks.
• Thickened liquids only group displayed a trend of deterioration in hydration.
• There were no significant differences in hydration levels for participants at any time point based on any of demographic.
• The thickened liquids only group had a significantly higher proportion of participants with UTI compared to the water protocol group.

• None of the participants in either group were diagnosed with pneumonia.

• The median number of days and until resolution of dysphagia for thin liquids for the water protocol group was 27 day and for the thickened liquids only group was 38 days.
WHAT INFORMATION DO CLINICIANS USE IN RECOMMENDING ORAL VERSES NONORAL FEEDING IN OPROPHARYNGEAL DYSPHAGIC PATIENTS LOGEMANN 2008

• “There is little evidence regarding types(s) of information clinicians use to make the recommendation for oral or non-oral feeding in patients with oropharyngeal dysphagia.”

• Part 1: Several small groups of clinicians were surveyed to obtain the variables used to make oral verses non oral recommendation

• 46 variables were identified

• The list of 46 variables was given to clinicians to rank the top 10 variables that were important

• 13 variables were identified
WHAT INFORMATION DO CLINICIANS USE IN RECOMMENDING ORAL VERSUS NONORAL FEEDING IN OPROPHARYNGEAL DYSPHAGIC PATIENTS Logemann 2008

• Part 2: 20 MBSS were sent to each of 23 clinicians
• Decisions:
  • Oral
  • Partially oral with nonoral feeding
  • Nonoral
• Include which of the 13 variables influenced their decision
<table>
<thead>
<tr>
<th>Frequency Rank</th>
<th>Criterion</th>
<th>Frequency %</th>
<th>Kappa</th>
<th>Agreement Rank</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Amt of aspiration</td>
<td>79.6%</td>
<td>0.0008</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Freq of aspiration</td>
<td>70.4%</td>
<td>0.059</td>
<td>8</td>
</tr>
<tr>
<td>3</td>
<td>Diagnosis</td>
<td>44.6%</td>
<td>0.011</td>
<td>11</td>
</tr>
<tr>
<td>4</td>
<td>History of pneumonia</td>
<td>40.4%</td>
<td>0.243</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>Ability to complete postures</td>
<td>35.4%</td>
<td>0.228</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>Cough ability</td>
<td>35%</td>
<td>0.137</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>Severity of med condition</td>
<td>32.0%</td>
<td>0.153</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>Recovery prognosis</td>
<td>26.7%</td>
<td>0.063</td>
<td>7</td>
</tr>
<tr>
<td>9</td>
<td>Respiratory status</td>
<td>22.6%</td>
<td>0.076</td>
<td>6</td>
</tr>
<tr>
<td>10</td>
<td>Silent aspiration</td>
<td>22.4%</td>
<td>0.222</td>
<td>3</td>
</tr>
<tr>
<td>11</td>
<td>Patient wishes</td>
<td>21.5%</td>
<td>0.056</td>
<td>9</td>
</tr>
<tr>
<td>12</td>
<td>Alertness</td>
<td>21.3%</td>
<td>0.038</td>
<td>10</td>
</tr>
<tr>
<td>13</td>
<td>Secretion mgt</td>
<td>11.7%</td>
<td>-0.001</td>
<td>13</td>
</tr>
</tbody>
</table>
DYSPHAGIA AND DIETARY LEVELS IN SKILLED NURSING FACILITIES  GROHER 1995

• 212 nursing home residents on mechanically altered diets
• Swallowing evaluation including:
  • Medical history
  • Physical examination
  • FEES
  • 31 received MBSS
  • Detailed observation of 2 meals
  • Sustained attention
  • Posture
  • Self feeding skills
DYSPHAGIA AND DIETARY LEVELS IN SKILLED NURSING FACILITIES  GROHER 1995

- Appropriate diet levels were determined by:
  - Integrity of physical examination
    - Xerostomia
    - Deglutitory muscle strength
    - Secretion and food management
    - Cognitive status
    - Ability to feed self
    - History of aspiration pneumonia
    - General health status
    - Overall abilities during mealtime
- Diet level was not considered to be changed unless the resident tolerated for 30 days without >2% weight loss and no pneumonia
DYSPHAGIA AND DIETARY LEVELS IN SKILLED NURSING FACILITIES  GROHER 1995

• 91% were able to eat diets above the prescribed diet level
• 4% were consuming diets above an appropriate level
• 5% were considered to be at the appropriate diet level
This systematic review identified major gaps in the understanding of the impact of liquid consistency and food texture on swallowing physiology, both in healthy and disordered populations.

With respect to objective measures that might be used to guide the classification of thickened liquids and texture modified foods, the review identified an absence of convention, particularly in terms of the shear rates that are used for reporting apparent viscosity.

Exceptionally limited information is available for objective measurement of texture-modified foods.
• Outcome
CHANGING DIET TEXTURE

• Study evaluated dietary intake over the course of a day in hospitalized patients older than 60 years comparing intake in patients consuming a regular diet to those consuming a texture modified diet.

• Patients on the modified diet had a significantly lower nutritional intake in terms of energy and protein.

• 54% of patients on a texture modified diet were recommended a nutritional supplement, compared with 24% of patients on a regular diet.

Wright 2005
CHANGING DIET TEXTURE

Compared with the normal diet the puréed and liquid diets were the ones with the most reduced:

• energy (31.4% and 39.9%, respectively),
• protein (45.4% and 79.8%, respectively)
• lipid (41.0% and 76.0%, respectively) contents.

Viganó 2011
THICKENED LIQUIDS

• Despite the lack of evidence to support first-line use of thickened liquids, many clinicians continue to believe they are an effective intervention. (Wang 2016)

• In a 2005 survey of speech-language pathologists, respondents prescribed thickened liquids to 25% to 75% of patients with dysphagia. (Garcia 2005)
The Influence of Food Texture and Liquid Consistency Modification on Swallowing Physiology and Function: A Systematic Review (Steele 2015)

“Qualitative synthesis revealed two key trends with respect to the impact of thickening liquids on swallowing: Thicker liquids reduce the risk of penetration–aspiration, but also increase the risk of post-swallow residue in the pharynx.”
THICKENED LIQUIDS

• “No strong evidence is available supporting the use of thickened liquids as an intervention for patients with dysphagia.” Sura et al. 2012

• Dehydration occurred to a significant degree in the presence of thickened liquids. Logemann 2003

• Dehydration in the elderly can lead to:
  • Hypotension
  • Falls
  • Constipation
  • UTI
  • Confusion
  • Delirium
  • Poor recovery from illness
THICKENED LIQUIDS

Complications that may arise from thickeners:

- Slow gastric emptying
- Increase risk of reflux
- Reduce appetite
“The generally accepted clinical notion that manipulation of thicker (more viscous) substances reduces occurrence of aspiration, or modifies other bolus flow characteristics in dysphagic persons that produce an “improved swallow,” has little support, other than anecdotal, in the literature. Despite the paucity of data, the manipulation of thickness in the diet has become a cornerstone of dysphagia management practice.”
“There is poor correlation between the viscosity of thickened liquids used during videofluoroscopic tests and the viscosity of liquids prepared to the same target levels for patients during mealtime.”
“Use of thickened liquids reduces videofluoroscopic evidence of aspiration in older adults with dementia but does not reduce the 3-month risk of pneumonia in the same population.”
CUP VERSES STRAW
Veiga 2014

- The cup provides a larger total volume in a shorter time of intake, yet it causes oral spillage of liquid.
- Oral spillage of liquid was observed solely during intake from the cup, with a statistically significant difference when compared to the straw.
- The straw seems to influence favorably the quality of sequential swallowing with respect to bolus containment within the oral cavity, which was better with that utensil.
- The present findings agree with the recommendation to healthy elderly individuals of using a straw, as use of this utensil showed a lower occurrence of oral spillage and therefore is a benefit to the oral phase of swallowing.
- No difference in penetration or aspiration was observed.
FEEDING TUBES

• We found no published randomized trials that compare tube feeding with oral feeding.
• We found no data to suggest that tube feeding improves any of these clinically important outcomes and some data suggests it does not:
  • Reduce risk of aspiration pneumonia
  • Prolong survival
  • Reduce the risk of pressure sores
  • Reduce risk of infections
  • Improve function
  • Provide palliation

Finucane 1999
FEEDING TUBES

- Over the last 2 decades, research has failed to demonstrate benefits of tube feeding in patients with advanced dementia.

- Expert opinion and position statements by national organizations increasingly advocate against this practice.

Mitchell 2016
Aspiration pneumonia is among the most serious complication of gastrostomy tube feedings. However, few data are available from the nursing home setting where tube feedings are used for extended periods.

- We reviewed 109 nursing facility charts in order to determine the incidence of, and risk factors for, aspiration pneumonia:
  - 22.9% of gastrostomy tube-fed patients aspirated.
  - A history of recent previous pneumonia was found in 40.7% of those who subsequently developed aspiration pneumonia.

Cogen 1989
REHABILITATION
AREAS OF BREAKDOWN

• Weakness
• Motor Planning
• Loss of Skill
  • Behavior Changes
  • Neurological Dysfunction
• Multifactorial
DYSPHAGIA THERAPY

Factors supporting the rehabilitation potential of many patients with dysphagia:

- Dysphagia research and clinical evidence indicate that positive neuroplastic changes are possible even in the presence of chronic conditions, multi-system atrophy and advanced age.
NEUROPLASTICITY

Neuroplastic improvements following disease can include:

- Reorganization of cortical representation
- Increased efficiency of residual pathways
- Greater use of alternative descending pathways
NEUROPLASTIC PRINCIPLES

- Use it or lose it
- Use it and improve it
- Repetition matters
- Intensity matters
- Plasticity is experience specific
- Salience
- Difficulty
- Transference
- Interference

Kleim 2008
Robbins 2008
USE IT OR LOOSE IT

Must consider important aspects of WHAT and HOW the system is being used and engaged to maximize functional outcomes.
USE IT AND IMPROVE IT

• With increased biological activity future functioning is enhanced.

• The object is not to merely use a function but to use with increasing competence (efficiency/accuracy)

• Simply swallowing does not improve the swallow
  • Goals for improvement must be specified and performance adequacy evaluated
REPETITION

- Neural substrates may be modified by extensive and prolonged practice

- Considerations for therapy:
  - number of repetitions
  - number of treatment sessions
  - treatment duration
Kleim et al 2002

TRIALS
INTENSITY

No adaptations will occur if the muscle(s) is not forced beyond “typical” activity level.
LOAD AND SWALLOWING

What are we working with?

- Tongue muscles
- Submental muscles
- Pharynx
- Hyoid movement
- Larynx elevation/excursion
LOAD AND SWALLOWING

What are the interventions?

- Lingual resistance exercise
- Jaw exercises
- Respiratory resistance (EMST)
- Effortful Swallow
- Mendelsohn Maneuver
- Chin tuck against resistance
SPECIFICITY

• Consider what is being repeated and work to enhance the **accuracy**, **quality**, **coordination** and **strength** of the affected system.

• Changes only occur in the neural substrates engaged in the trained behavior.

• The type of training will determine the functional outcome (skill verses strength verses endurance)
Only behaviorally relevant experiences cause neuroplastic changes

• Best induced with movement is purposeful and related to the behavior being trained

• The patient needs to be attentive to task

• The patient needs proprioceptive awareness of trial accuracy (errors/ success)
DIFFICULTY

- Achievable to the patient
  - If unattainable they will lose interest and lose motivation
- Will challenge the patient
  - Ensures attention and interest
- Progression in targets
  - Progressive strength/load paradigms - Increasing demands on timing, coordination
  - Moving to more complex/challenging food stimuli
TRANSFERENCE

• Would training other systems target your goal and lead to functional improvements in swallowing?

• Is the training provided transferring to the targeted functional task?

• Understand the transference effects of the treatment provided
INTERFERENCE

Plasticity in response to one experience can interfere with the acquisition of other behaviors.

• Sometimes we are really good compensators. And developing neural connections that help us compensate for lost function may actually interfere with the likelihood of developing a different neural connection related to that function.
• Perhaps enhancing some speech or voice skills such as articulation might interfere with other aspects of speech production such as prosody or rate.
• When maladaptive, compensatory strategies may induce plasticity that will have to be overcome with subsequent rehabilitation and other treatment approaches.
STRENGTH FUNDAMENTALS
A fundamental requirement of strength exercise is “overload”. To increase the force-generating ability of a muscle, it must be progressively challenged at a sufficient intensity. (Wheeler-Hegland 2008)

Strength exercise research demonstrates that if more than 30 repetitions can be performed at a set resistance load, the intensity is insufficient to stimulate a significant muscle strength gain.
STRENGTH EXERCISE FUNDAMENTALS

• Principle of “One Repetition Maximum” or “One Rep Max”

• The intensity of a strength exercise should be reported as a percentage of one rep max

• According to exercise research, performing an exercise where more than 30 reps can be completed does not efficiently increase muscle strength
SWALLOW EXERCISES

• There are two general types of exercise.

• High repetition with low intensities
  
  • Influences motor learning/neuroplasticity

The Typical Swallow: The patient performs numerous good quality swallows to practice swallow timing, triggering and coordination.
SWALLOW EXERCISE

• Low repetition with high intensities

• Improves Strength and motor learning/neuroplasticity

• Examples: Effortful Swallow and Mendelsohn Maneuver

“Dysphagia therapy that incorporates systematic and progressively more challenging swallowing exercises generates superior clinical outcomes.”

Carnaby 2010
EXERCISE FUNDAMENTALS

• Early changes in strength training are generally the result of modifications in how the nervous system activates the muscle rather than a structural alteration in the muscle itself.

• Improved performance may be the result of an increased number of motor units recruited or improved speed and coordination of the motor unit recruitment.
EXERCISE FUNDAMENTALS

• These early alterations in neural activity can improve force production, coordination, and precision of movement.

• As training progresses, strength gains then appear to be more the result of morphologic changes within the muscle tissue because the relative contribution of neural factors decreases.

• Burkhead-Morgan et al 2007
EXERCISE FUNDAMENTALS

• Effortful Swallow and Mendelsohn Maneuver exercises are based on fundamental strength exercise principles regarding:
  
  • Intensity of effort (level of difficulty and rating of perceived exertion)
  • Progression of resistance as strength increases
  • Functional activity incorporated into exercises
INDIRECT SWALLOWING INTERVENTIONS
ORAL MOTOR EXERCISES

Oral motor exercise may:

• Facilitate anterior lip closure
• Improve the management of secretions
• Reduce anterior spillage
• Improve ability to maintain closure on cup, straw or spoon
• Enhance mastication
• Improve bolus management
LIP EXERCISES

• Murray, Larson, Logemann (1998) revealed extracting liquid from a straw produced more muscle activity in the labial muscles than the maximal compression task.

• Overall, the straw swallows revealed the highest sEMG signals suggesting a swallowing rehabilitation program using a straw exercise maybe warranted to improve labial strength.
LINGUAL EXERCISES

Tongue movement against resistance
THE EFFECT OF TONGUE STRENGTH ON MEAL CONSUMPTION IN LONG TERM CARE

• Tongue pressure measurement has been shown to hold promise as an indicator of poor meal consumption for elderly residents in long term care.

• There was a clear difference in tongue strength between LTC residents who showed signs of swallowing difficulty at mealtimes and those who did not.

• Reduced tongue strength was also associated with
  • longer meal times,
  • reduced food intake and the
  • presence of observable choking and coughing at the meal

(The literature suggests that healthy elderly adults should have anterior maximum isometric pressures of at least 40 kPa and saliva swallow pressures between 20 and 30 kPa.)

Namasivayam 2015
IOPI/SWALLOW STRONG

- Increased swallowing pressures
- Airway invasion was reduced for liquids
- Lingual muscle volume increased
## NORMATIVE DATA

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<table>
<thead>
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<tr>
<td>Normal Range</td>
<td>40-80 kPa</td>
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<tr>
<td>Average</td>
<td>63 kPa</td>
</tr>
<tr>
<td>Needs evaluation</td>
<td>&lt;34 kPa</td>
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Outcomes of tongue-pressure strength and accuracy training for dysphagia following acquired brain injury Steele 2013

• Findings suggest that tongue–palate pressure generation plays a pivotal role in establishing the overall strength of a swallow
• Tongue-pressure plays a primary role in controlling the flow of liquids through the mouth and pharynx
• The tongue is responsible for initiating the driving forces that propel liquids and foods through the oropharynx into the esophagus
• When tongue-pressure generation is impaired, liquids may spill into the pharynx before the airway is protected, or bolus clearance may be impaired, leaving residue in the pharynx. In both of these situations, there is a heightened risk of aspiration
Outcomes of tongue-pressure strength and accuracy training for dysphagia following acquired brain injury Steele 2013

- All six participants in this study achieved increases in either anterior and/or posterior tongue strength
- Even the participants with dysphagia of longer than 18 months chronicity demonstrated convincing improvements in both anterior and posterior tongue strength
- Tongue-pressure resistance exercises, practiced 2–3-times weekly are an effective method for increasing tongue strength in individuals with neurogenic dysphagia
- Five of the six patients displaying aspiration on thin liquids showed resolution of this impairment
- Did not observe any positive trends with respect to improved bolus clearance and reduced residues in the valleculae and pyriform sinuses
“Findings indicate that lingual exercise enables acute and chronic stroke patients to increase lingual strength with associated improvements in swallowing pressures, airway protection and lingual volume.”

Robbins 2007
SWALLOW STRONG
The unassisted TPB may not be any more helpful for improving tongue-base retraction 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;

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.
The maneuver “was not designed to increase BOT retraction”

“It is important to note that the effects of the Masako maneuver have not been studied using rehabilitation exercise paradigm in any individuals, particularly those with dysphagia.”

Johnson 2014
• “...tongue and pharyngeal muscle activity increased during the tongue hold maneuver...”

• These results suggest that increased superior pharyngeal constrictor activity may serve to maintain relatively stable pharyngeal pressures in the absence of posterior tongue movement.

Hammer 2014
In oral motor training, specificity and intensity of exercise are important elements for successful outcome. Tongue-hold swallow can be considered an exercise that meets the principle of specificity. However, it was pointed out that the inability to manipulate the physiological load is a major drawback. Of this technique...In this study, the patterns/forms of pressure waves became irregular as the load increased. It is speculated that because the maneuver disturbed the anchoring function of the anterior tongue, the tongue could not move freely and lost its regular movement pattern...Subsequently, irregular production of pressure, such as multiple peaks and asymmetrical wave formations, was seen.” Fujiu-Kurachi 2014
“Caution must be taken when clinically using the maneuver for the following reasons... three negative findings were noted. These include:

• increased pharyngeal residue, particularly in the valleculae
• shortened duration of airway closure
• increased pharyngeal delay time in triggering the pharyngeal swallow.

Since these negative findings can increase... aspiration, the maneuver should not be used as a facilitating technique for safe food/liquid intake.”

Fujiu-Kurachi 2002
SHAKER

Systematic Review

• Nine studies were included in the review

• Reported Effects:
  
  • increase in the anterior excursion of the larynx
  • increase in diameter of the upper esophageal sphincter opening
  • elimination of dysphagic symptoms

Antunes 2012
CHIN TUCK AGAINST RESISTANCE (CTAR)/MODIFIED SHAKER

- Improved superior-anterior movement of the hyoid bone through increasing strength of the suprahyoid muscles

- Improve UES opening

- Research suggests that CTAR activates muscles to a greater degree

Yoon 2004
ELECTRICAL STIMULATION
ELECTRICAL STIMULATION META-ANALYSIS

• Two researchers independently performed data extraction

• 81 studies reviewed but only 7 met criteria
  • Methodology
  • Quantitative Analysis
  • Publication Bias

• Carnaby-Mann 2007
“The reaction to VitalStim was from clinicians eager to offer a uniform treatment procedure to their oropharyngeal dysphagic patients without the need for careful assessment of the patient’s swallow physiology to define the specific swallow problems from which the patient was suffering. VitalStim gave some clinicians an “easy out” from understanding each patient’s underlying swallow physiology, if they so desired. Unfortunately, this led to a large market for VitalStim among clinicians and desperate patients willing to ‘try anything’ whether or not it had a firm scientific base and known efficacy.”
Eighty-eight patients were randomized over three treatment groups.

- Traditional therapy
- Treatment combined with NMES at sensory level
- Treatment combined with NMES at motor level

All groups showed significant therapy effects. However, only slight non-significant differences between groups were found.
“In conclusion, this preliminary meta-analysis examining the effectiveness of NMES has shown a small statistically significant improvement in clinical swallowing performance for adult dysphagic patients receiving this form of treatment.”
Twenty post-stroke dysphagic patients were randomly divided into two groups: those who underwent effortful swallow with infrahyoid motor electrical stimulation (experimental group, n = 10) and effortful swallow with infrahyoid sensory electrical stimulation (control group, n = 10).

In the motor level group, the maximal vertical displacement of the larynx was increased significantly after the intervention.

Conclusion

Effortful swallow combined with surface electrical stimulation as a form of resistance training increased the extent of laryngeal excursion in post-stroke patients with dysphagia.
A systematic review reveals that surface NMES to the neck has been most extensively studied with promising findings, yet high-quality controlled trials are needed to provide evidence of efficacy.
SURFACE ELECTRICAL STIMULATION PERTURBATION CONTEXT DETERMINES THE PRESENCE OF ERROR REDUCTION IN SWALLOWING HYOLARYNGEAL KINEMATICS HUMBERT 2015

• Peak hyolaryngeal elevation was perturbed during swallowing in 16 healthy adults with surface electrical stimulation in 2 different ways during videofluoroscopy: intermittent was applied only during swallowing, and continuous was applied during swallowing and during inter-swallow intervals.

• Although peak hyoid elevation was significantly lower at the start of the perturbation phase, LVC timing was maintained in these healthy adults.

• Gradual return to baseline was significantly different between the two groups across the 20 trials for hyoid and laryngeal elevation.

• Estimates of fixed effects showed that peak elevation gradually increased in the continuous group for both the hyoid and the larynx.

• Importantly, no trend toward baseline levels was observed within the intermittent condition.
“We conclude that feed-forward control in error based learning of swallowing hyolaryngeal elevation can be modified depending on the perturbation experience. Similar to adaptation in other behaviors, hyolaryngeal adaptation movements during swallowing were context specific.”
ELECTRICAL STIMULATION AT A SENSORY LEVEL

• NMES that targets either sensory input or motor muscle coupled with traditional therapy is conducive to recovery from dysphagia and improves quality of life for dysphagic patients with medullary infarction.

• Sensory approach appears to be better than motor approach.

Shou-Wei Yue 2015
ELECTRICAL STIMULATION

“We need to improve our understanding of the effects of e-stim in specific types of disorders and specific levels of severity before we can widely apply the treatment to the general dysphagic population.”

Humbert 2012
EXPIRATORY MUSCLE STRENGTH TRAINING (EMST)
60 participants with PD completed EMST 4 weeks, 5 times per week using a calibrated or sham device

The EMST group demonstrated improved swallow safety as evidenced by improved Penetration-Aspiration Scores.

The EMST group demonstrated improved hyolaryngeal function.

The EMST group displayed improved airway closure
71 year old male with spinal onset ALS was provided with expiratory muscle strength training.

- Maximum expiratory pressure declined 9% over an 8-week sham training period.
- Expiratory pressure improved 102% following 8 weeks of actual training.
- Improvements in maximum expiratory pressures were maintained for 6 months following training.
25 ALS patients participated.

Patients completed a 5 week EMST protocol.

There were significant improvements in maximum expiratory pressures.

Maximum hyoid displacement during swallowing occurred.

No significant differences were observed for PAS or cough spirometer measures.
EMST

• EMST provides improvement in force generating capacity of respiratory muscles

• This improvement translates into an improvement in cough effectiveness in sedentary elderly

Kim 2009
DIRECT SWALLOW INTERVENTIONS
TYPICAL SWALLOW

- Good quality, high repetition typical swallows influence motor learning
- The average person swallows up to 2000 times per day about once every 1.3 minutes.
- The repetition of a dysfunctional swallow does not improve swallowing ability.
TYPICAL SWALLOW

• sEmg can provide feedback concerning the quality of typical swallows.

• sEmg/biofeedback can influence the following swallow behaviors:
  • Pre-swallowing time
  • Duration
  • Increase proprioceptive awareness
TYPICAL SWALLOW

- sEMG can provide feedback concerning the quality of typical swallows.
- sEMG/biofeedback can influence the following swallow behaviors:
  - Pre-swallowing time
  - Duration
  - Increase proprioceptive awareness
EFFORTFUL SWALLOW
Sixty-four healthy men and women between 45 and 93 years of age from the community participated.

Participants swallowed 3-mL thin liquid boluses both normally and using the effortful swallow strategy.

The biomechanics and bolus flow patterns of swallows were analyzed from videofluoroscopic and simultaneous oral pressure data.

Subjects at all ages generated significantly increased oral pressures using the effortful swallow.
Several durational measures were significantly longer with the effortful swallow including:

- Hyoid maximum anterior excursion
- Laryngeal vestibule closure
- Duration of the upper esophageal sphincter opening
- The hyoid bone moved further in the superior direction with the effortful swallow.
- There was a trend of decreased oral residue with the effortful swallow.
Timing of pharyngeal and upper esophageal sphincter pressures as a function of normal and effortful swallowing in young healthy adults

- Eighteen adults, nine males and nine females
- Timing of pharyngeal pressure and onset and duration of UES relaxation were measured across ten trials of normal and ten trials of effortful swallows
- The effortful swallow elicited longer pharyngeal pressure and UES relaxation durations
THE EFFECT OF AN EFFORTFUL SWALLOW ON THE NORMAL ADULT ESOPHAGUS
Lever 2007

• The effect of an effortful swallow on the healthy adult esophagus was investigated using concurrent oral and esophageal manometry on ten normal adults while swallowing 5-ml boluses of water

• Effortful swallowing resulted in significantly increased peristaltic amplitudes within the distal smooth muscle region of the esophagus, without affecting the more proximal regions containing striated muscle fibers

• The results of this study hold tremendous clinical potential for esophageal disorders that result in abnormally low peristaltic pressures in the distal esophageal body, such as achalasia, scleroderma, and ineffective esophageal motility
The effects of swallow condition (effortful vs non-effortful), were examined for 18 adults via combined solid-state manometry and intraluminal impedance

The effortful swallow condition yielded significantly higher esophageal amplitudes across all sensor locations

Further, the effortful swallowing decreased the risk of incomplete bolus clearance when compared with non-effortful swallowing

The effortful swallow offers a behavioral manipulation of the esophageal phase of swallowing, and future studies will determine its clinical potential for treating esophageal dysmotility in patient populations
Fourteen normal subjects swallowed multiple, 5-ml water boluses using three techniques: normal swallow, effortful swallow, and the Mendelsohn maneuver.

- Effortful swallow increased maximum velopharyngeal pressure.
- Increased minimum UES pressure.
The novel aspect of the present study of the effortful swallow is that measurements were taken at the posterior circumferential parts by having five point sensors and then compared.

In the effortful swallow, both the magnitude and the integrated value of tongue pressure were significantly.

It appears that tongue pressure increases in a widespread area on the hard palate in the effortful swallow because tongue movement is anchored and accentuated at the anterior part of the hard palate during swallowing.
EFFORTFUL SWALLOW

Effortful swallows impact:

• Increases tongue to palate contact
• Improved hyolaryngeal elevation
• Hyolaryngeal anterior excursion
• Increase tongue contact with pharyngeal wall
  • May contribute to increasing pharyngeal pressure and driving force, which propel a bolus from oral cavity into the pharynx (Fukuoka 2013)
• Increased/prolonged pharyngeal pressure
• Increased duration of UES opening
• Increase Velopharyngeal pressure
• Increased esophageal peristalsis
Effortful Swallow
EFFORTFUL SWALLOW

• Huckabee (2006) reported that tongue-to-palate emphasis during execution of the effortful swallow increased submental activation, oro-lingual pressure, and upper pharyngeal pressure to a greater degree than a strategy of inhibiting tongue to palate emphasis.
MENDELSOHN MANEUVER

Logemann 1999 instructions for performing a Mendelsohn Maneuver

*Place the fingers of one hand over the front of your neck. When you swallow, you will feel your Adam’s Apple go up and down. When I tell you to swallow, I want you to hold your Adam’s Apple up for a few seconds, squeezing with your throat and neck muscles and not letting go.*
The Mendelsohn maneuver was intended to volitionally augment UES opening by prolonging elevation of the larynx for an extended period of time during the swallow.

Mendelsohn 1989
The purpose of this study was to determine whether any lasting physiologic changes in swallowing function can occur from utilizing the Mendelsohn maneuver as an exercise.

18 participants with dysphagia post-stroke evaluated with videofluoroscopy after treatment using the Mendelsohn maneuver versus no treatment.

Participants performed Mendelsohn maneuvers between 30 and 40 times in therapy sessions but did not use it when swallowing during VFSS examinations or when eating at home.

Physiologic changes in the extent of hyoid movement during the swallow and concurrent opening of the UES occurred.
EFFECTS OF MANEUVERS ON SWALLOWING FUNCTION IN A DYSPHAGIC ORAL CANCER PATIENT LAZARUS 1993

• Studied various maneuvers
• The Mendelsohn maneuver improved coordination and timing of pharyngeal swallow events
  • Timing of posterior movement of the tongue base to the pharyngeal wall in relation to airway closure and cricopharyngeal opening
  • Elimination of aspiration
• The Mendelsohn maneuver compensated for anatomic and physiologic changes in the oropharyngeal swallow and enabled reinstatement of safe oral intake in this surgically treated head and neck cancer patient who was previously unable to take nutrition orally
Fourteen normal subjects swallowed multiple, 5-ml water boluses using three techniques: normal swallow, effortful swallow, and the Mendelsohn maneuver.

- Duration of velopharyngeal pressure above baseline increased significantly.
- UES pressure duration was prolonged by the Mendelsohn maneuver.
- An increase in tongue base pressure duration occurred with the Mendelsohn maneuver, but this increase was not statistically significant.
MENDELSON MANEUVER

Research suggests that because of the sustained muscle contractions, the Mendelsohn Maneuver may result in greater cortical stimulation. McCullough 2013

• Benefits of the Mendelsohn Maneuver

  • Increased hyolaryngeal excursion
  • Increased hyolaryngeal elevation
  • Increased duration of UES opening
  • Increased timing and coordination
SKILL BASED THERAPY
HISTORICAL PERSPECTIVE

• Historical approaches to swallowing rehabilitation have lacked specificity

• Approaches have persisted with a strong bias toward a presumption of weakness and consequent strengthening tasks.

• Speech pathologists...should know from other areas within our domain, that this is unlikely to be the case.

Huckabee 2015
HISTORICAL PERSPECTIVE

• The bias toward strengthening as may be encouraged by our understanding of swallowing neural control and modulation.

• Unlike motor speech impairment, where motor plans are generated at cortical levels, the primitive swallowing motor plan is generated at subcortical levels.

• Swallowing produces a reasonably well-explored sequence of motor events that are generally considered to be fairly invariant

Jean 2001
Miller 2008
SKILLED BASED TRAINING

• Strengthening approaches appear to be predicated on an assumption of weakness underlying swallowing impairment,

• It could be argued that skill-based training is predicated on an assumption of impaired motor planning and execution.
SKILL BASED TRAINING

Skill-based training can be defined at a basic level as the acquisition of skill through functional repetition and refinement of movement patterns.
SKILL BASED TRAINING

Three key ingredients for successful skill acquisition include:

• specificity of practice
• task challenge
• feedback.
SKILL BASED TRAINING

The specificity of practice hypothesis proposes that specific motor skills are developed and stored through practice, and that these motor skills do not generalize across tasks. Therefore, it is important that skill-based training involves exercise that replicates the desired task.

Barnett 1973
SKILL BASED TRAINING

• Skill-training has been documented to influence strength gains to a greater extent than strength-training alone, despite training at submaximal levels of muscle contraction.

• This phenomenon has been attributed to improved movement coordination and neural adaptations due to proprioceptive facilitation in skill-based training.

Liu-Ambrose 2003
SKILL BASED TRAINING

- Repetition of motor activity alone is not thought to result in functional recovery, particularly in the context of rehabilitation where impaired motor performance is the baseline.

- A key component of skill-based training is that of task challenge. Encouraging a dysphagic patient to “practice” a dysphagic swallow with no adaptation to this task is unlikely to produce a desired effect.
SKILL BASED TRAINING

Skill training involves the introduction of a challenge component, requiring an individual to problem-solve the movement each time it is practiced rather than memorizing and replaying the sequences of muscle/joint contractions.

Krakauer, 2006
These novel challenges activate different brain circuits to those that control previously acquired movements, inducing neural and behavioral changes associated with learning.

Functional cortical reorganization occurs when there is motor-learning rather than motor repetition.

Plautz 2000
SKILL BASED TRAINING

• Practicing impaired swallowing through ingestion of a safely tolerated diet may facilitate pulmonary safety, but have no therapeutic benefits.

• Systematically challenging the system in a controlled therapeutic environment may facilitate recovery.
SKILLED BASED TRAINING

• Findings of a skilled based training program suggest that skill training may have increased the neuromuscular coordination, timing, speed of reaction, and planning of movement of orolingual structures.

• Additionally, heightened cortical awareness may have contributed to better movement planning and sequencing, resulting in an increased rate of swallowing.
SKILL BASED TRAINING

• The final key element in motor learning is feedback regarding task performance.

• Swallowing produces no clear external movement patterns, and in the case of patients with neurological impairment, intrinsic feedback systems are more likely to be impaired, and learning through repetition is thus less likely to occur.

• Additional information provided by augmented feedback provides a necessary component for conveying cues regarding movement accuracy and improving performance of swallowing strategies.

Rose 2006; Schmidt 1999
SKILL BASED TRAINING

• A common tool for training rehabilitation strategies in dysphagia management involves the use of surface electromyography (sEMG). sEMG offers a non-invasive method of biofeedback.

• Historically sEMG biofeedback has been used to facilitate mastery of effortful-type swallowing maneuvers.

• Recent research suggests great benefit of this modality for increasing skill and precision of movement using a targeted, skill-based rehabilitation protocol.
“For motor disorders (e.g., PD), providing external feedback may activate the parietal-premotor network by bypassing the basal ganglia and facilitating movement control. Similar improvements have been reported in gait speed and step length in patients with PD when external visual and auditory cues were provided as a result of bypassing the defective basal ganglia and using the frontal cortex to consciously control movement.”

Huckabee 2015
SKILL TRAINING FOR SWALLOWING REHABILITATION IN PATIENTS WITH PARKINSON’S DISEASE

Athukorala 2014

• Patients underwent 10 daily sessions of skill training therapy focused on increasing precision in muscle contraction during swallowing using visual feedback.
• Main Outcome Measures: Data from the timed water swallow test, Test of Mastication and Swallowing Solids, surface electromyography of submental muscles, and swallowing-related quality of life questionnaire were collected at 2 baseline sessions (conducted 2wk apart) at the end of treatment and after 2 non treatment weeks to assess skill retention.
SKILL TRAINING FOR SWALLOWING REHABILITATION IN PATIENTS WITH PARKINSON’S DISEASE

• Results: Immediately after post treatment, the swallowing rate for liquids, sEMG durational parameters of premotor time, and pre-swallow time improved. A functional carryover effect was seen from dry to water swallows. Swallowing related quality of life improved.
• Reassessment at 2 weeks after treatment termination revealed short-term retention of treatment effects.
• Conclusions: A skill-based training approach produced functional, biomechanical, and swallowing-related quality of life improvements in this cohort indicating compelling evidence for the effectiveness of this novel approach for dysphagia rehabilitation in PD.
MOTOR LEARNING PRINCIPLES IN SWALLOWING THERAPY
Learning occurs on a continuum

Implicit: What is learned is basically unknown

Explicit: What is learned is basically known
IMPLICIT LEARNING

• A feed–forward mechanism enables planning a future movement even before the movement starts
• Movements can be influenced in the presence of a perturbation
Human Hyolaryngeal Movements Show Adaptive Motor Learning During Swallowing
HUMBERT 2013

- Adaptive motor learning was investigated in nine healthy adults
- Electrical stimulation was put on the anterior neck to reduce hyolaryngeal elevation
- This required more strength to swallow during the perturbation period
- Peak laryngeal movements were measured using videofluoroscopy across 35-5 ml water swallows
Evidence of adaptive motor learning of hyolaryngeal movements was found.

- Participants showed systematic gradual increases in elevation against the force.
- Hyolaryngeal elevation overshot the baseline range of motion, showing behavioral aftereffects when the perturbation was unexpectedly removed.

Conclusion:
Healthy older adults implicitly reduce swallowing error in the presence of a perturbation.
EXPLICIT LEARNING

Practicing Mendelsohn Maneuvers increased hyolaryngeal elevation and duration of UES opening

Or is it something else?
MOTOR LEARNING

Adaptation allows for the nervous system to have highly flexible control that can account for temporary, predictable changes in the demands of the task. A finite number of learned motor patterns can be adapted to account for many different situations.

Bastian 2008
Swallowing has many different variables

<table>
<thead>
<tr>
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Taken from “Critical Thinking in Dysphagia Management” Humbert 2016
MOTOR LEARNING

- Compare abnormal and normal swallows
- Establish a baseline
- Track the same behavior over time
- If you can’t see it you probably cannot confirm what it is doing
TREATMENT CONSIDERATIONS
THE BOLUS AS A THERAPEUTIC TOOL
• Velopharyngeal duration, maximum tongue base pressure, tongue base pressure rise rate, UES opening duration, and total swallow duration varied significantly across bolus volume.

• Maximum velopharyngeal pressure and minimum UES pressure had a direct relationship with increase in bolus volume

• Maximum tongue base pressure had an decreased with bolus volume

• Velopharyngeal pressure duration, UES opening duration, and total swallow duration increased as bolus volume increased.
A volume effect was also found for upper pharyngeal pressure duration. One may expect that larger volumes would elicit longer pharyngeal pressure duration but ironically, the opposite phenomenon was observed. It is plausible that a larger bolus can capitalize on its weight, velocity, and gravity better than a 5-mL bolus. A 5-mL bolus is more dependent on driving pressure durations from above to maintain an efficient bolus transit through the pharynx.”
Increased bolus volume

• Increases UES opening duration
• Increases laryngeal closure duration
• Pharyngeal transit time interval
• Caused shorter temporal intervals between the closing of the laryngeal vestibule and opening of the UES
Earlier onset and increased duration of anterior and superior hyo-laryngeal movement.
- Increased laryngeal vestibule closure as bolus volume increases
- Bolus head is farther down the pharynx before UES opening
- Tongue base posterior motion occurs later relative to onset of UES opening
- Later epiglottic inversion with increased volume
- Earlier laryngeal vestibule closure in relation to UES opening, providing additional airway protection
• Bolus viscosity also induced an increase of tongue pulsive force and clearing pressure by the oral tongue.
• There was no force adaptation with increased bolus volume.
• The anterior two thirds of the tongue showed both greater forces and greater modulation than did the tongue base.
EFFECT OF BOLUS CONSISTENCY ON SWALLOWING – DOES ALTERING CONSISTENCY HELP? RAUT 2001

- Increased bolus viscosity led to increased amplitude of the bolus wave and clearing contraction within the pharynx.

- Bolus consistency influenced the coordination of the swallow response with delayed pharyngeal clearance.
The major effects of high bolus viscosity were
• To delay oral and pharyngeal bolus transit,
• Increase the duration of pharyngeal peristaltic waves,
• Prolong and increase UES opening
Increased muscle activity on EMG
- Increased peak force
- Increased palatal pressure
- Retro-lingual and Pharyngeal pulsive force increases with bolus viscosity
- Increased pharyngeal contraction amplitude
- Increased duration of pharyngeal contraction wave
- Total swallow duration increases
• Tasting salty or sweet substances, heightened facial nerve activation because branches of the facial nerve innervate the taste buds in the more anterior folds which are more sensitive to salty and sweet tastes

• The posterior part of tongue and the upper pharyngeal regions are innervated by the glossopharyngeal nerve, which is more sensitive to sour and bitter tastes

• Under sweet and sour taste conditions, the submental and infrahyoid muscle activation started significantly earlier than in the no-taste condition
EFFECTS OF A SOUR BOLUS ON OROPHARYNGEAL SWALLOWING MEASURES IN PATIENTS WITH NEUROGENIC DYSPHAGIA

Logemann 1995

- Subjects revealed significantly improved onset of the oral swallow in response to the sour bolus as compared to the non-sour bolus. The subjects who had suffered a
- Stroke patients exhibited improvements in the swallow as a result of the sour bolus, including:
  - reduced pharyngeal delay time,
  - reduced oral transit time
  - Reduced pharyngeal transit time
  - Reduced aspiration
- The subjects with neurogenic dysphagia other than CVA exhibited reduced aspiration
- Both groups exhibited increased “speed and efficiency”
effects of carbonated liquids on oropharyngeal swallowing measures in people with neurogenic dysphagia sdravou 2012

• we conclude that carbonated thin liquid shows promise in significantly reducing penetration and aspiration in people with CNS neurogenic dysphagia.
• It is theorized that chemesthetic stimuli such as carbonation excite peripheral sensory receptors and activate sensory fibers in the CPG
• Although in the present study CTL did not elicit a faster swallowing response, it did significantly decrease penetration
• and aspiration compared to non carbonated thin liquid
EFFECT OF TEMPERATURE ON ELECTROPHYSIOLOGICAL PARAMETERS OF SWALLOWING SELÇUK, 2007

- The time for triggering of the pharyngeal phase of swallowing was found to be shorter for cold and hot water than for normal temperature water.
- The duration of the pharyngeal phase of oropharyngeal swallowing was also shorter for cold and hot water than for normal temperature water.
- Bolus size capacity was significantly less for hot water relative to normal temperature water and cold water.
• The thicker bolus showed significantly longer oral and pharyngeal transit times and extended duration of pharyngeal peristaltic waves
• With thin liquids, the bolus reached the hypopharynx earlier and remained in the hypopharynx longer than with thick liquids
• The duration of laryngeal closure was significantly longer for liquids than for paste
PROGRESSION OF EXERCISE

- Think systematically
- Measure presentations
- Increasing bolus size challenges timing, triggering and coordination
- Increasing bolus viscosity/texture challenges strength
- Most patients with dysphagia demonstrate problems in both areas
- Sour/tart can speed up the swallow
- Carbonation may decrease penetration/aspiration
- Cold or hot can speed up the swallow
SURFACE ELECTROMYOGRAPHY
BIOFEEDBACK

- Biofeedback refers to the use of equipment to measure body functions that are not monitored consciously.
- These measurements are displayed as a signal that clients can learn to manipulate, allowing them to develop control over the corresponding body functions.
- Biofeedback has been widely used in physical therapy, psychiatry, and medical settings for management of functions such as hypertension, anxiety, pain, and incontinence.
- A familiar example to most speech-language pathologists is the use of a Visipitch to display vocal functions (e.g., pitch and intensity). Clients gain improved vocal control through vocal exercises guided by the Visipitch display.

Steele 2004
Surface ElectroMyOGraphy (sEMG) is a non-invasive technique for measuring muscle electrical activity that occurs during muscle contraction and relaxation cycles.
sEMG

• sEMG provides information regarding the amount of muscle activity during a task.

• sEMG biofeedback can help patients:
  - Learn new or unfamiliar motor tasks (i.e. Effortful Swallow)
  - Gain voluntary control of physiologic processes
  - Increase or decrease muscle activity
  - Improve coordination
sEMG Research
sEMG RESEARCH

• Huckabee 1999

• Chronic Brainstem Stroke
  • Average of 26.9 months post-stroke
  • N=10
  • 10 one hour sessions and required home practice

• Outcomes:
  • 9 out of 10 patients showed positive changes as demonstrated by videofluoroscopy swallow studies
  • 8 of 10 were able to discontinue PEG tube feedings and return to an oral diet
  • One year post intervention 6 of 10 maintained an oral diet
• Crary 2004
• Brainstem strokes and Head and Neck Cancer
  • Stroke s/p 25 months
    • Average of 12.3 treatments
  • CA in remission 17 months
    • Averaged 9.3 treatments
• Treatments provided “daily”
• 87% of subjects improved safe oral intake per the Functional Oral Intake Scale:
  • Stroke Group average improvement 3.0 levels
  • Cancer Group average improvement 1.6 levels
• Pre-study, 32/45 required tube feeding
• Post-study, 18/45 of subjects required tube feeding
sEMG DYSPHAGIA RESEARCH

Conclusion:

Surface EMG biofeedback plays an important role in the cost-effective rehabilitation of people with chronic dysphagia by improving swallowing abilities and enabling less restrictive diets.
sEMG & DYSPHAGIA RESEARCH

- sEMG-guided treatments may generate clinical benefits:
  - Reduce aberrant movement patterns
    - Tongue pumping/rocking
    - Re-swallows
  - Improve pharyngeal response time
  - Increase hyolaryngeal elevation/excursion
  - Influence swallow duration
  - Improve proprioception
CONCLUSION
DETERMINING CLINICAL APPROPRIATENESS OF INTERVENTION

- What are my patient’s wishes?
- What physiological Deficits that need to be rehabilitated?
- What are the research based interventions?
- Do I have a strong rationale?
Suggestions for Critical Evaluation of an Approach

• Where did you hear about it? Most responsible researchers will willingly offer their work for peer review and critique as a necessary step in working toward acceptance. Thus, research that eventually makes it to press has a much higher chance of presenting unbiased and well-substantiated information.

• Critically evaluate even what you read in journals with a keen eye on methodology, underlying theoretical support, and evaluative measures.

• Search the literature for replications of the research that supports the technique.

• Consider the professional and personal implications of utilization of the technique as being equally important as the possible implications for patient care.

• Recall your responsibility to the ASHA *Code of Ethics* under which we all practice.

  Huckabee 1997
Q and A
“Never believe that a few caring people can’t change the world. For, indeed, that is all who ever have.”

-Margaret Meade