DYSPHAGIA OUTCOME MEASURES: ADVANCING PRACTICE

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NEED FOR STANDARDIZATION AND PROTOCOLS

Variability in Clinical Practice (Carnaby & Harenberg, 2013)
Most respondents use self-developed assessment techniques versus research supported EBP
-47 different treatments prescribed for single case

Having precise measurement and common practices in our evaluation and treatment: Demonstrate Effectiveness

PROTOCOLS COMPARED (INSTITUTION, BOLUS CHARACTERISTICS, MINIMAL # OF SWALLOWS)

<table>
<thead>
<tr>
<th>Institution</th>
<th>Bolus Characteristics</th>
<th>Minimal # of Swallows</th>
</tr>
</thead>
<tbody>
<tr>
<td>RIC</td>
<td>3mL thin</td>
<td>12</td>
</tr>
<tr>
<td>Lazarus Beth Isra</td>
<td>5mL thin</td>
<td>20</td>
</tr>
<tr>
<td>Martin-Harris MUSC</td>
<td>Single Sip</td>
<td>30</td>
</tr>
<tr>
<td>Daniels U of Houston</td>
<td>Nectar</td>
<td>50</td>
</tr>
<tr>
<td>Leder &amp; Suiter Yale &amp; VA</td>
<td>AP 5mL Nectar</td>
<td>20</td>
</tr>
<tr>
<td>Logemann NMH</td>
<td>3mL thin</td>
<td>10</td>
</tr>
<tr>
<td>Lazarus Beth Isra</td>
<td>1,3,5,10ml thin</td>
<td>10</td>
</tr>
<tr>
<td>Martin-Harris MUSC</td>
<td>3cc pudding</td>
<td>10</td>
</tr>
<tr>
<td>Daniels U of Houston</td>
<td>½ Cookie</td>
<td>10</td>
</tr>
<tr>
<td>Leder &amp; Suiter Yale &amp; VA</td>
<td>AP 5mL Nectar</td>
<td>20</td>
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ICCD 2014
**Dysphagia Outcome Measures:**
**Advancing Practice**

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<th>Minimal # of Swallows</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langmore, 2004</td>
<td>2 trials of bolus</td>
<td>2 trials of bolus</td>
</tr>
<tr>
<td>University of Iowa</td>
<td>5, 10, 15 cc/5 cc</td>
<td>5, 10, 15 cc/5 cc</td>
</tr>
<tr>
<td>Singapore Lim et al., 2001</td>
<td>Puree</td>
<td>3-6 sips of Puree, Honey, Jello</td>
</tr>
<tr>
<td>Leder &amp; Suiter Yale &amp; VA, 2011</td>
<td>Hedgehog protocol with slight deviation</td>
<td>3+ trials of 5mL</td>
</tr>
<tr>
<td>Leder &amp; Suiter Yale &amp; VA, 2013</td>
<td>Hedgehog protocol with slight variation</td>
<td>Approx. 5mL to 10mL volumes</td>
</tr>
</tbody>
</table>

**PROTOCOLS DO NOT INCREASE EXPOSURE TIME**

- **295 VFSS (Kim et al., 2012)**
  - 133 CNS lesion, 87 HNC, 37 Cardio/Pulm Disease and 15 Pediatric
  - Adults: Ave time 3.37 minutes +/- 1.32
  - Pediatrics: Ave time 2.42 +/- 1 min
  - CVA longer than HNC
- **739 VFSS (Bonilha et al., 2013)**
  - Ave time 2.9 minutes
  - Time not associated with dx
  - Oral and pharyngeal deficit associated with increased fluoro time
  - Standard protocol does not lead to longer rad time
- **Using time wisely: Cost/Benefit**

**COMPENSATORY STRATEGIES TRIALED ONLINE (WHEELER-HEGLAND, 2009)**

<table>
<thead>
<tr>
<th>Strategy</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chin Down</td>
<td>For: Delayed Swallow, Reduced Airway Closure, Reduce BOT movement. Decreases the angle between the mandible and the PPW, the angle between the epiglottis and the anterior wall of the trachea, the distance from the epiglottis to the PPW, and the width of the airway entrance.</td>
</tr>
<tr>
<td>Head back</td>
<td>For: Delayed Oral Transit</td>
</tr>
<tr>
<td>Head Turn</td>
<td>For: Unilateral pharyngeal/laryngeal weakness or CP dysfunction</td>
</tr>
<tr>
<td>Increased Sensory Input</td>
<td>For: Delayed Oral or Pharyngeal Initiation or swallowing apraxia</td>
</tr>
<tr>
<td>Effortful Swallow</td>
<td>For: Reduced tongue base retraction, poor pharyngeal stripping wave. Influence on pressures/timings variable</td>
</tr>
<tr>
<td>Supraglottic</td>
<td>For: Reduced closure of laryngeal entrance. Increased excursion for the larynx and the width of UES opening, early closure</td>
</tr>
<tr>
<td>Super Supraglottic</td>
<td>For: Reduced hyolaryngeal movement and CP opening. Largest effect on peak pharyngeal contraction duration, modest effect on laryngeal elevation</td>
</tr>
</tbody>
</table>
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ADMINISTRATION OF BOLUS

- **Cue provided** e.g., "Swallow Now" (Nagy et al., 2013; Daniels et al., 2007)
  - Cue to determine delay in oral initiation
  - No Cue: natural, reduced cortical upregulation
  - swallow onset patterns and timing differs between cued and uncued conditions
  - Need to assess both conditions during evaluations to be sure we are not missing something (Coyle, SIG Discussion)

- **Bolus Given by Clinician or Self-fed?**
  - Given: lack of control, anticipation
  - Self-fed: naturalistic, pre-swallow behaviors influence swallowing biomechanics

- **Replicable**: Report procedures to enhance consistency

MEASURES FROM INSTRUMENTAL EXAMINATIONS

<table>
<thead>
<tr>
<th>Past</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aspiration: Binary (yes/no)</td>
<td>Amount of Aspiration/Residue (Estimated or Calculated)</td>
</tr>
<tr>
<td>Aspiration: Before, During or After Swallow</td>
<td>PAS scale (includes response and presence of residue, lacks temporal and mechanical measures)</td>
</tr>
<tr>
<td>Residue: yes/no (location)</td>
<td>Observation of Physiology</td>
</tr>
<tr>
<td></td>
<td>Temporal Measures:</td>
</tr>
<tr>
<td></td>
<td>Pharyngeal Delay</td>
</tr>
<tr>
<td></td>
<td>Total Pharyngeal Transit</td>
</tr>
<tr>
<td></td>
<td>Mechanical Measures</td>
</tr>
<tr>
<td></td>
<td>Trialed Compensatory Strategies</td>
</tr>
<tr>
<td>Disordered yes/no (Diagnostic Level 1)</td>
<td>Cause (Level 2)</td>
</tr>
<tr>
<td></td>
<td>Intervention Effectiveness (Level 3)</td>
</tr>
</tbody>
</table>

Estimated Percent of Bolus

- **Ordinal Scales**: challenges/unacceptable reliability
  - Kuhlemeyer et al., 1998; Stoeckli et al., 2003; McCullough et al., 2001

- **When**: After first swallow when hyoid bone returns to rest
  - Eisenhuber et al., 2002; Rademaker, 1994

- **Estimated Percent of Bolus**
  - Pauluski et al., 2002; Rademaker, 1994
  - Modest correlation with experienced raters ($r = .60 - .61$)

- **Raw Area** (2-Dimensional Measurement) (mm$^2$)
  - Penny on mastoid
  - Image-J

- **Normalized Residue Ration Scale** (Pearson et al., 2012)
  - (2-Dimensional Measurement) = $\frac{(A1/(A1+A2)^2)}{(A1/N)^2 \times 10}$
  - Marker Image-J

PERCENT OF BOLUS ESTIMATED/MEASURED

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**IMAGE J MEASUREMENT OF RESIDUE OR ASPIRATION**

[Image J Measurement of Residue or Aspiration]

http://imagej.nih.gov/ij/download.html

**PENETRATION ASPIRATION SCALE (PAS)**

- Not established as interval – not equal distances
- Some judges believe any material expelled is better than no matter initial depth than material with remaining residue
- Single Summary Score:
  - Mean score is misleading
  - Majority of manuscripts: Using worst swallow
  - DRS Recommended: Range of performance and Median Score
  - MD Anderson (median score) and # of trials
- Thin liquid 3cc – PAS 1-3 normal in healthy subjects (Robbins et al., 1999)
- Aspiration is not a normal finding. Penetration is present in 11.4 percent of normal adults and is more common with a liquid bolus > 30 cc (Allen et al., 2009)
- After 50: penetration of liquid and pudding (Daggett et al., 2006)
- Variability between the 1st & 2nd swallow greater than normals in pathology (Robbins et al., 1999)

Example Excel Sheet

**OBJECTIVE MEASURES OF TIMING**

- Pharyngeal onset/delay (Logemann, 1994)
- Total pharyngeal time (Leonard, 2012)
- Temporal Measures (duration of UES opening and laryngeal closure) influenced by bolus volume: not participant height or sex (McFerrin & Stea on, 2013)

Excel Sheet

Example of Taking these Measurements
**CLINICAL MEASURES: SIP SIZE, MASA, FOIS IOPI, AND PRO MEASURES**

- **Use of Scale in Clinical Assessment** – are unregulated sips similar to those from VFSS?
  - Has the participant learned to take small sips independently per recs?
- **MASA** – Are your treatments targeting the worse score?
- **Functional Oral Intake Scale (FOIS)** (Cream et al., 2005)

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>NPO</td>
</tr>
<tr>
<td>2</td>
<td>Tube Dependent, Minimal PO attempts</td>
</tr>
<tr>
<td>3</td>
<td>Tube Dependent, Consistent PO attempts</td>
</tr>
<tr>
<td>4</td>
<td>Total Oral Diet: Single Consistency</td>
</tr>
<tr>
<td>5</td>
<td>Total Oral Diet: Multiple Consistencies, Special Preparation or Compensations</td>
</tr>
<tr>
<td>6</td>
<td>Total Oral Diet: Multiple Consistencies, Specific Food Limitations</td>
</tr>
<tr>
<td>7</td>
<td>Total Oral Diet: No Restrictions</td>
</tr>
</tbody>
</table>

- **PRO MEASURES**

  - **Patient Reported Outcomes:**
    - **SWAL-QOL**
      - Score individual domains
      - Total score = \( \frac{x}{100} \)
    - **EAT-10**
      - Associated with PAS scores in ALS non dementia \( r = .55, p = .001 \)
      - Brief
    - **Sydney Swallow Questionnaire**
      - Question #17 has been suggested to strongly predict swallowing impairment in disordered populations.

- **TONGUE STRENGTH AND SWALLOWING PRESSURE: IS LINGUAL WEAKNESS OR FATIGUE A FACTOR?**

  - **Anterior Placement**
  - **Posterior Placement**
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IOPI TASKS

- Maximum Isometric Pressure (MIPA or MIPP)
  - Greatest Pressure Across 3 trials (Gingrich et al., 2011)
  - Up to 9 trials (MOST/SwallowStrong)
- Lingual-Palatal Swallowing Pressure (LSPA or LSPP)
  - Average pressure Across 3 trials
  - Saliva or 10 mL boluses given by syringe
- Percentage of Maximum Tongue Pressure (PMTPA or PMTPP) (Gingrich et al., 2011)
  - Amount of strength used during swallowing: Functional Reserve
  - Range for healthy adults 18 to 94 years old (30%-50%) for thin, nectar-thick, honey-thick, and puree 10mL bolus

ASSESSMENT: FUNCTIONAL RESERVE

TONGUE STRENGTH NORMS

- IOPI
  - Luschei (IOPI Manual) < 40kPa weakness (anterior tongue only)
  - Gingrich et al., 2011 (IOPI) healthy adults:
    - Young (Anterior and Posterior Tongue)
    - Older (Anterior and Posterior Tongue)
- MOST/SwallowStrong Device (hPa)
  - Robbins – establishing range of normal performance for tongue bulbs
  - Anterior tongue (Type IIA fibers--fast pressure) – selective to sarcopenia
  - Posterior Tongue (Type I--fatigue resistant)
EXERCISE-BASED TREATMENT

- Exercise Physiological Principles such as intensity, specificity, and resistive load (Carnaby-Mann et al., 2010; Crary et al., 2005, 2007; Yeates et al., 2008)

- Exercise efforts that do not force the neuromuscular system beyond the level of usual activity will not elicit adaptations (Polluck et al., 1998).

INTERVENTIONS IN RCTS (15 STUDIES; CARNABY & MADHAVAN, 2013)

- Average # of days in Treatment = 40.47 (SD 36) > 5 weeks
- Average # of Treatment Hours = 55.7 (SD 61)
- Ave # of session per day = 1.7 (range 1 to 3),
  - 1 study used alternated days
- Sessions ranged from 15 – 60 minutes; however, 15 – 45 mins was typical for protocols seen 2-3x daily for prophylactic exercise
- Vast majority are 30-60 mins/daily for 2 weeks for total of 10 sessions (Drulia & Ludlow, 2013)
- Tongue strength change is trending but not significant at 4 weeks therapy (12 to 16 sessions; Robbins et al., 2007; Pitts et al., 2014)

RECOMMENDATIONS FOR STRENGTH TRAINING BY THE AMERICAN COLLEGE OF SPORTS MEDICINE (1990)

- 30 reps
- 3x daily
- 3x week = 270 reps per week per lingual region

(Tongue Strength and Swallowing changes) 8 weeks = 2160 reps

- Divide by # of sessions
  - Example: OP 15 sessions = 2160/15 = 144 reps per session
  - IP (3 weeks, seen daily = 2160/3/7 = 102 reps per session)

Always considering rest and recovery (Clark et al., 2013)
Strength, speed, and power are specific targets (Clark et al., 2012)
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SETS:  
- Tongue Strength per lingual region:  
  - 3 sets of 10, 3x daily (Robbins)  
  - 2 sets of 25, 1x daily (Pitts)  
  - 10 sets of 5, 1x daily (Stierwalt)  
- Documentation of Protocol: Length and # of Sets

DOSAGE FOR SWALLOW-SPECIFIC IOPI EXERCISES  
- Healthy adults, CVA, TBI, and PD populations  
- 90 to 360 lingual presses per day  
- 6 to 40 saliva or bolus swallows per training session  
- The treatment schedules vary between 3 and 5 days/week  
- Approximately 2 to 24 weeks  
- Exercises  
  - Saliva swallows,  
  - Effortful swallows  
  - Pressure targets  
(Pitts et al., 2014; Robbins et al. 2005, 2007; Steele et al., 2008)

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