Clinical Methods for Evaluating Dysphagia

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What is DYSPHAGIA?
• Difficulty with eating that includes any of the following:
  – Sucking (primarily pertains to pediatric pops)
  – Chewing food
  – Swallowing liquids or solids
  – Coughing or choking when eating
  – Food sticking in the throat or chest

Taken from ASHA/Special Interest Group 13 member slideshow information, 2005

How big of a problem is dysphagia?
• >6.6 Billion people in the world are affected
• More than 15 million individuals in the United States have dysphagia
  – ~1 million more people per year newly diagnosed
• ~60,000 people die each year in the US from complications related to swallowing problems

Complications of Dysphagia
• Pneumonia
  – Aspiration is the most common cause of death after stroke
• Malnutrition
• Dehydration

Evaluation of Individuals with Dysphagia is multi-disciplinary
• SLP
• Physician(s)
• Nursing
• Dietitian
• Occupational therapist
• Physical therapist
• Pharmacist
• Radiologist
• Social Worker
• (Caregivers)

Dysphagia is a SYMPTOM

Adults
• Head & neck cancer
• Cerebral palsy
• Stroke
• Head Injury
• Parkinson’s Disease
• Multiple Sclerosis
• ALS
• Spinal cord injury
• Cancer
• Dementia

Pediatrics
• Prematurity/Low birth weight
• Nervous system disorders (CP, meningitis)
• Genetic syndromes
• Gastrointestinal conditions
• Cardiothoracic abnormalities
• Cleft lip and palate
• Pulmonary abnormalities
• Brain tumors

Taken from ASHA/Special Interest Group 13 member slideshow information, 2005
Signs of Dysphagia

- Patient complaints of swallowing difficulties
- Gurgly voice quality
- Coughing/choking before, during, or after a swallow
- Frequent coughing toward the end or immediately after a meal
- Recurring pneumonia or upper respiratory infections
- Difficulty in placing food in the mouth
- Inability controlling saliva or food in the mouth
- Fever within an hour after eating
- Weight loss when no other reason can be defined

How do I determine the best way to manage someone with dysphagia?

- Key to effective treatment is diagnostic precision requiring that the SLP:
  - Have the knowledge & skills about normal and abnormal swallowing (ASHA, 2003)
  - Undergo relevant training, mentoring, and clinical experience
    - “The only way to consistently perform at your potential is to ask: Am I better than I was yesterday?” Chris Matakas
  - Implement recommended systematic and standard evaluation methods by profession
    - see ASHA Family of Documents on feeding and swallowing

Diagnostic Precision

- Requires
  - KNOWLEDGE & SKILLS ABOUT SWALLOWING
    - STRUCTURES INVOLVED
    - NORMAL PHYSIOLOGY
  - PROBLEM-SOLVING ABILITY AND FLEXIBILITY
  - SYSTEMATIC CLINICAL APPROACH
    - Clinical (Bedside)
    - Imaging
    - Supplemental Tools

Phases of Deglutition

Oral prep Oral transit Pharyngeal Esophageal

Oral Stage (Prep and Transit)

1. Food/liquid is placed into the oral cavity
2. Food/liquid is maintained within the oral cavity without falling into the sulci
3. Food is manipulated by the tongue and mixed with saliva while the base of tongue forms a seal posteriorly against the soft palate
4. Mastication occurs making use of dentition and complex jaw/tongue movement
5. A bolus is formed and positioned for transport into the pharynx

Pharyngeal Stage Events

- Transit of bolus through the pharynx
  1. Closure of the velopharyngeal port
  2. Pharyngeal shortening and expansion ahead of the bolus
  3. Constriction of pharynx behind the bolus
  4. Closure and anterio-superior movement of the airway
  5. Relaxation and opening of the upper esophageal sphincter
Esophageal Stage

- The bolus passes through the upper esophageal sphincter (UES)
- Sequential esophageal muscular action propels the bolus through and into the stomach

Evaluation of Dysphagia

- Clinical Evaluation of Swallowing
  - Screening
  - “Bedside”, or Clinical Assessment
- Imaging Studies
  - Endoscopic Evaluation of Swallowing (FEES)
  - Videofluoroscopic Evaluation of Swallowing (VFE)
- Supplementary Tools
  - Oropharyngeal manometry
  - Surface EMG

Clinical Evaluation Goals:

- First step toward providing critical information for dysphagia diagnostic and therapeutic purposes
- Thoroughly examines motor and sensory aspects of oral mechanism
- Formulates hypotheses about signs & symptoms and underlying swallowing physiology

Clinical Evaluation of Swallowing

- Allows examiner to determine:
  - The need, or best timing for additional testing
    - Endoscopic Evaluation of Swallowing (FEES)
    - Videofluoroscopy (VFE)
  - Progress across treatment duration
Requires evaluation of important features of normal deglutition:

- Adequate control of the bolus
- Adequate clearance of the bolus from the oral and pharyngeal cavities
- Respiratory coordination with swallow
- Adequate airway protection before, during, and after the swallow
- Normal executive functions

Crucial to Clinical Evaluation Directives

- What was the referral question?
- Recommendations will need to specifically address information sought by:
  - Patient
  - Caregiver
  - Healthcare provider

Limitations – Clinical Evaluation CANNOT:

- Visualize the entire digestive tract involved in deglutition
  - Timing and magnitude of pharyngeal stage events
  - Presence and amount of residue
  - Laryngeal penetration/aspiration (this is inferred)

Equipment: Clinical Swallowing Kit

- 00 mirror
- Tongue blade
- Cup
- Spoon
- Straw
- Syringe
- Catheter
- Q-tips
- Gauze
- Items for testing taste and smell
- Tuning forks or portable audiometer
- Flashlight
- Gloves
- Food, liquid, ice chips
- Emesis basin
- Suction available

Essential Components of Clinical Evaluation of Swallowing

- Medical & Feeding history
  - Current method & schedule for feeding
- Patient interview
- Examination
  - Oral & Pharyngeal Anatomy/Function
  - Respiratory Assessment
  - Food assessment
- Documentation & Recommendations

Medical Information Sources

- Medical record
- Professionals involved in the client’s care
- Referring professional
- Client or caregiver
### Pertinent Medical History

- Primary diagnosis
- General medical status
- Referral source
  - Referral source
  - Patient’s physician
- Patient’s chief complaint/concern

### Medical History: Medications

- Be aware of their side effects:
  - Antidepressants (drying to mucosa, drowsiness)
  - Antipsychotics (dyskinesias, altered mental status, muscle rigidity)
  - Sedatives (CNS depressant, drying of mucosa)
  - Antihistamines (drying to mucosa, sedative)
  - Diuretics (dehydration, dryness)
  - Mucosal anesthetics (suppresses gag, cough)
  - Anticholinergics (dry mouth, reduced appetite)

### Patient Interview

- Chief complaint
- Perception of the problem
- Terms they use to describe it
  (See Table 1-21, Murray, see next slide)
- Their description of the progression of the problem
- Activities of their daily living
- Their report of previous treatment

### Patient Complaints as Clues

(taken from Murray’s Table 1-21)

- Coughing/choking = aspiration
- Food coming out nose = poor velar closure
- Food falling from mouth = poor lip seal/oral containment
- Food stuck in throat = weak pharyngeal stage and residue
- Something feels stuck in throat (not food) = Globus sensation, usually reflux
- Throat burns on swallow = reflux
- Food returns to mouth = Pharyngeal pocket/Zenker’s diverticulum
### Historical Patterns of Interest

- Onset, progression and consistency of the problem
- Site of the impairment (e.g., oral, pharyngeal, esophageal)
- Timing & consistency of the problem (e.g., before, during, after swallow)
- What happens with various food consistencies, temperature, postural changes, duration of feeding/fatigue
- Method and schedule of feeding and eating (e.g., oral, tube feedings, syringe, utensils)

### Associated signs
- Voice quality, dysarthria, choking or coughing, repeated swallows, throat clearing, fullness sensation in throat, pain

### Subjective description of the problem
- Point to affected area? Appetite changes?

### Social or emotional impact
- Are they concerned? Eating goal? Reaction to problem?

### Ancillary signs
- Weight loss, chronic fatigue, change in appetite, respiratory problems, changed salivation

### Compensations
- Changes in rate, consistency, posture, or other tactics that help deal with the swallowing problem

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### Direct Physical Evaluation

**AKA: Oral Mechanism Evaluation**

Refer to the Clinical Swallow Evaluation Form Handout

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### Direct Observations of the Patient

- Posture
- Alertness and reaction to clinician’s entrance
- Presence/absence of trach tube
- General awareness and handling of own secretions
- Ability to follow directions/answer questions
- Overall conditioning
- Endurance

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### Evaluation of the Oral Mechanism

**Cranial Nerves**

- **Three Components**
  - OBSERVE STRUCTURES AT “REST”
  - MOVEMENT ASSESSMENT
    - Strength
    - Range of Motion
    - Coordination for speech tasks
  - SENSORY ASSESSMENT

### Oral Mechanism (Cranial Nerve) Examination

Refer to Clinical Evaluation Form Handout

- **Face & Lips**
  - Motor testing of CN VII
  - Sensory testing of CN V

- **Jaw & Tongue**
  - Motor Testing of CN V and XII
  - Sensory Testing of CN VII and IX
  - Glandular motor of CN VII to sublingual and submandibular or CN IX to parotid glands

- **Hard/Soft Palate, Pharynx, & Larynx**
  - Motor Testing of IX, X, and XI
  - Sensory Testing of IX and X
Respiratory Assessment

- Observations
  - Breathing rate
  - Timing of saliva swallows in phases of respiratory cycle
  - Timing of coughing in relation to respiration-swallow coordination
  - Duration of comfortable breath holding
  - Resting breathing pattern (oral vs. nasal)
- Swallowing coordination with breathing
- Speech production and endurance

Respiratory Assessment

- 80% to 95% of bolus swallows interrupt expiration and are followed by expiration
  - Expiration – Swallow - Expiration
- This proportion diminishes with saliva swallows and in food/liquid swallows in some patient populations, particularly
  - Stroke
  - Chronic Obstructive Pulmonary Disorder (COPD)

Respiratory Assessment

- Oxygen Saturation
  - Healthy individuals maintain oxygen saturation while they eat
  - Some reports show patients with dysphagia will desaturate while they eat

Food Assessment

- Two Types of Patients....
  - Patients who are NPO (nil per os, or not eating orally)
  - Patients who are eating orally (PO)
Food Assessment

- Patients who are NPO
  - Start “easy”
  - They may have a very dry oral cavity, which will interfere with a normal swallow
    - Introduce ice chips to moisten mouth
    - Present food in controlled amounts, initially
    - Listen to vocal quality before and after each bite/swallow

Food Assessment

- Patients who are eating orally
  - Schedule your evaluation near mealtime so you can observe the patient with the food they typically receive on their tray
  - Ask the patient to bring typical foods, or a meal to eat during your session

Food Testing

<table>
<thead>
<tr>
<th>FOOD OR LIQUID ADMINISTERED</th>
<th>EVALUATE THE FOLLOWING:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ice Chips:</td>
<td>Voice quality remains clear? (Y/N)</td>
</tr>
<tr>
<td>1 tsp of water:</td>
<td>Timely onset of swallow? (Y/N)</td>
</tr>
<tr>
<td>3 ounces of water:</td>
<td>Cough response observed? (Y/N)</td>
</tr>
<tr>
<td>Typical large sip of water</td>
<td>If cough observed, was it effective in clearing the bolus? (Y/N)</td>
</tr>
<tr>
<td>from a cup (10-20 ml):</td>
<td>Struggle observed initiating a swallow? (Y/N)</td>
</tr>
<tr>
<td>Sequential swallows using</td>
<td>Multiple swallows or other signs of difficulty clearing the bolus? (Y/N)</td>
</tr>
<tr>
<td>a straw:</td>
<td>Evidence of nasal regurgitation? (Y/N)</td>
</tr>
<tr>
<td>1 tsp of applesauce:</td>
<td>Was the bolus adequately controlled during the trial? (Y/N)</td>
</tr>
<tr>
<td>1 tsp of pudding (e.g., Jell-O pudding cups):</td>
<td>Compensatory behaviors observed due to eating difficulties? (Y/N)</td>
</tr>
<tr>
<td>A bit of saltine cracker or</td>
<td>OTHER OBSERVATIONS:</td>
</tr>
<tr>
<td>cookie:</td>
<td></td>
</tr>
</tbody>
</table>

Food Assessment

- Note the following (Cognitive, Feeding, Oral Stage):
  - Attention to process
    - Do they stop talking?
    - Do they show signs of neglect?
  - Appropriate selection of bolus size
  - Ability to retrieve food from utensil
    - Lip closure around utensil or straw
    - Is there leakage from the mouth?
    - Is there food remaining on the utensil?
  - Patient’s reaction to food
    - Are they aware that food is in their mouth?
    - Do they complain of altered taste?

Food Assessment

- Note the following (oral sensori-motor)
  - Oral movements in food manipulation and chewing
    - Is chewing adequate?
    - Is there food remaining in the mouth?
      - Where is it located—roof of mouth, midline of tongue, lateral pocketing?
      - Is the patient aware that food remains?
      - Does the patient self-initiate removal of food?
      - Can the patient follow directions to remove food?

Food Assessment

- Note the following (pharyngeal stage)
  - Coordination of breathing and swallowing
  - Coughing, throat clearing, or struggling behaviors
    - Does this occur
      - On every swallow? (liquids vs. solid bolus swallow, for example)
      - After the patient has been eating for 5 or 10 minutes?
Food Assessment

• Note the following (pharyngeal stage)
  – Laryngeal elevation
  – Timing of the swallow
  ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
  – Using a light touch, place.....
    • index finger immediately behind the mandible
    • Middle finger on the hyoid bone
    • Fourth finger on top of the thyroid cartilage
    • Little finger on the bottom of thyroid cartilage
  – Swallow, and feel the movement of the structures

Food Assessment

• Movement associations:
  – The index finger is feeling initiation of tongue movement
  – The time between movement felt by the index and middle fingers is an estimate of oral transit time
  – Movement between the 4th finger and little finger signified laryngeal elevation

Food Assessment

• Duration of the meal and total intake
  – Effortless swallow
  – Multiple swallows per bolus
  – Delay of swallow in excess of 10 seconds
    • nonfunctional as oral eater

Food Assessment

• Use the information obtained to determine
  – Best posture
    • Adjustments for compensation for tongue, lip problems
    • Pharyngeal and laryngeal compensation, neck flexion (i.e. chin tuck)
  – Optimal food position in the mouth
    • Oral sensitivity should determine this
  – Selection of possible food consistencies
  – Selection of possible swallowing instructions

Recommendations
Recommendations

• Is the patient safe for oral eating? With modification?
• Is the patient aspirating or at risk for aspiration?
  – Can swallow be modified to eliminate/reduce aspiration?
• Do you need additional imaging evaluation?
  – Detail pathophysiology of the swallow
  – Confirm aspiration and whether it can be prevented
  – Determine effectiveness of compensations and maneuvers
• Is evaluation by another professional needed?

Considerations

• Patient’s living situation
  – Acute vs. Rehab
  – Home setting
• Expected recovery
  – Degenerative disorder
  – Partial or full recovery
• Resources available
• Caregiver factors
• Further testing to come
• Referral

DISCUSSION

Imaging Studies: (Flexible) Endoscopic Evaluation of Swallowing (FEES)

FEES EQUIPMENT

Flexible Endoscopic Evaluation of Swallowing (FEES)
FEES ANATOMICAL VIEW

Indications to use FEES to assess:

- Altered naso-/oropharyngeal, or laryngeal anatomy, including views of vocal folds
- Sensory integrity of pharynx or larynx
- Concerns about airway protection
- High risk of aspiration requiring swallow assessment without food or liquid
- Testing fatigue in patient across swallows
- Symmetry of pharyngeal constriction, particularly to view posterior tongue/pharynx

Indications to use FEES to provide:

- Online visual feedback to the patient or others
- Assessment of various strategies several times over a period of time
- Presence of secretions in the airway

FEES Anatomical & Swallow Evaluation Protocol

- Crary and Groher Video Example (2003)
  - Inspection of the anatomical structures and airway integrity
  - Administration of materials for swallowing (dyed green or blue, barium)
    - Saliva
    - Ice Chips
    - Thin/thickened liquids
    - Semisolid materials
    - Paste material
    - Mastication materials (e.g. cookie or cracker)
    - Sensory testing of pharyngeal walls, aryepiglottic fold
FEES

- Additional indications for use
  - Patient transport is an issue
  - Concerns about radiation exposure
  - Require answers before can schedule with radiology

Compared to Videofluoroscopy, FEES:

- Is equivalent for
  - diagnosing the presence of dysphagia
  - Observing whether treatment strategies promote a safe or effective swallow
  - Sensitivity
    - to delayed onset of swallow
    - Penetration or aspiration
    - Post-swallow residue presence

COMPARISON OF VFE & FEES

Limitations of FEES

- Cannot view oral stage
  - must infer based on bolus patterns relative to swallow
  - Cannot observe bolus formation or its manipulation
- “white out”: During the moment of a swallow, the tongue and pharynx approximate occluding views of the swallow
  - Penetration/aspiration cannot be seen during the swallow (inferred)

Comparisons of VFE & FEES

Limitations of FEES

- Structural movements, or degree of constriction of pharynx, UES, and esophagus are not observed during swallow
  - Timing and displacement of these cannot be measured
- Patient allergic to topical anesthesia, or decongestant used for exam
- Nosebleed
- Laryngospasm
- Vasovagal reaction (faint)
  - Due to unstable cardiac condition
  - Due to anxiety

Contraindications for FEES

- Inadequately trained examiner
- Patients should be seen only under controlled conditions with medical staff close at hand
- Patients with
  - cardiac arrhythmias
  - recent respiratory distress or respiratory arrest
  - bleeding disorders
Contraindications for FEES
- Patients who are difficult to evaluate related to being agitated, or aggressive, or hostile
- Movement disorders
- Septal deviations preventing passage of the flexible scope
- Oral or esophageal stage dysphagia

Airway Assessment Using FEES

Penetration Aspiration Scale

- 1. No penetration of airway whatsoever
- 2. Penetrates larynx, above folds, no visible laryngeal residue
- 3. Penetrates larynx, above folds, visible laryngeal residue
- 4. Penetrates larynx, contacts folds, no visible laryngeal residue
- 5. Penetrates larynx, contacts folds, visible laryngeal residue
- 6. Below folds, no visible tracheal residue
- 7. Below folds, visible tracheal residue despite effort
- 8. Below folds, no response or effort, tracheal residue

Case Examples for P/A Scale

FEES Case Example

Videofluoroscopic Evaluation of Swallowing (VFE)

- Patient factors for consideration (derived from Clinical Evaluation)
  - Physical status
  - Cognitive status
  - Upright vs. supine testing
  - Age factors
    - infant vs. child vs. adult
**Videofluoroscopy (VFE)**

- A motion x-ray study of the neck (cervical spine) during eating.
- The entire study can be recorded and analyzed to contribute to evaluation and treatment of individuals with dysphagia.

**Planes of View**

- LATERAL PLANE
  - 1 cc liquid contrast (2 trials)
  - 3 cc liquid contrast
  - 3 cc paste contrast
  - ¼ Lorna Doone cookie coated with paste contrast
  - 20 cc liquid contrast
  - 60 cc liquid contrast straw drinking

- ANTERIOR-POSTERIOR PLANE
  - 1 cc liquid contrast
  - 3 cc paste contrast
  - 20 cc liquid contrast
  - Tablet

- SWALLOWING MANEUVERS
  - Craty & Groher (2003) Videofluoroscopy

**Videofluoroscopy Protocol (~ 2-3 minutes of recording duration)**

**Videofluoroscopy Equipment**

**Pros:**
- can view all the structures except for a transverse view of the vocal folds
- movement patterns (kinematics) of the structures can be studied
- can view the bolus during both the oral and pharyngeal stages of deglutition
- can determine the cause of aspiration best with this procedure
- Can identify dysphagia during any stage of deglutition
Videofluoroscopy

• Cons:
  – Radiation exposure
  – Often difficult to position the patient for this procedure
  – Dependent upon the goodwill of radiology department

Videofluoroscopy

• Contraindications:
  – no swallow elicited at bedside
  – no new or useful information will be obtained
  – decreased level of patient alertness making it inadvisable to feed the patient anyhow
  – extreme illness where it is unlikely that patient will get sufficient nourishment by mouth
  – Inability to transport the patient to radiology and no portable unit available

Videofluoroscopy

Evaluation and Interpretation

Two Methods for Interpretation

QUALITATIVE
Subjective description of bolus:
1. Path
2. Timing
3. Clearance

Historically, unstructured and unreliable judgments within and between raters

QUANTITATIVE
Measurement of:
1. Duration of bolus transit
2. Timing of structural movements (gestures)
3. Measures of structural displacement
4. Maximum and minimum areas of the pharyngeal cavity during swallowing

What are your qualitative impressions?

Evidence of problems with UES opening and hyolaryngeal excursion

Reduced hyolaryngeal excursion
Impaired CP relaxation

Vallecular and Pyriform residue
Cricopharyngeal bar
Standardized Measurement of Swallowing Physiology
Bonnie Martin-Harris, PhD, CCC-SLP, BCS-S, ASHA Fellow

Professor, Dept. of Otolaryngology-Head & Neck Surgery
Professor, Dept. of Health Sciences & Research
Director, Evelyn Trammell Institute for Voice & Swallowing
Director, PhD Program in Health & Rehabilitation Sciences
Clinical Scientist, Ralph H. Johnson VA Medical Center
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WHY Standardized Measurement?
TRANSLATING RESEARCH INTO PRACTICE (TRIP)-II. FACT SHEET, AHRQ PUBLICATION No. 01-P017.
• EVIDENCE, rather than opinion, should guide clinical decision-making
• BROADER RANGE OF PATIENT OUTCOMES needs to be measured in order to understand the true benefits and risks of health care interventions
• RESEARCH PRIORITIES should be guided in part by public HEALTH NEEDS

WHAT Should Be Standardized?
TRANSLATING RESEARCH INTO PRACTICE (TRIP)-II. FACT SHEET, AHRQ PUBLICATION No. 01-P017.
• The INSTRUMENT – Contents and format
• DATA COLLECTION Protocol – Approach and method
• ANALYSES – Minimize variation in scoring and interpretation
• REPORTING – Well-tested approaches to presenting results

STANDARDIZED MBSS MEASUREMENT Tool:
MBS of Swallowing IMPAIRMENT

MBSImP™
• Standardized
• Validated
• Reliable
• Linked to clinical actions
• Database

Modified Barium Swallowing Impairment Profile
MBSImP™

Martin-Harris et al., 2008
Functional Domains of Swallowing Impairment

- Oral
  - Lip Closure
  - Bolus Hold Position
  - Bolus Preparation/Mastication
  - Bolus Transport/Lingual Motion
  - Oral Residue
  - Initiation of Pharyngeal Swallow
  - Soft Palate Elevation
  - Laryngeal Elevation
  - Anterior Hyoid Excursion
  - Epiglottic Movement
  - Laryngeal Vestibular Closure
  - Pharyngeal Stripping Wave
  - Pharyngoesophageal Segment Opening
  - Tongue Base Retraction
  - Pharyngeal Residue
  - Esophageal Clearance

- Pharyngeal

- Esophageal

Impaired Tongue Base Retraction

Clinical Application

Tongue Base (TB) Retraction
0 = No bolus between TB and posterior pharyngeal wall (PW)
1 = Trace column of contrast or air between TB and PW
2 = Narrow column of contrast or air between TB and PW
3 = Wide column of contrast or air between TB and PW
4 = No appreciable posterior motion of TB

The Modified Barium Swallow Impairment Profile MBSImP™ WEB-BASED LEARNING ENVIRONMENT

Personal Log-In

Standardized Training

Patient Data and Standardized Reports

https://www.mbsimp.com
Study Specific Information
Patient Positioning, Viewing Planes, Contrast, and of course, **MBSImP™ SCORES**!

Clinician’s Name: [Blank]

Patient Positioning
- [ ] Sitting
- [ ] Supine
- [ ] Prone

Contrast Visibility Level: [Blank]

Viewing Planes:
- [ ] AP View
- [ ] PA View
- [ ] Lateral View

**MBSImP™ Scores**

<table>
<thead>
<tr>
<th>Physiologic Component</th>
<th>Oral Impression</th>
<th>Lateral View</th>
<th>Overall Impression AP View</th>
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<tbody>
<tr>
<td>Laryngeal Maneuver</td>
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<tr>
<td>Pharyngeal Manuever</td>
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<tr>
<td>Soft Palate Function</td>
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<td>Laryngeal Function</td>
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<td>Hypopharyngeal Function</td>
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<td>Interpharyngeal Function</td>
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<td>Esophageal Function</td>
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The MBSImP™ Study Clinical Report, p. 1

**Standardized Training in Swallowing Physiology:** Evidence-Based Assessment Using the Modified Barium Swallowing Impairment Profile (MBSImP™) Approach


**Personal Disclosure regarding Quantitative Measurement**
Advantage of Quantitative Measures

- Relatively poor reliability of qualitative measures
- Can reference to normal data by younger and older age group
- Requires a uniform protocol for comparison
- Improved accuracy of pathophysiology
- May improve diagnostic and management decisions for improved treatment outcomes

**TIMING**

- **BOLUS TRANSIT TIMES**
- **SWALLOW GESTURE TIMES**


**TIMING MEASURES**

- **B1** = first movement of head of bolus past posterior nasal spine
  - Posterior nasal spine stable reference
  - Establishes a zero point marking onset of the bolus entry into the pharynx
  - Reference point from which other measures are determined

**TIMING MEASURES**

- **BV1** = Moment that the bolus (B) reaches the base of the vallecula (V)
  - BV1 marks the end of the oropharyngeal transit and beginning of hypopharyngeal transit
  - Absent in some head and neck cancer patients

**TIMING MEASURES**

- **BV2** = first exit of the bolus head from the valleculae and the beginning of hypopharyngeal transit
  - Bolus sizes > 3-cc cannot be distinguished between BV1 and BV2

**TIMING MEASURES**

- **BP1** = first entrance of Bolus head into Pharyngoesophageal sphincter (PES) (as sphincter opens)
**TIMING MEASURES**

- **BP2** = Moment that the tail of the bolus clears the PES and resides fully within the esophagus
  - This marks the end of the pharyngeal stage
  - Typically also the end of the PES opening

**TIMING MEASURES: TRANSIT TIMES**

- **Total pharyngeal transit time** = BP2 - B1
- **Oropharyngeal transit time** = BV1 - B1
- **Hyopharyngeal transit time** = BP2 - BV2

**Total Pharyngeal Transit Time**

- No change in total pharyngeal transit time has been found in those younger than 60 years of age regardless of
  - BOLUS SIZE
  - CONSISTENCY
- For those > 65 years of age, transit times significantly differ between
  - 1, 3, and 20-cc bolus volumes
  - Significantly prolonged transit times for older patients than younger
  - Presents challenges to the airway with longer laryngeal closure times
  - Delayed or prolonged pharyngeal transit is associated with increased risk of aspiration pneumonia

**SWALLOW GESTURE TIMES**

- Gesture measures are compared to a reference position
  - “Hold” position = position of structures while the patient holds 1-cc bolus of liquid in their mouth prior to swallowing

**ALL MEASURES OF MAXIMUM DISPLACEMENT REFERENCED TO POSITION OF STRUCTURES WITH 1CC BOLUS HELD IN ORAL CAVITY**

1.9cm ring in mid-line


**SWALLOW GESTURE TIMES**

- **AE start** = Onset of the most superior part of the arytenoid cartilages movement during swallowing
- **AEclose** = When the most superior part of the arytenoid cartilages make contact with the epiglottis
**Hyoid bone movements**

- Preparatory hyoid movements occur in normal swallowers
- Hyoid movement for a swallow is more vigorous and stereotypical
- The hyoid bone does not always move in a straight line
  - Circular motions
  - Curves
  - Figure eight

**Swallow Gesture Times**

- \( \text{PA max} = \) time when the pharyngeal chamber is **maximally constricted**
- \( \text{Pcl} = \) First frame where PES closes, typically on the bolus tail (end of pharyngeal transit)

**Pharyngeal Constriction**

- \( \text{PA max} = \) time when the pharyngeal chamber is **maximally constricted**
- \( \text{Pdl} = \) First frame where PES closes, typically on the bolus tail (end of pharyngeal transit)

**Hyoid Excursion**

- \( \text{H1} = \) First superior-anterior displacement of the hyoid bone associated with a swallow
- \( \text{H2} = \) First frame where the hyoid bone has reached its max superior-anterior excursion during a swallow
- \( \text{H3} = \) First return of the hyoid bone from max displacement

**Swallow Gesture Times**

- \( \text{AEs} = \) First swallow
- \( \text{AEc} = \) Last swallow
Bolus size and gesture times

- PES opening time (Pcl – Pop) increases with increased bolus size in all age groups
- Duration of PES increases with increased bolus size (overall duration of swallow remains the same)
- Max hyoid displacement time (H3-H2) is significantly reduced in elderly compared to younger ages

Timing is important, but so is location, location

HYOID POSITIONS ARE ALIGNED AT VERTEBRA AND DISTANCE FROM “HOLD” TO MAXIMUM DISPLACEMENT IS THEN MEASURED
DISPLACEMENTS: PHARYNGEOESOPHAGEAL SEGMENT (PES)


DISPLACEMENTS: PHARYNGEAL CONSTRICTION RATIO (PCR)

PCR = PAmax / PAhold

Available soon...
http://www.belldevmedical.com/swallowtail-1

Quantitative Measures

- ELABORATE ORAL-PHARYNGEAL SWALLOW MECHANICS, NORMAL AND IMPAIRED
- PROVIDE EVIDENCE-BASED TREATMENT DIRECTIONS
- DOCUMENT CHANGES IN PATIENT OVER TIME AND TREATMENT; COMPARE DIFFERENCES ACROSS PATIENT POPULATIONS
- PERMIT ASSESSMENT OF RISK AND POTENTIAL IN INDIVIDUAL PATIENTS
- MAXIMIZE POTENTIAL OF VIDEOFLUOROSCOPY

ASSESS RISK

- FLUORO STUDY PROVIDES BRIEF SAMPLE OF SWALLOW FUNCTION
- IF WE CAN ANTICIPATE, OR PREDICT, LIKELIHOOD OF ASPIRATION AWAY FROM FLUORO SUITE, STUDY IS MORE POWERFUL

Training and Support of the Swallow Team

- Primary swallow diagnosticians are a subgroup of speech language pathologists with special training in swallowing disorders
- These clinicians are trained in diagnostic methods (Modified Barium swallow, functional endoscopic examination of swallow and now High Resolution Manometry and HRM with Impedance)
  
  - We have a highly formalized training program which all our clinicians have completed [at UW-Madison]


Diagnostic Testing with HRM

Most patients are going to have an abnormality that would be best diagnosed and then treated if the manometry data is available

Possible abnormal findings with Clinical HRM

- Pharyngeal weakness
- UES (cricopharyngeal) abnormal relaxation
- Nasopharyngeal leak or palate weakness
- Low pressure zones due to pouches or diverticulum
- Esophageal dysmotility
- Multi-factorial dysfunction
- High pressure in the bolus due to down stream obstructions
- Compensatory high pressure in the nasopharynx due to tongue or pharyngeal weakness

Additional value

- Documentation of pre treatment status
- Documentation of disease progression
- Documentation of treatment success


Bolus movement is a Pressure driven event

What is high resolution manometry?

- A high resolution manometer allows us to measure pressures along the entire aerodigestive pathway with excellent spatial (1 cm) and temporal resolution (100 Hz)

Components

- Catheter
- Processor
- Computer
- Screen
- Cart

Catheter

- Catheter
  - 36 circumferential sensors
    - 1 cm spacing
  - 4 or 2.1 mm diameter flexible

Procedure

- Nasal topical or no anesthetic
- Insertion of catheter
- Quiet rest
- Trials
  - Liquid
  - Food
  - Saliva swallow
  - Interventions

High Resolution Manometry Plots
(continuous recording of pressure from the nasopharynx to the upper esophagus during a swallow)
Summary

- The key to effective management of dysphagia is diagnostic precision
  - DETERMINATION OF PATHOPHYSIOLOGY
- Improve diagnostic precision by using:
  - Systematic clinical and imaging protocols
  - Standard methods of measurement
    - Qualitative
    - Quantitative
- Technological advances may bring improved elucidation regarding dysphagia pathophysiology
References


References