Dysphagia Treatment: Exercise-Based Interventions

James Curtis, MS, CCC-SLP, BCS-S

Restoration: From Start to Finish

1. Perform instrumental imaging assessments of swallowing to assess swallowing physiology and identify specific physiologic impairments

Restoration: From Start to Finish

1. Perform instrumental imaging assessments of swallowing to assess swallowing physiology and identify specific physiologic impairments
   - Is this normal or abnormal?
   - Is this low risk or high risk?

Is liquid spillage to the piriforms prior to swallow initiation (i.e., 'delayed swallow') normal? Is it risky? How about with solids?

Is penetration "normal"? Is it risky?

Is aspiration "normal"? Is it risky?

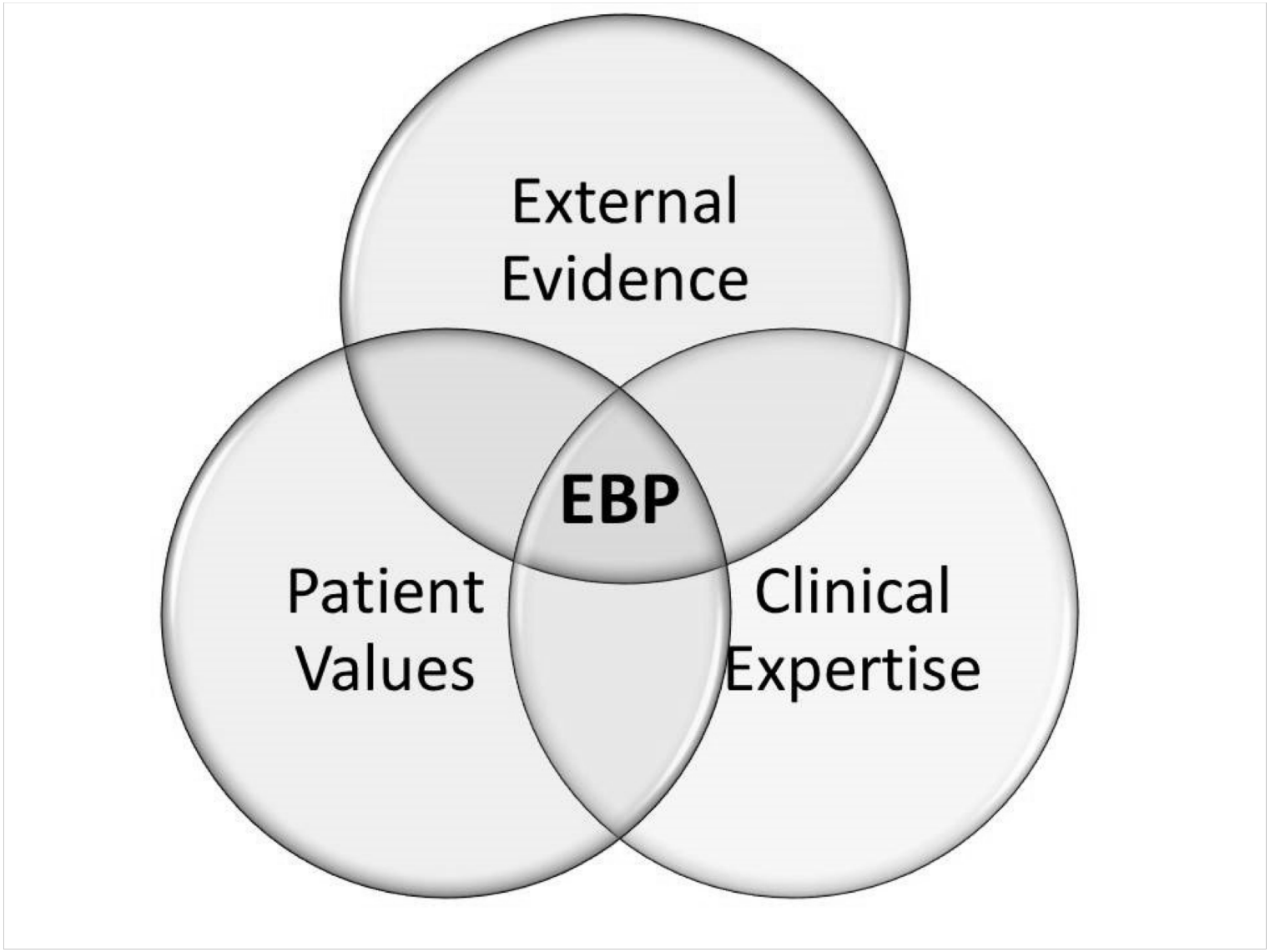
Restoration: From Start to Finish

1. Perform instrumental imaging assessments of swallowing to assess swallowing physiology and identify specific physiologic impairments
2. Hypothesize what the underlying pathophysiology is to the physiologic impairment identified on exam
   - Diagnosis: sensory vs motor control vs weakness
   - General health status: weight loss, bed bound, non-ambulatory
   - Subjective CNE Findings: sensation, force, accuracy, consistency, etc.
   - Objective Clinical Findings: IOPI, MicroRPM, cough

Restoration: From Start to Finish

1. Perform instrumental imaging assessments of swallowing examine swallowing physiology and identify specific physiologic impairments
2. Hypothesize the pathophysiology of the physiologic impairment identified on exam
3. Select an exercise that (best) targets the physiologic impairment and the pathophysiology
   - Does the exercise (published or not) make sense, given your understanding of anatomy, physiology, motor learning, neural plasticity, and strength training
   - Evidence-Based Practice and Theory-Based Practice

EBP & TBP



EBP & TBP

- Key Steps in the EBP Process
  1. Framing the clinical question (PICO)
  2. Finding the evidence
  3. Assessing the evidence
  4. Making the clinical decision

http://www.asha.org/Research/EBP/Evidence-Based-Practice-Tutorials-and-Resources/

EBP & TBP

Organization	Name of Platform	Website
American Speech-Language-Hearing Association (United States)	Evidence Maps	www.asha.org/Evidence-Maps/
Speech Pathology Database for Best Interventions and Treatment Efficacy (SpeechBITE) (Australia)	SpeechBITE	www.speechbite.com
National Institute for Health and Care Excellence (NICE) (United Kingdom)	Evidence search	www.evidence.nhs.uk
Taylor & Francis Online	Evidence-Based Communication Assessment and Intervention (journal)	www.tandfonline.com/toc/tebc20/current.com

EBP & TBP

- Just because it is published, doesn't make it "true"
  - Significant results, non-significant results, and publication trends → *p* < .05 and *false positives*
  - Theories are developed by trends in the literature
  - Do not use an exercise as your "get out of jail free card" – always have theoretical support and rationale

EBP & TBP

- Just because it is not published, doesn't make it not "true"
  - Research lags behind clinical needs
  - Use your understanding of how systems work to develop a rational exercise regimen.
  - Use literature in related patient populations or fields (e.g., physical therapy) to draw from
  - Have a standardized protocol for evaluation and treatment to track changes over time

Restoration: From Start to Finish

1. Perform instrumental imaging assessments of swallowing examine swallowing physiology and identify specific physiologic impairments
2. Hypothesize the pathophysiology of the physiologic impairment identified on exam
3. Select an exercise that targets the physiologic impairment with the underlying pathophysiology
4. Initiate therapy
   - Take initial measures of the exercise
   - Is the exercise initially too easy? Why?
   - Track changes in exercise-specific outcome measures overtime. Why?

Restoration: From Start to Finish

1. Perform instrumental imaging assessments of swallowing examine swallowing physiology and identify specific physiologic impairments
2. Hypothesize the pathophysiology of the physiologic impairment identified on exam
3. Select an exercise that targets the physiologic impairment with the underlying pathophysiology
4. Initiate therapy
5. Repeat evaluation to determine effectiveness of exercise regimen
   - Are kinematic changes (DSS, MBSImP) being appreciated?
   - Do you need to adjust intensity of exercises?
   - Do you need to change exercises all together?

For learning and clarity, I have categorized exercises as either:

- “Resistance-training” exercises: limited to non-swallowing force generation exercises aimed at improving strength, power, or endurance)

- ”Skill-based” exercises (including swallowing specific exercises targeting increased timing, coordination, and force during swallow)

- Note that “strength-training” can be targeted through resistance training or skill-training, which should vary given the pathophysiology of the weakness

Resistance Training Interventions

- As able, identify the one repetition maximum (1 RM)

- Modify the percentage of the 1RM for each rep, the number of reps/set, and amount of rest between sets to adjust the intensity of the exercise

Lingual Resistance Training (LRT)/Tongue Press

- Instruction: “Push your tongue against the roof of your mouth”
- Physiologic Targets: oral tongue swallowing pressures, base of tongue swallowing pressures, hyoid excursion, PES opening
- Studied Patient Populations: presbyphagia, post-stroke, TBI, Parkinson’s Disease, Amyotrophic Lateral Sclerosis

Lingual Resistance Training (LRT)/Tongue Press

1. Measure tongue strength (IOPI) – MIP, MSP, PR
   - If WNL, consider another exercise
   - If ONL, consider as potential exercise

2. Perform strength (3 second presses, 60-80% RM) or endurance presses (50% RM as long as able)
   1. Use IOPI for biofeedback regarding effort level
   2. Dose varies, though frequently performed at 10 reps/set, 3 sets/session

3. Track changes in the exercise over time

Lingual Resistance Training (LRT)/Tongue Press

LRT Modalities

Tongue-to-palate

Tongue Depressors

TonguePRESS

IOPI

MOST

LED	%
9	100
8	87.5
7	75
6	62.5
5	50
4	37.5
3	25
2	12.5
1	0

J C [illegible] gia

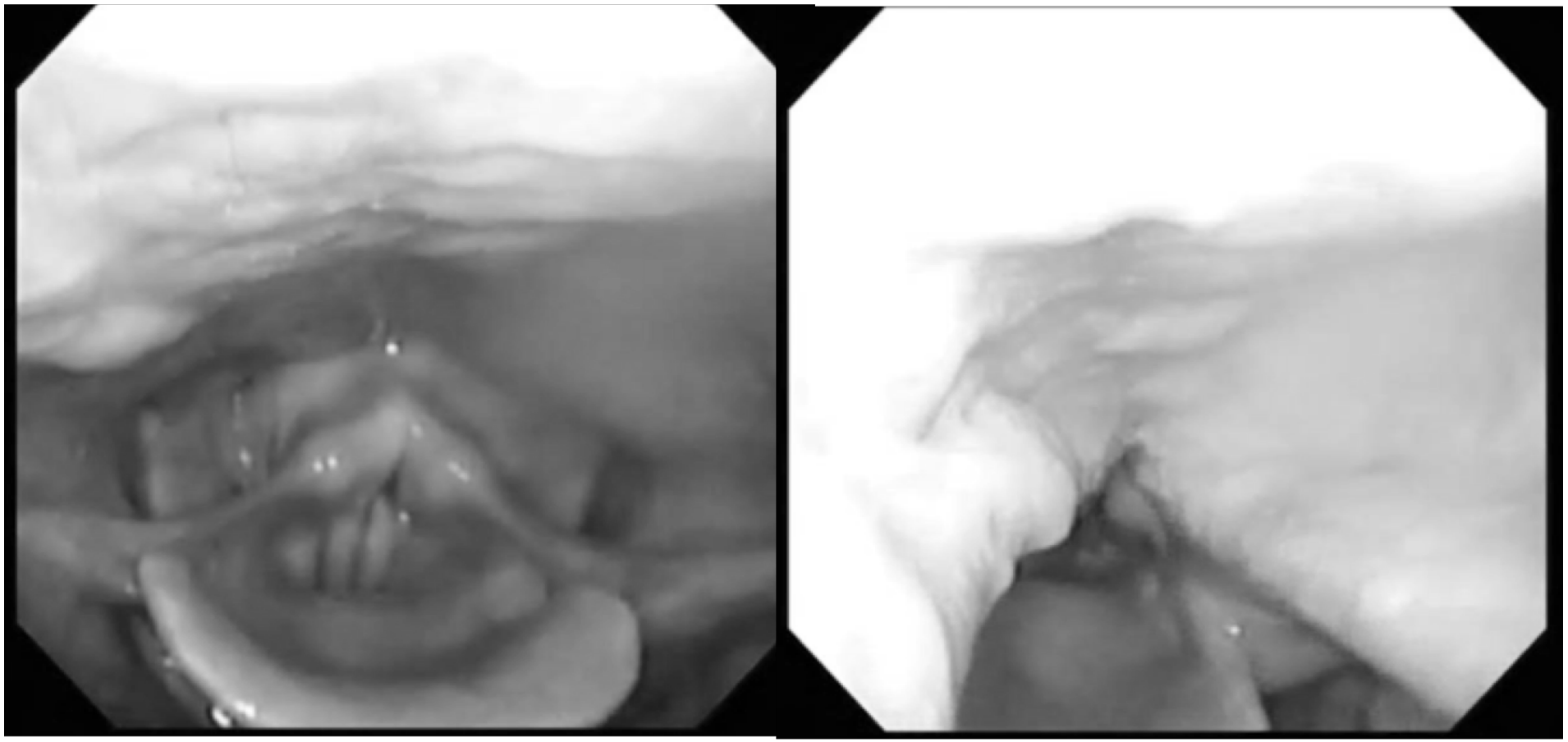
Effortful Pitch Glide

1. Instruction: “Glide up to your highest pitch ‘e’ - exert force and effort when at the highest pitch”

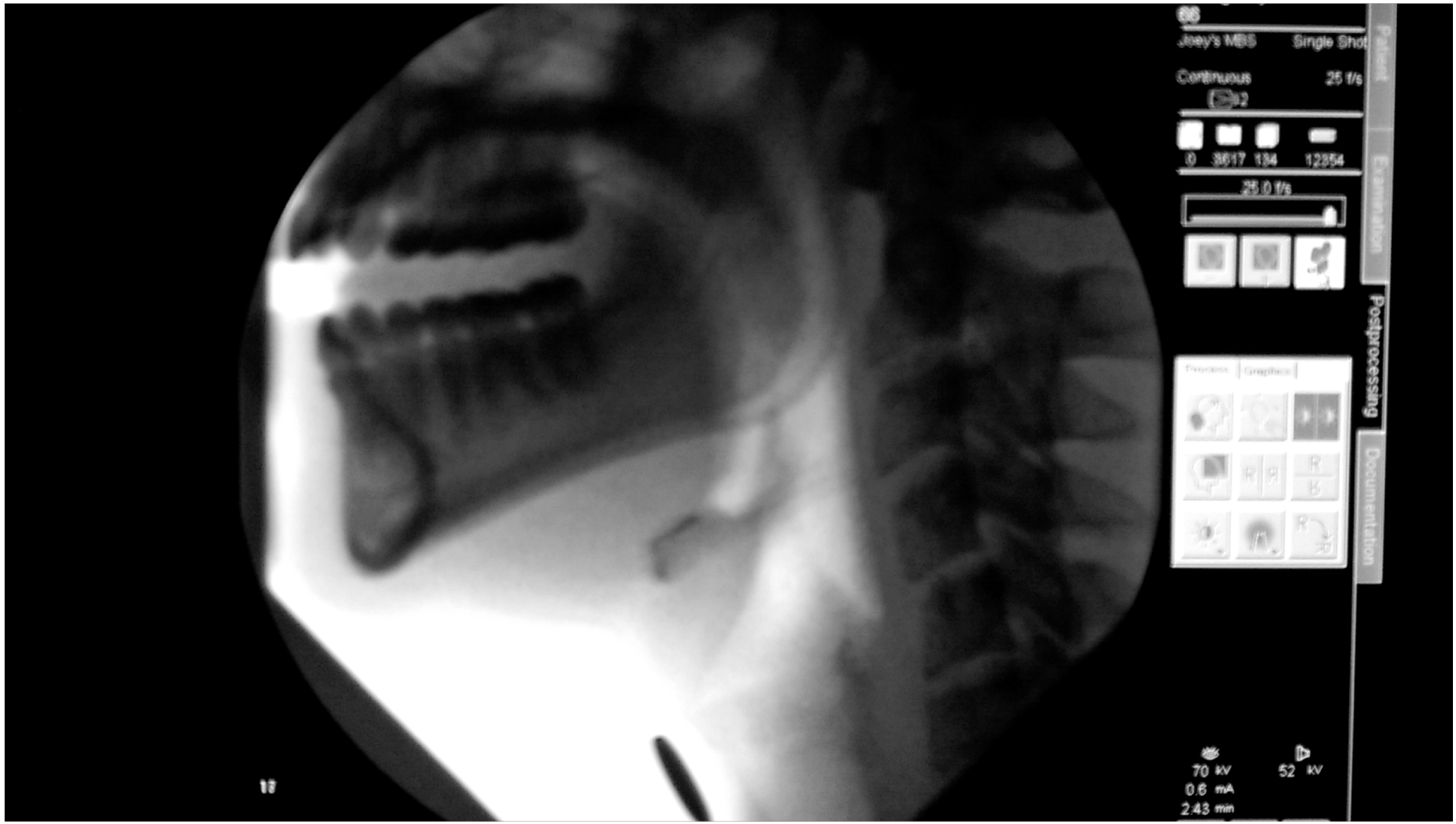
2. Physiologic Targets: pharyngeal wall medialization, pharyngeal shortening, anterior hyoid excursion, and hyolaryngeal approximation

3. Studied Patient Populations: healthy young adults

Effortful Pitch Glide



Effortful Pitch Glide



Maximal Jaw Opening

- Instruction: “Open jaw as wide as you can”
- Physiologic Targets: mylohyoid and anterior digastric muscle activity, vertical hyoid displacement, PES opening, shorter pharyngeal transit time
- Studied Patient Populations: chronic dysphagia (no CVA?)

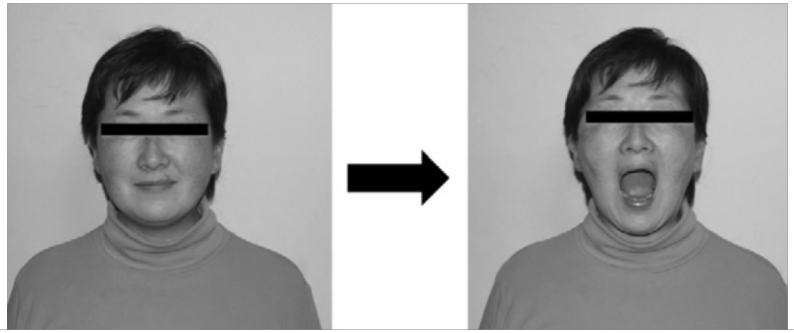


Table 2: Comparison of Swallowing Function Before and After the Jaw-Opening Exercise (N=8)

	Before			After				Effect Size	
		95% CI			95% CI		z		
Measure	Mean ± SD	Lower	Upper	Mean ± SD	Lower	Upper	Score	*r*	*P**
Upward movement of the hyoid bone (mm)	6.05±4.16	2.57	9.52	10.60±4.52	6.83	14.38	2.52	.89	.012
Forward movement of the hyoid bone (mm)	7.17±5.66	2.44	11.90	9.82±4.04	6.44	13.20	1.96	.69	.050
UES opening width (mm)	6.30±2.20	4.47	8.14	7.22±2.60	5.05	9.39	2.10	.74	.036
Time for pharynx passage (s)	0.98±0.09	0.90	1.05	0.75±0.33	0.47	1.02	2.03	.74	.043

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Wada et al., 2014

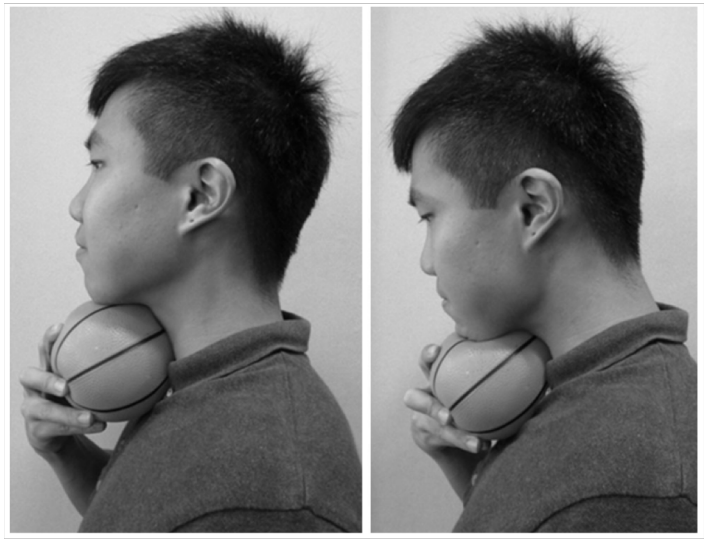
Shaker/Head Lift

- Instruction: “Lay flat on the ground. Lift head (chin to chest) to look at feet without letting your shoulders off the ground and keeping your belly soft”
- Physiologic Target: thyrohyoid approximation, strength & endurance of suprahyoid and infrahyoid muscles, and increase anterior hyoid excursion & PES opening
  - Greater TH activation, but less SH activation and patient compliance, when compared to CTAR & JOAR
- Studied Populations: healthy, stroke, HNC

White, 2008; Shaker, 1997, 2002; Mepani, 2008; Jurell, 1996, 1997; Ferdjallah, 2000; Easterling, 2005;

Chin Tuck Against Resistance (CTAR)

- Physiologic Target: thyrohyoid approximation, strength & endurance of SH and IH muscles, and increase anterior hyoid excursion & PES opening
  - Greater SH activation and patient compliance, but less TH activation, when compared to Shaker
- Studied Populations: healthy adults
- Modalities:
  - Cushion balls
  - Neckline Slimmer
  - Other devices



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Kraaijenga, 2015; Watts, 2015; Yoon, 2013; Kraaijenga, 2015

“-AR” Variants

- CTAR; CTAR + swallowing; Jaw Opening Against Resistance (JOAR)
  - Increased HL and SH muscle activity
  - Increased SH muscle volume
  - Increased hyoid displacement
  - Increased tongue endurance
  - Shorter swallow transit times
- Studied in elderly over 8 weeks

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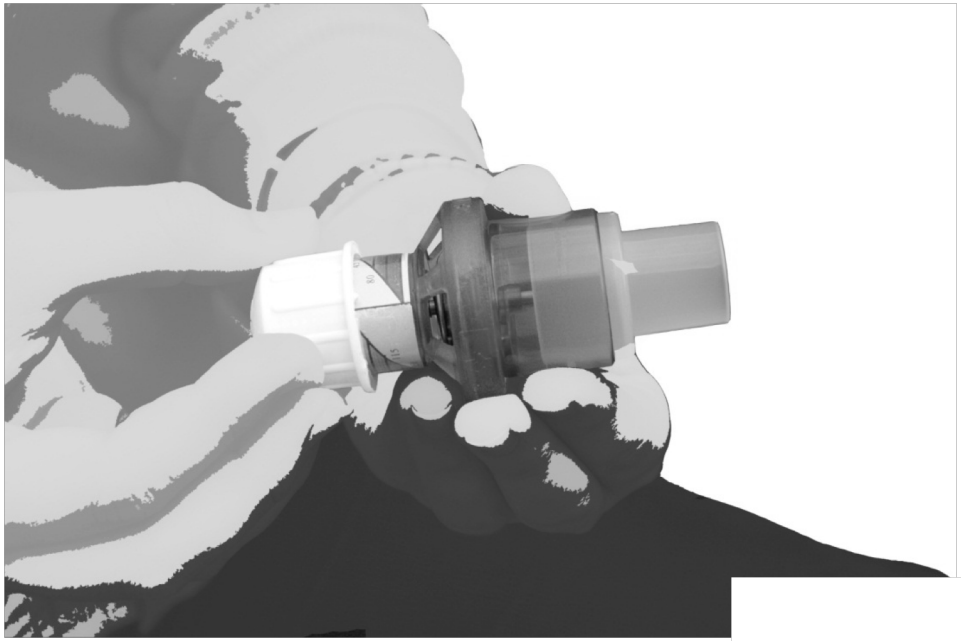
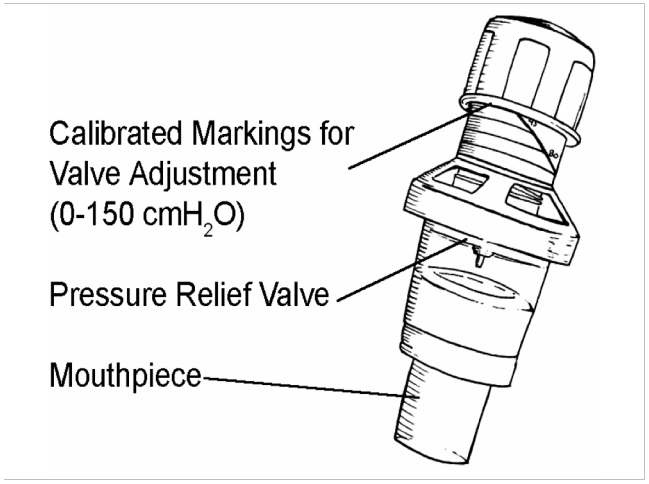
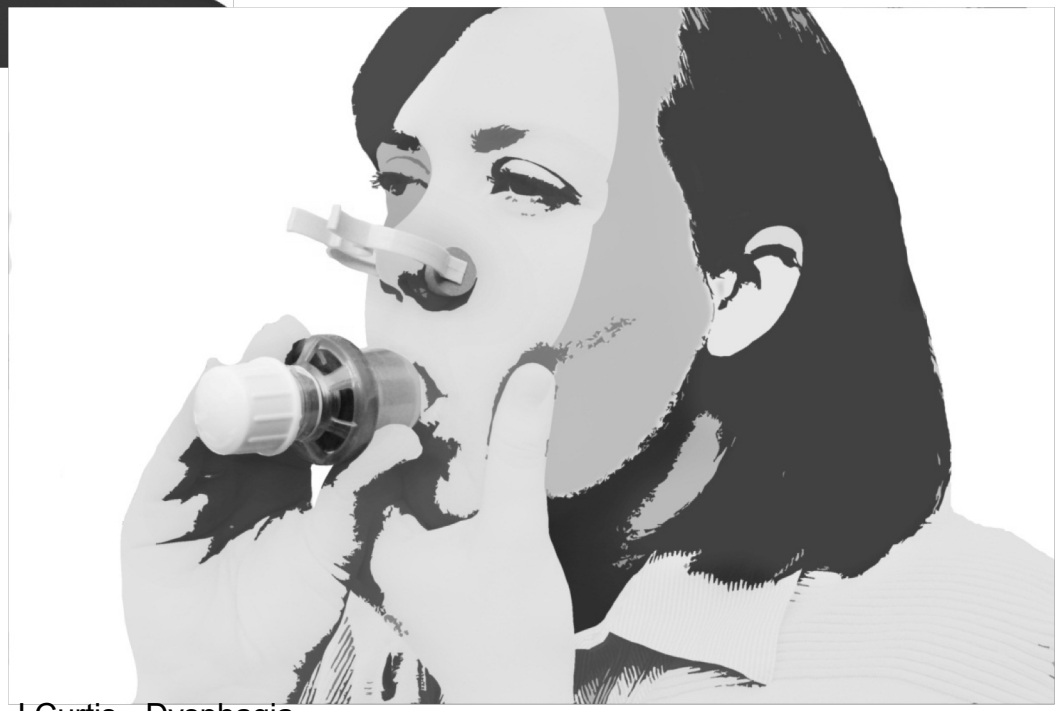
Kraaijenga, 2015;





Expiratory Muscle Strength Training (EMST)

Respiratory Muscle Strength Training (RMST)



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(e.g., Sapienza, Davenport, & Martin, 2002; Sapienza et al., 2011)

EMST

- Instruction: “Take a big breathe in, bit on the mouth piece, and blow!”
- Physiologic Targets: hyoid displacement, extent of UES opening, maximal expiratory pressures, cough effectiveness
- Studied Patient Populations: presbyphagia, post-stroke, TBI, Parkinson’s Disease, Amyotrophic Lateral Sclerosis

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The Rationale

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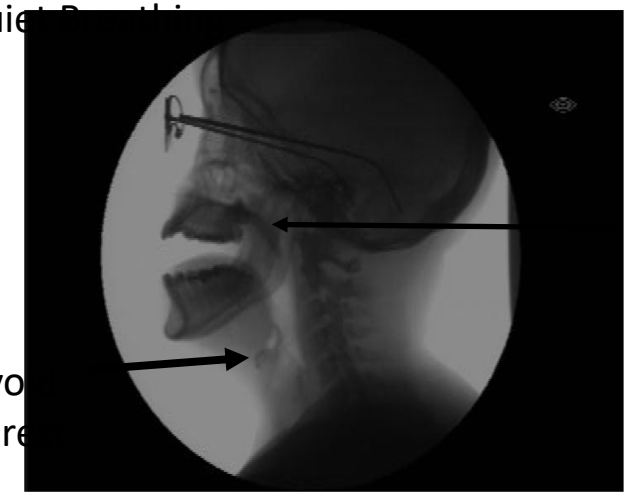

Resting Palate

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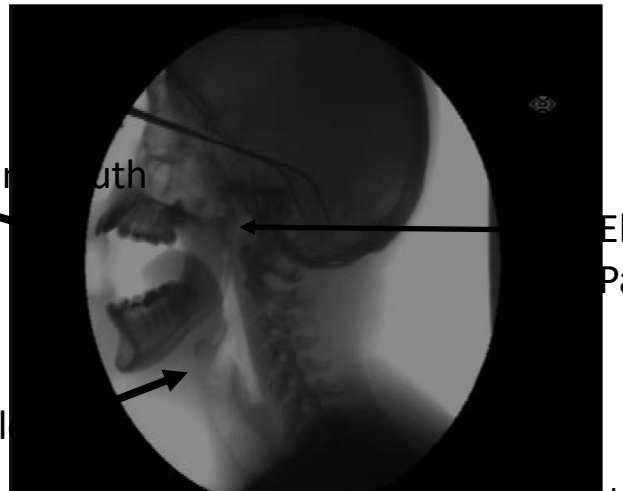
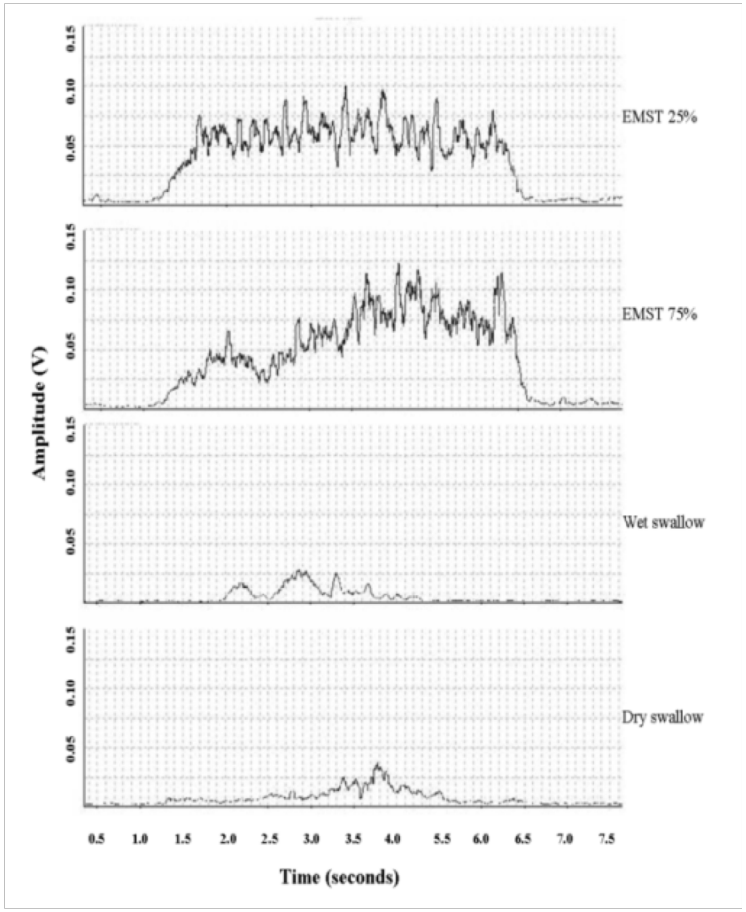


Elevated Palate

Hyoid el



(Wheeler et al., 2007; Wheeler-Hegland et al., 2008)

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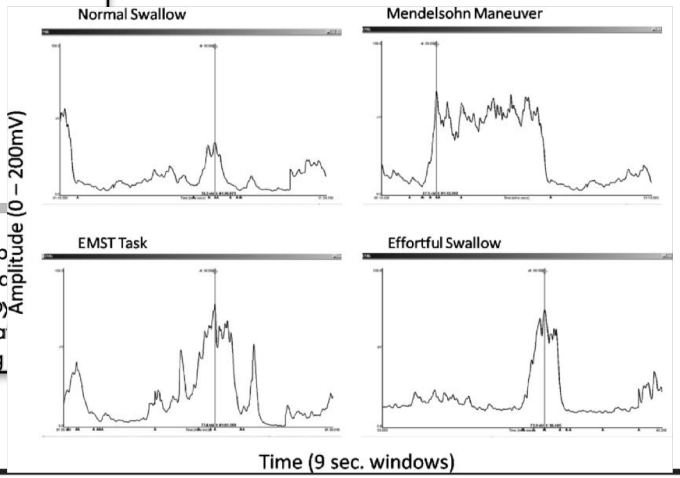
Submental sEMG and Hyoid Movement During Mendelsohn Maneuver, Effortful Swallow, and Expiratory Muscle Strength Training

Karen M. Wheeler-Hegland
Arizona State University, Tucson

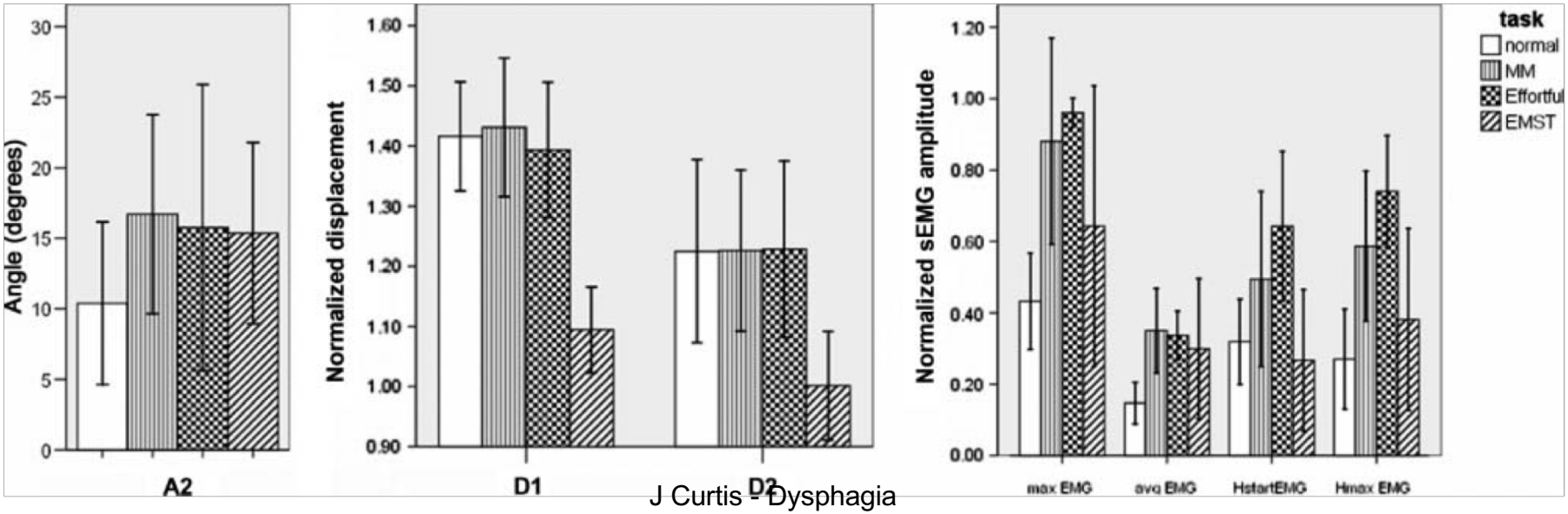
John C. Rosenbek
Christine M. Sapienza
University of Florida

Purpose: This study investigated the concurrent biomechanical and electromyograp
properties of 2 swallow-specific tasks (effortful swallow and Mendelsohn maneuver) c
1 swallow-nonspecific (expiratory muscle strength training [EMST]) swallow therap
task in order to examine the differential effects of each on hyoid motion and associa
submental activation in healthy adults, with the overall goal of characterizing

Figure 3. Waveforms obtained for sEMG biofeedback for Mendelsohn maneuver and effortful swallow (right top and bottom, respectively) compared with normal swallow (left) for task learning.



(Wheeler-Hegland, Rosenbek & Sapienza, 2008)



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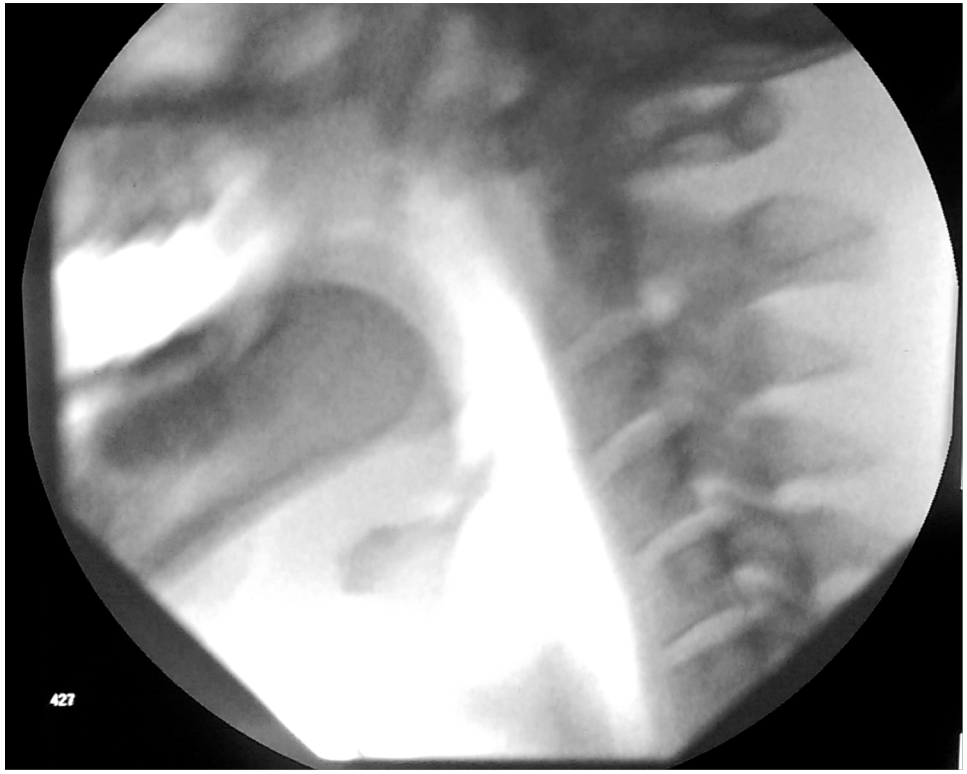
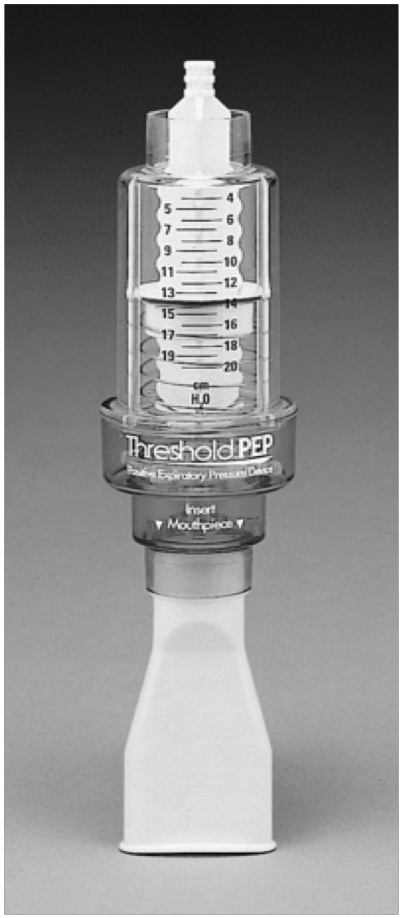
Expiratory Muscle Strength Training (EMST)



EMST is a Pressure Threshold Trainer

Modalities

- Pressure threshold devices (recommended)
  - EMST-150
  - Threshold PEP
- Continuous resistive devices (not recommended)
  - Straws
  - The Breather

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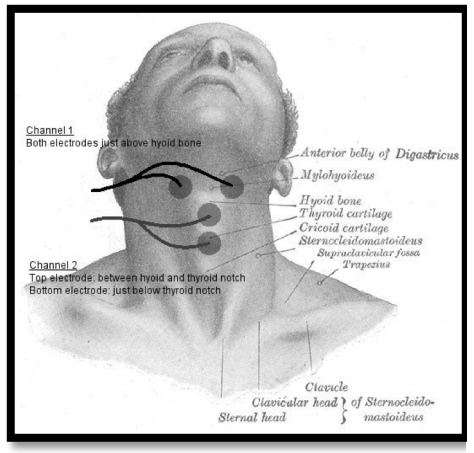
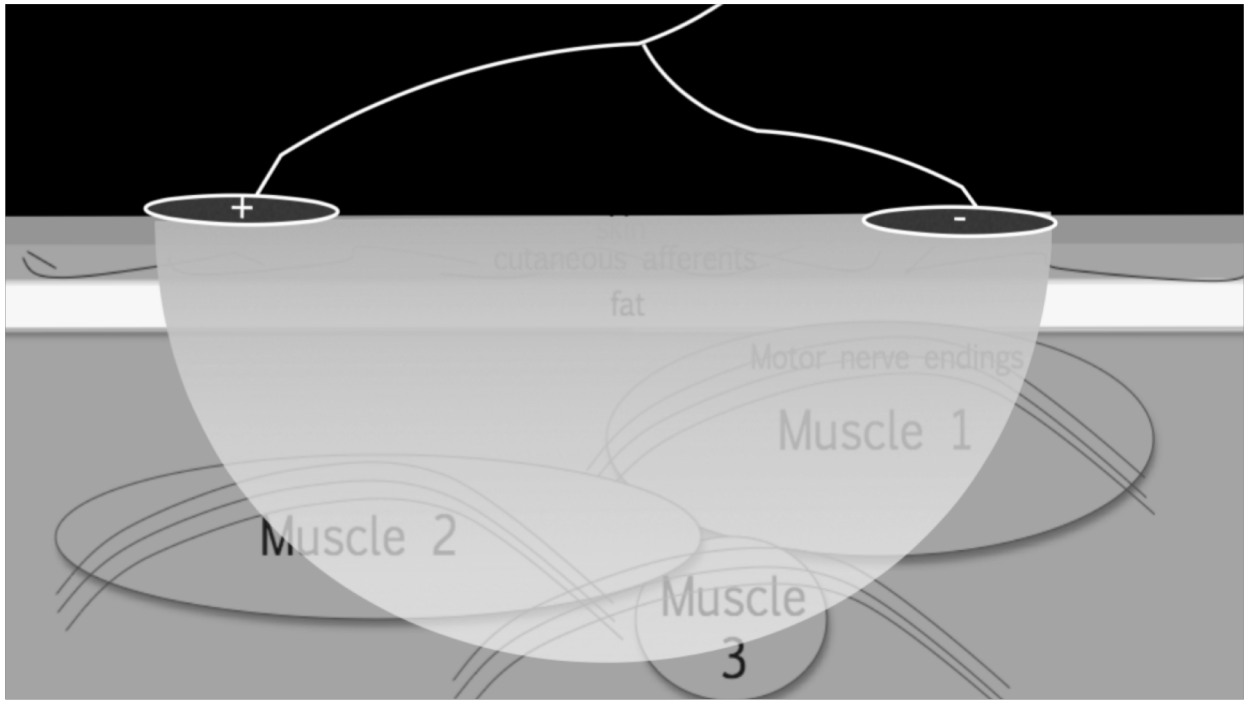
Neuromuscular Electrical Stimulation (NMES)

- NMES is a therapeutic modality NOT an exercise
- It uses electrical pulses as a means of exciting peripheral nerves and evoking an action potential and muscle contraction, either through skin (sEMG/tEMG) or directly into the muscle (hookwire)
- NMES is a modality that, if used, should be performed in conjunction with exercises
- Most studied therapy (modality) in dysphagia rehabilitation, but with inconclusive findings – why?
  - Major hot topic in SLP world



Neuromuscular Electrical Stimulation (NMES)

- Rationale for use:
  - To increase strength
  - To increase sensation
  - To increase skill/coordination



Neuromuscular Electrical Stimulation (NMES)

- Electrodes may be placed unilaterally, bilaterally, or midline, and on the submental region, thyroid region, or both

- Different electrode placements target different motor units/muscle groups, and may have different therapeutic goals
  - Is goal to assist in muscle contraction?
  - Is goal to provide opposing resistance?

- Signal is more strong superficially

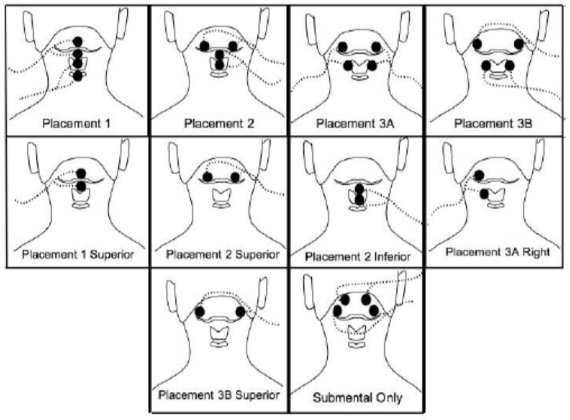


Figure 1.
shows the electrode positions relative to the hyoid bone, thyroid cartilage, and cricoid cartilage. The bipolar electrode pairs for each placement are connected by lead wires (dotted lines) with current flowing between the two electrodes of each pair. Placement 1, 2, 3A, and 3B have electrodes on both submental and laryngeal regions. Placements 1 superior, 2 superior, 2 inferior, 3A right, and 3B superior are individual electrode pairs. The submental-only placement has two electrode pairs above the hyoid bone on the submental region.

Neuromuscular Electrical Stimulation (NMES)

- Popularized by an NMES company, VitalStim, to dysphagia clinicians in the 1990s, but there are many NMES companies each with their own recommended protocols:
  - VitalStim
  - Ampcare
  - Guardian Way

Neuromuscular Electrical Stimulation (NMES)

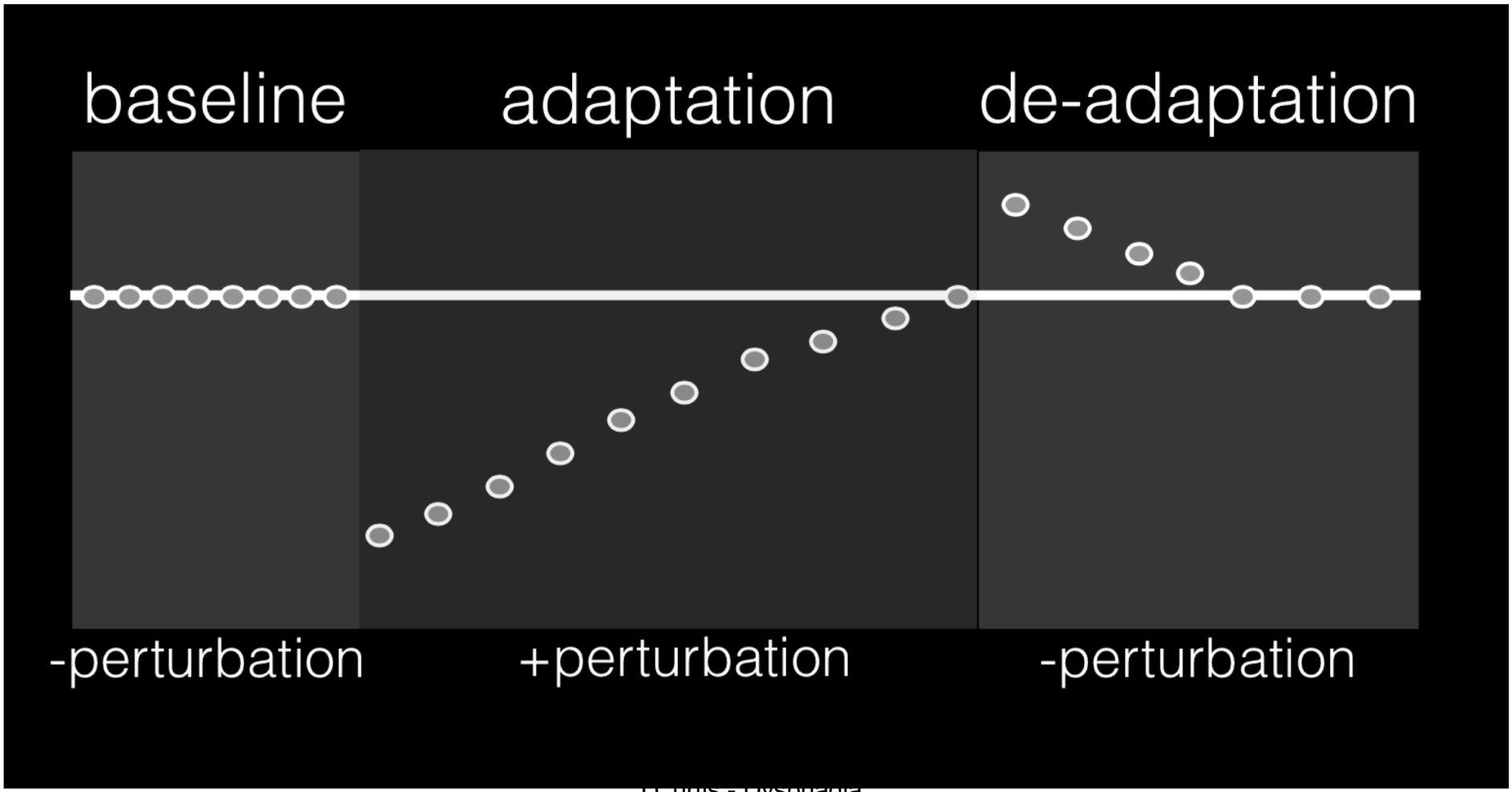
SH Stimulation

IH Stimulation

SH + IH Stimulation

Skill-Based Interventions

Are we capable of (implicitly or explicitly)
"learning" to swallow?



Adaptive Motor Learning - vLVC

Examination of swallowing maneuver training and transfer of practiced behaviors to laryngeal vestibule kinematics in functional swallowing of healthy adults

Renata Guedes [a,b], Alba Azola [c], Phoebe Macrae [d], Kirstyn Sunday [a], Veerley Mejia [a], Alicia Vose [a], Ianessa A. Humbert [a,*]

[a] Swallowing Systems Core, Department of Speech, Language and Hearing Sciences, University of Florida, Gainesville, FL, United States
[b] AC Camargo Cancer Center, Brazil
[c] Department of Physical Medicine and Rehabilitation, Johns Hopkins School of Medicine, Baltimore, MD, United States
[d] Department of Communication Disorders, University of Canterbury, Christchurch, New Zealand

- Guedes et al had two questions:
  - Compare and contrast laryngeal vestibule closure reaction time (LVCrt) and duration of laryngeal vestibule closure (dLVC) between normal swallowing and swallows with volitional laryngeal vestibule closure (vLVC)
  - Compare pre- and post-training LVC temporal kinematics (LVCrt and dLVC) following a vLVC training period

Adaptive Motor Learning - vLVC

Table 2
Pairwise comparisons.

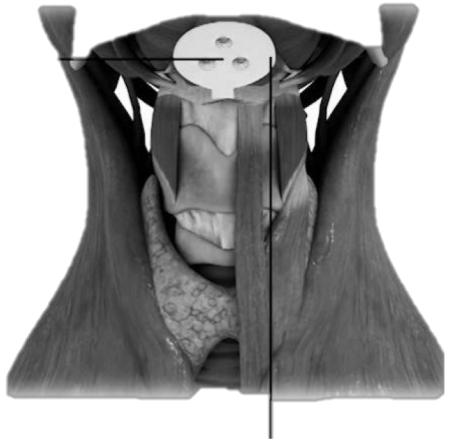
Comparisons	dLVC		LVCrt	
	p-value	Cohen's D	*p*-value	Cohen's D
Question 1: Are LVC kinematics during vLVC maneuver training different than pre-vLVC training natural swallows?				
Long-hold training				
Pre-5 ml water vs vLVC swallow	<**0.001**	−1.31	**0.001**	0.65
Pre-10 ml water vs vLVC swallow	<**0.001**	−1.30	0.931	0.04
Short-hold training				
Pre-saliva vs baseline vLVC swallows	<**0.001**	−2.27	0.133	−0.19
Pre-saliva vs vLVC train block 1	<**0.001**	−2.40	0.037	−0.22
Pre-saliva vs vLVC train block 2	<**0.001**	−2.96	0.182	−0.15
Pre-5 ml barium vs baseline vLVC swallows	<**0.001**	−2.38	<**0.001**	0.51
Pre-5 ml barium vs vLVC train block 1	<**0.001**	−2.55	<**0.001**	0.43
Pre-5 ml barium vs vLVC train block 2	<**0.001**	−3.16	<**0.001**	0.53
Question 2: Do the kinematics practiced during vLVC maneuver training transfer to mid- or post-training natural swallows?				
Long-hold training				
Pre 5 ml water vs post 5 ml water	1.000	−0.48	**0.01**	0.72
Pre 10 ml water vs post 10 ml water	1.000	0.02	0.809	0.04
Short-hold training				
Pre-saliva vs mid-saliva	0.981	0.01	0.877	−0.20
Pre-saliva vs post-saliva	0.635	−0.16	0.346	0.15
Pre-5 ml barium vs mid-5 ml barium	1.000	0.00	0.320	0.13
Pre-5 ml barium vs post-5 ml barium	0.780	−0.24	**0.003**	0.39

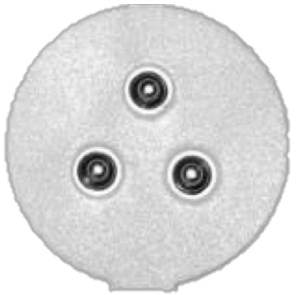
Table displays *p*-values and Cohen's D (effect size) for dLVC and LVCrt for Long- and Short-hold trainings. Outcomes are categorized by research question and comparison. Bold text indicates statistically significant differences.

J Curtis - Dysphagia
Guedes et al., 2017

Biofeedback in Swallowing Skill Training (BiSSkiT)

- Aimed to improve coordination of swallow timing and force (submental focus)
- sEMG with accompanying BiSSkiT software (available commercially) is used display submental muscle contraction during swallowing
- Output is displayed in real time on a computer monitor with the patient goal of producing a swallow pressure with correct ***timing*** and ***amplitude*** based on a changing target





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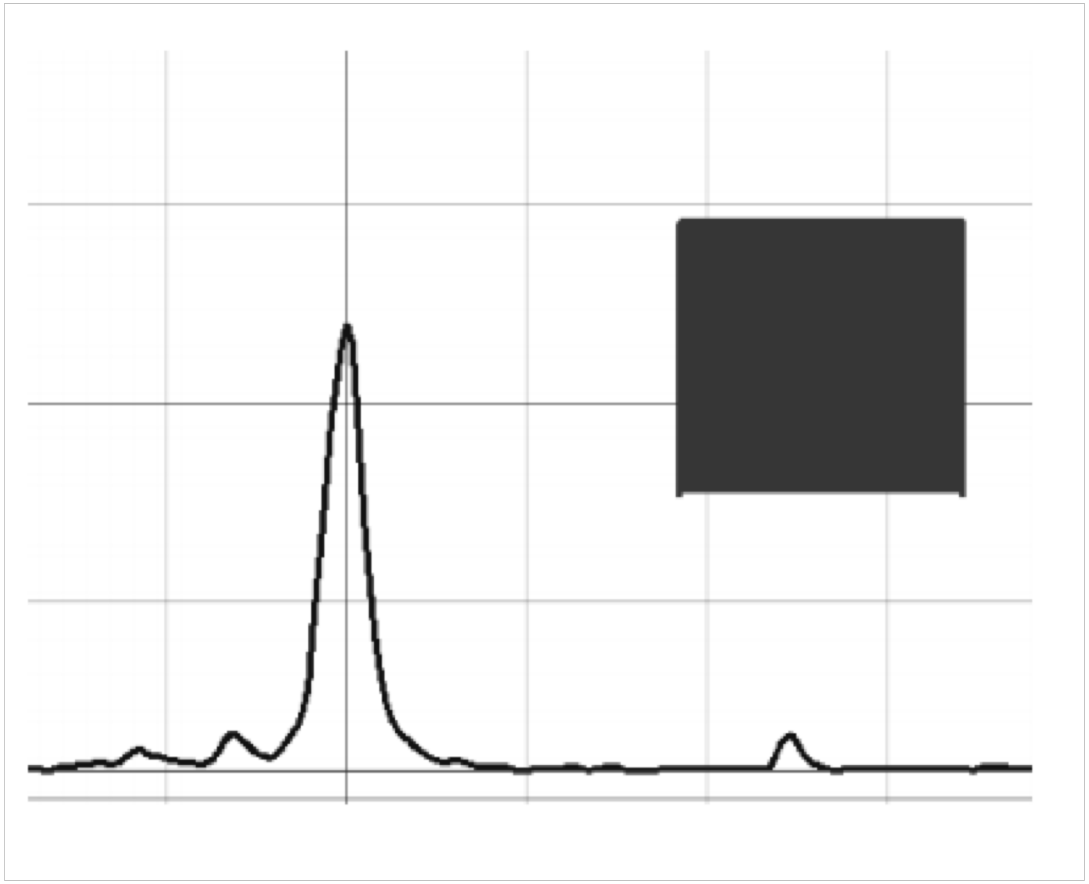
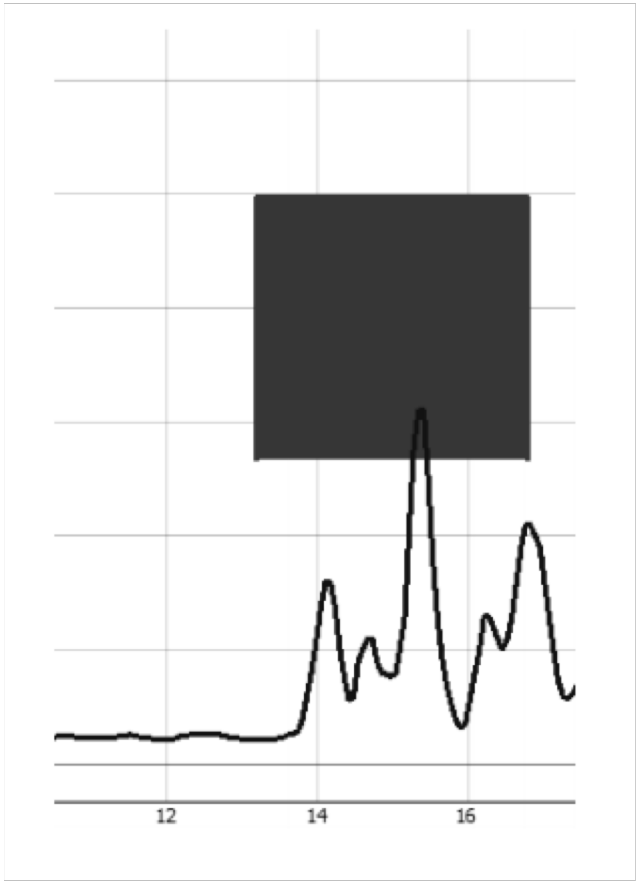
Athukorala et al., 2014; Huckabee et al., 2013;

Biofeedback in Swallowing Skill Training (BiSSkiT)





J Curtis - Dysphagia

Martin-Harris, 2015

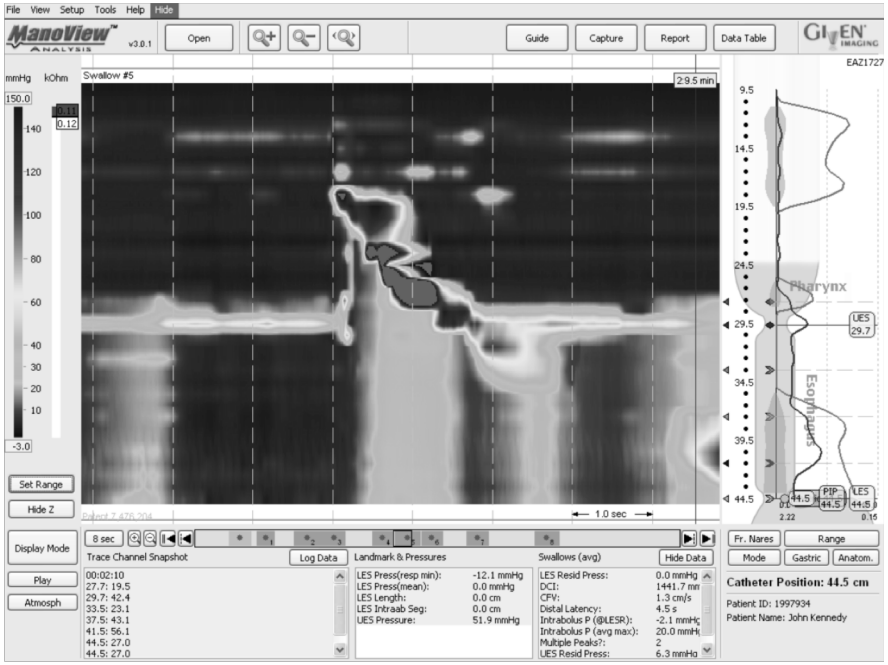
Biofeedback in Swallowing Skill Training (BiSSkiT)

J Curtis - Dysphagia

Martin-Harris, 2015

Effortful Swallow

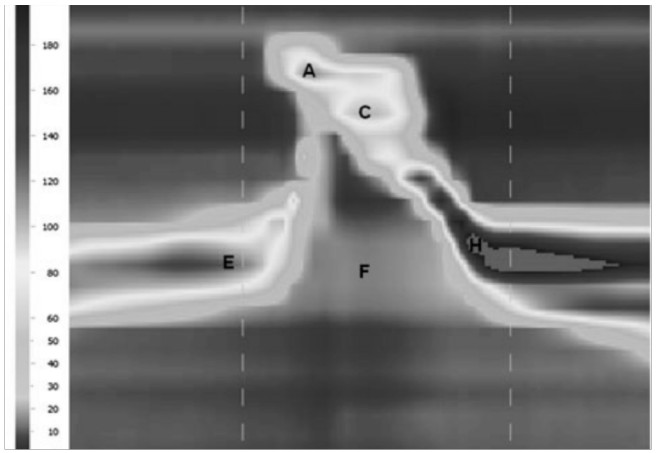
- Instruction: “Swallow with effort, as if getting down a golf ball”
- Physiologic Targets: cortical activation, swallowing pressures, swallowing gesture durations, bolus transit times, esophageal peristalsis
- Studied Populations: healthy, dysphagic (non-specific)

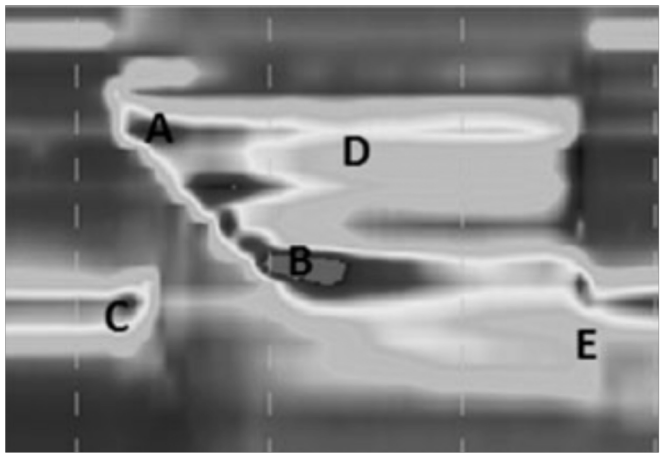


J Curtis - Dysphagia

Mendelsohn Maneuver

- Instruction: “Start a swallow, but then squeeze, and hold it halfway through”
- Physiologic Targets: hyoglossus and suprahyoid muscle activity, extent and duration of superior and anterior excursion, extent of PES relaxation and mechanical opening, duration (though reduce pressure) of VP closure, timing and coordination of pharyngeal events
- Studied Populations: healthy, post-stroke, HNC





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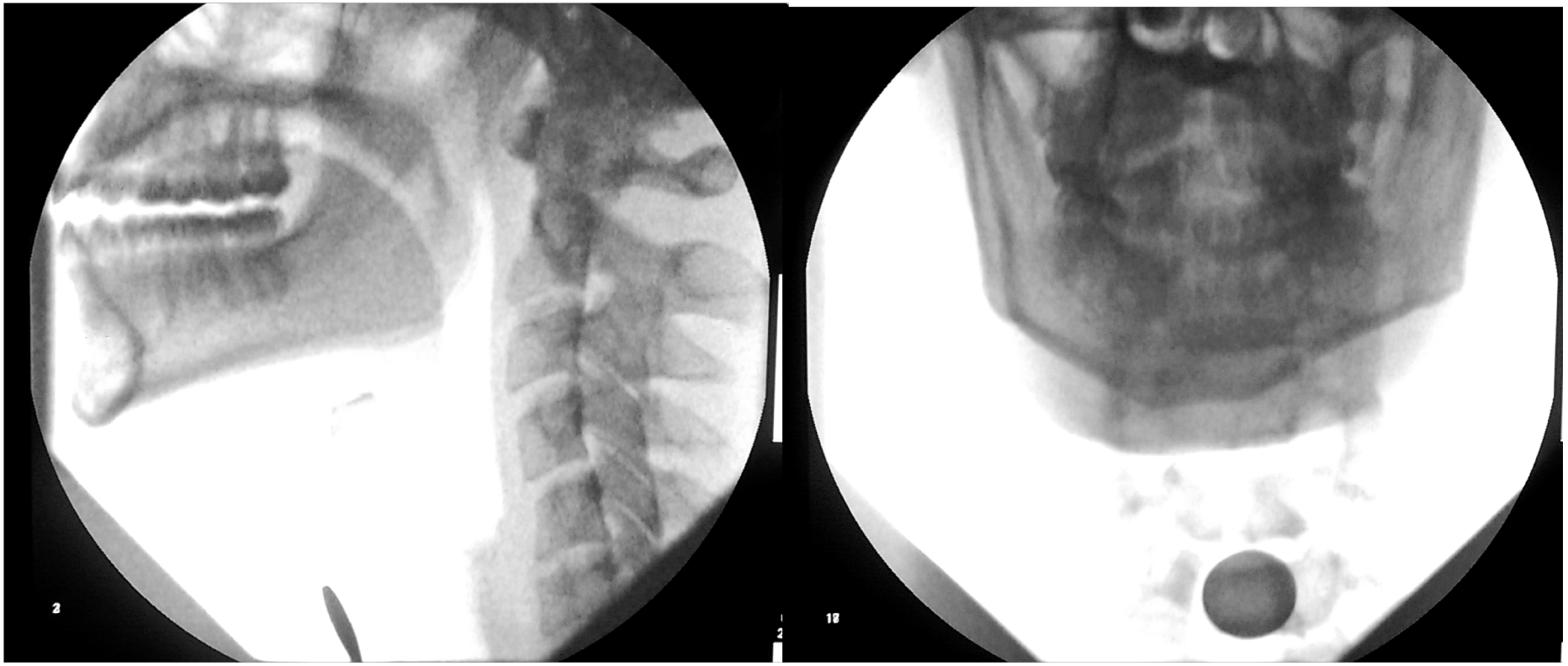
Gasert, 2015; Ding, 2002; Kahrilas, 1991; Lazarus, 1993; Logemann, 1990, 1991, 2002; Lazarus, 1993; Hoffman, 2012; Peck, 2010

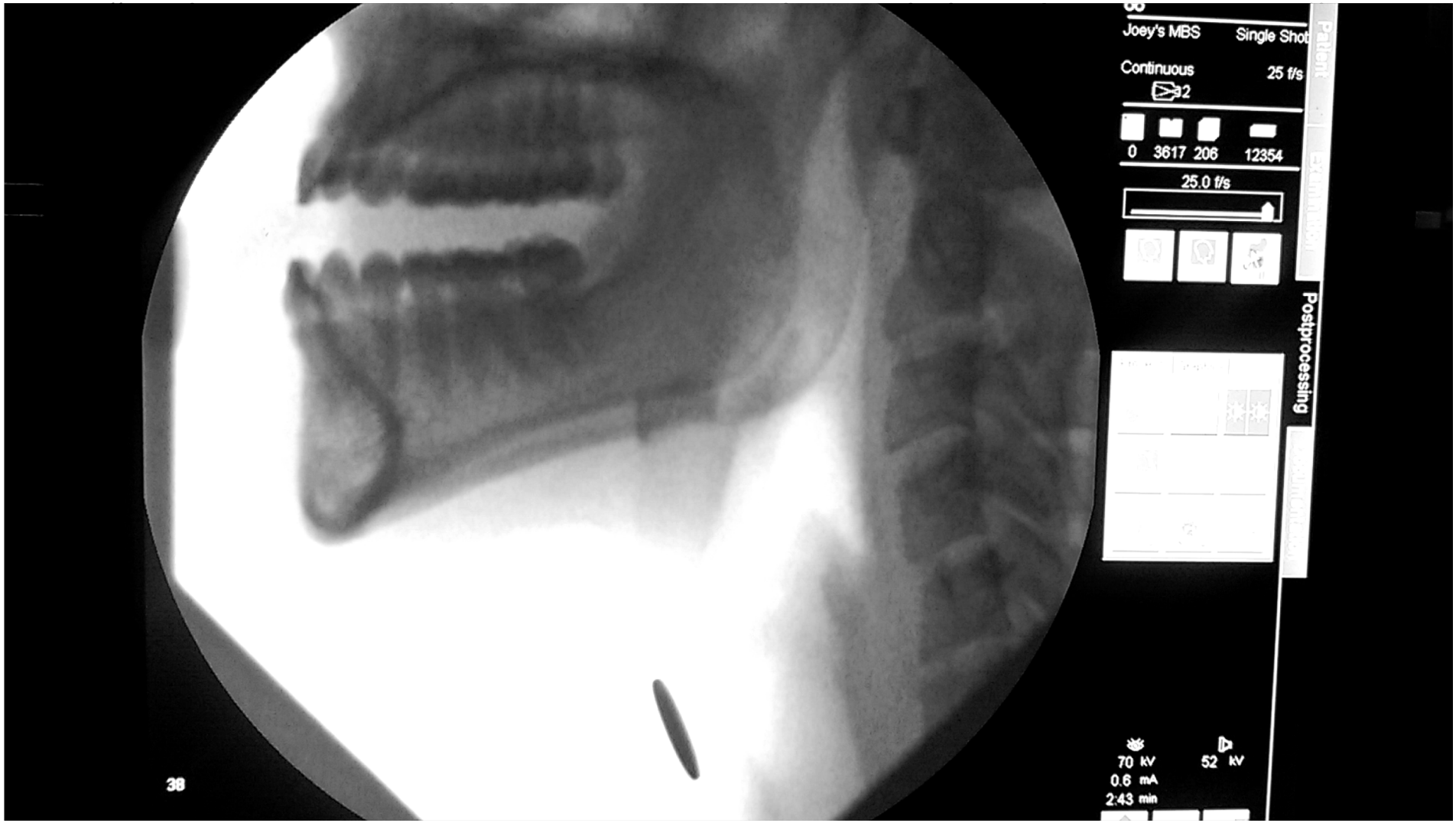
Mendelsohn Maneuver



Masako/Tongue-Hold

- Instruction: “Stick your tongue between your teeth, gently bite down, now swallow hard”
- Physiologic Targets: increased pharyngeal stripping wave and constriction (and ultimately extent, duration, and pressure magnitude of BoT-PPW contact)

Masako/Tongue-Hold



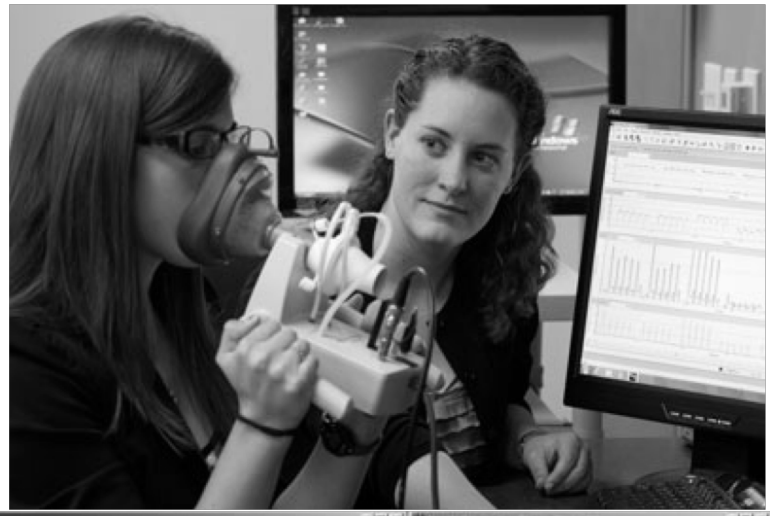
Head Extension Swallowing Exercise

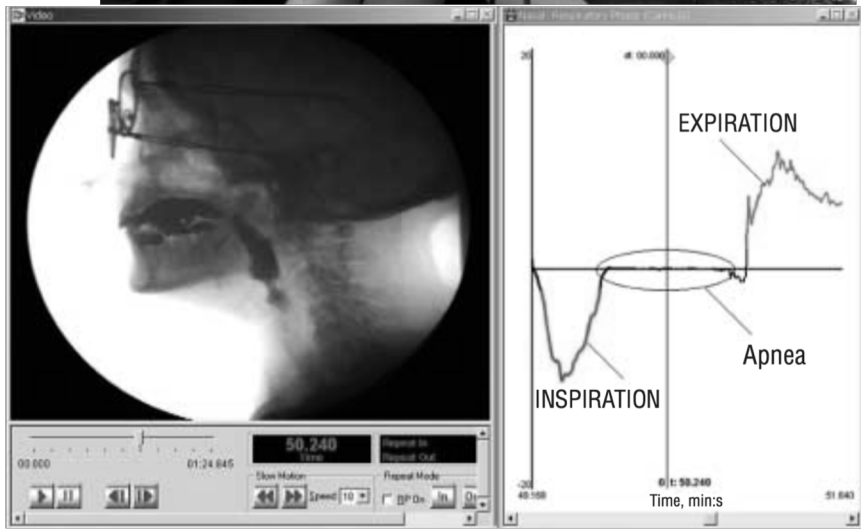
- Instruction: “Extend head to ceiling as much as possible, and while watching the ceiling, swallow your saliva” (repeat every 10 seconds for a duration of 20 minutes)
- Physiologic Target: Intended to improve suprahyoid and tongue muscles (why not pharyngeal wall?) during effortful swallow task
- Studied Populations: healthy individuals

J Curtis - Dysphagia

Respiratory-Swallow Pattern Training

- Aimed to improve airway protection by way of improving respiratory swallow pattern (exhale-swallow-exhale)
- Used biofeedback training protocol to train optimal respiratory-swallow patterning
- Studied in HNC with chronic dysphagia >12 months. Findings include significant improvements in
  - Vestibular closure
  - Tongue base retraction
  - Pharyngeal residue
  - PAS scores
  - EX-EX phase patterning





Cases

Putting it all together – AO History

- 66-year-old male with 2 year history of PD diagnosis and with symptom onset 1 year prior

- Patient reports increased effort with swallowing characterized by sensation of gradually increasing frequency and severity of foods sticking in the mid/lower throat. Patient also reports an unintentional weight loss of ~10 pounds over the course of a few months, though stable now for 1 year.

- Patient denies any other swallowing symptoms (coughing, choking, regurgitation, avoidance of specific foods/liquids, increased meal lengths), nor any recent URIs or PNAs

AO Clinical Findings

- Intact cognition and language (not formally tested)
- Masked facial quality
- Hypophonic voice (soft), though stimulable for increased loudness
- MPT ≈ 12 seconds
- IOPI: maximimal tongue press = 26 kPa (>2 SD); swallowing pressure ~10 kPa (ONL); maximum endurance 8 seconds (>2 SD)
- MEPs = 65 cmH20 (>2 SD)
- PEFR during voluntary cough = 4.79 L/S (>2 SD)
- Respiratory Swallow Patterning = In-Sw-Ex (for 4/5 swallows)
- No UtC during single sips of barium water

AO SEES – Voice Sample

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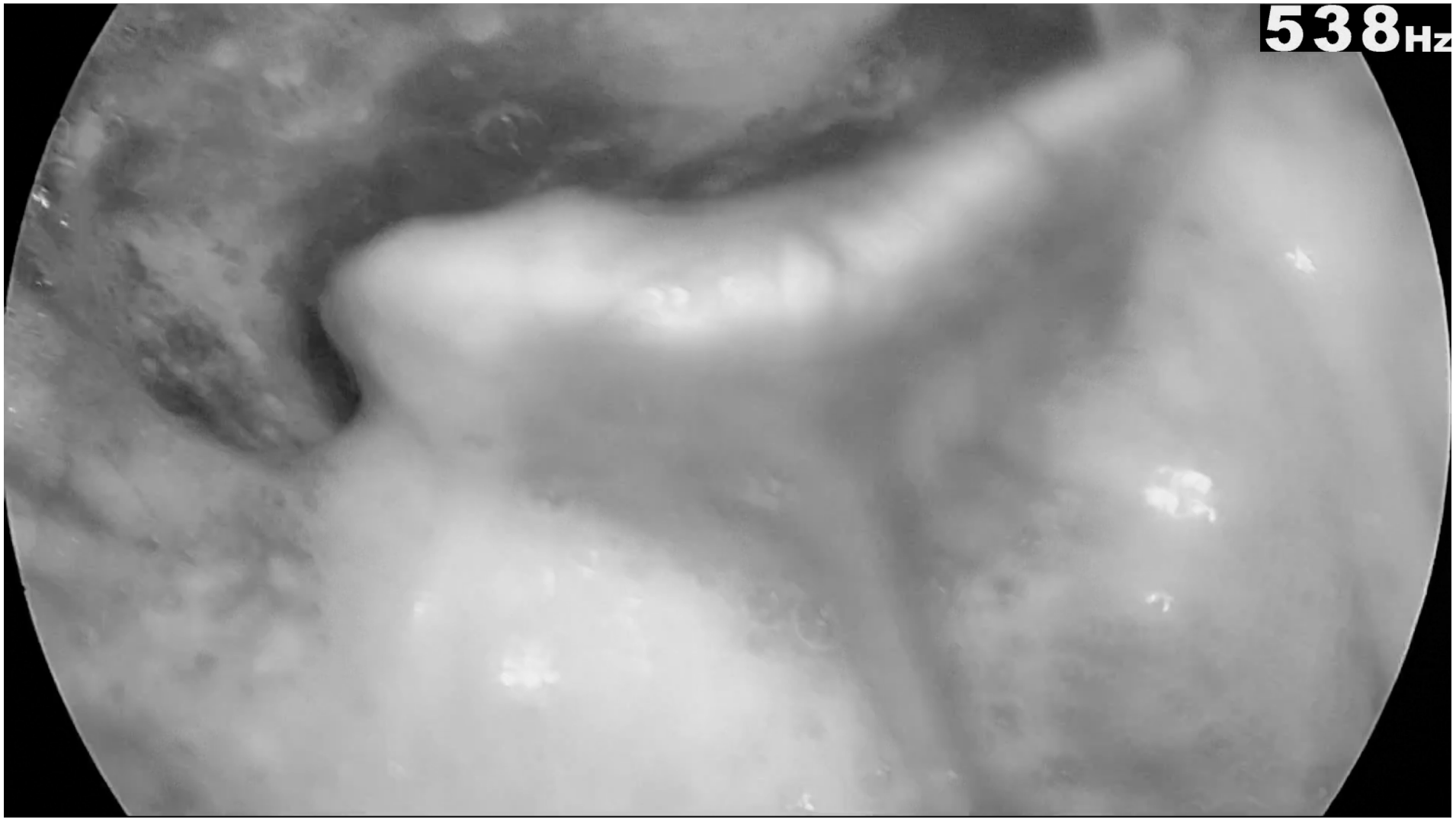
AO SEES – Secretions, VF Mobility, PSM

J Curtis - Dysphagia

AO SEES – Post-Dry Solid (1/8th Graham Cracker)



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AO SEES – Post-Barium Sip (Single Cup Sip)

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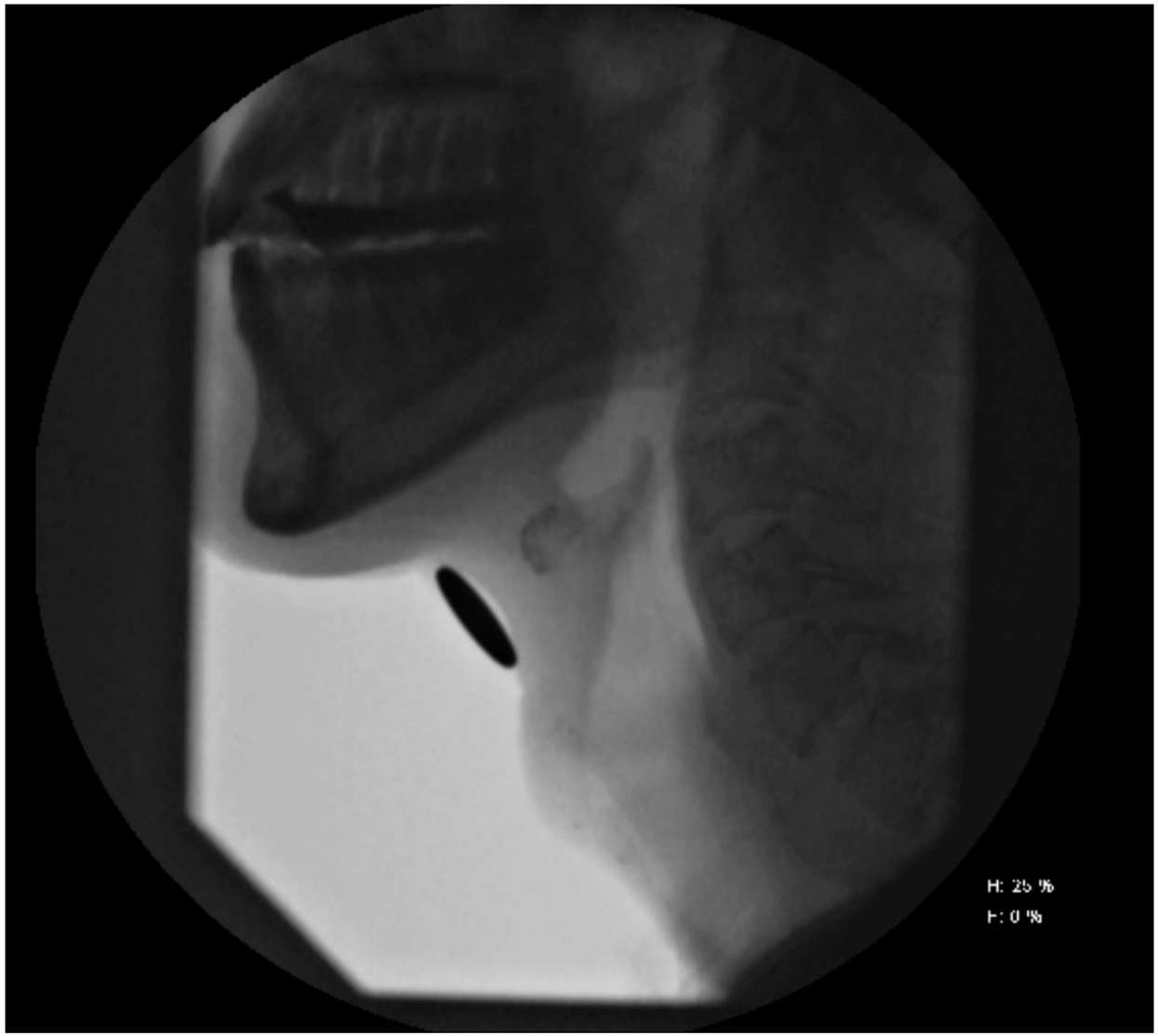
AO – VFSS



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AO

What to do from here?

AO - Therapy

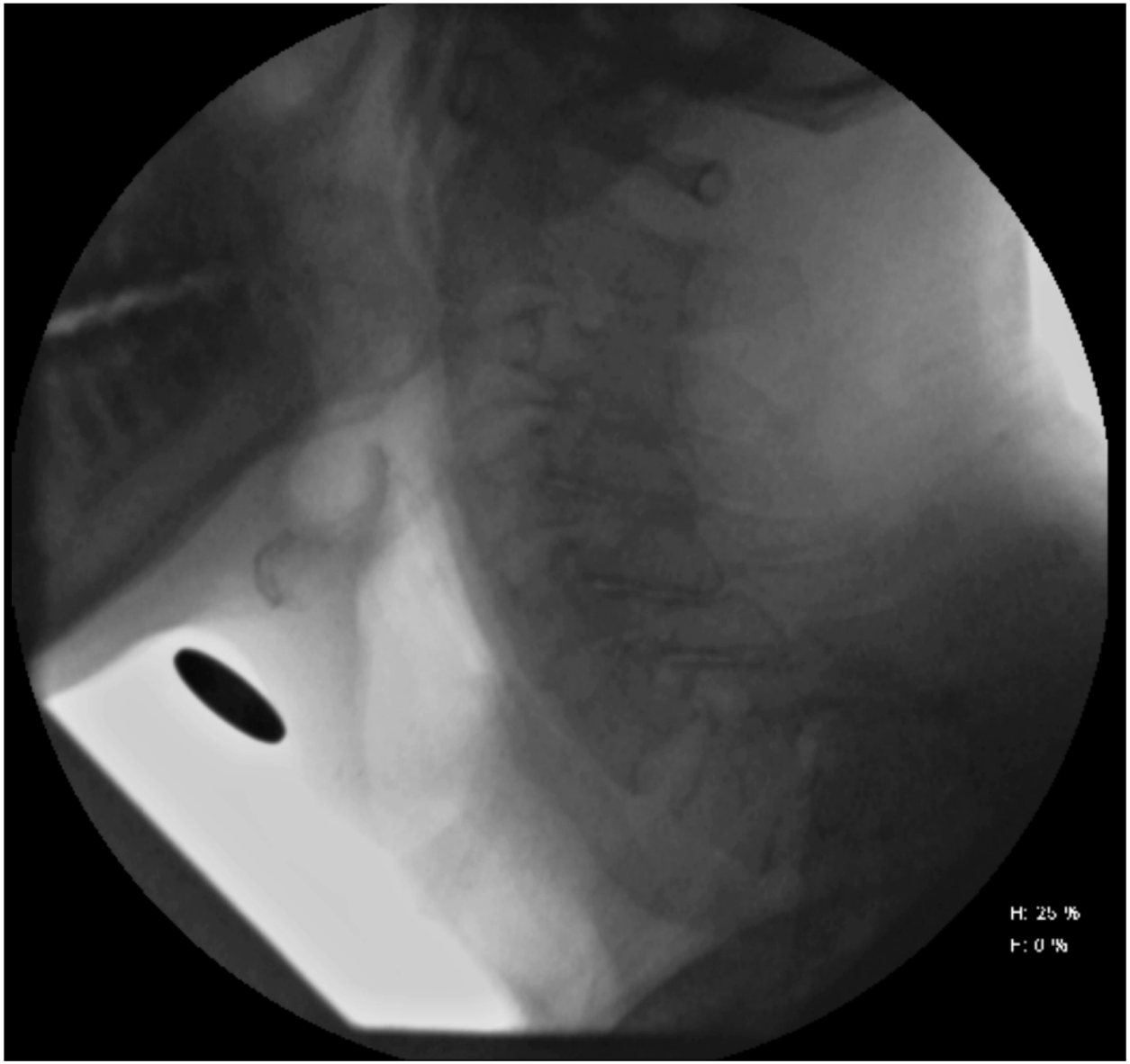
- 4 months of intense rehab focusing on improving force generation and displacement kinematics, specifically: BoT retraction, pharyngeal constriction, and anterior hyoid excursion (and secondarily, epiglottic inversion)
  - Mendelsohn Maneuver: 5 seconds/rep, 10 reps/set, 3 sets/session
  - Lingual Resistance Training: 3 seconds/rep (~80% RM), 10 reps/set, 3 sets/session
  - Expiratory Muscle Strength Training: 90 cmH20 (~75% RM), 5 reps/set, 5 sets/session
  - 1 session/day, 5 days/week
- Re-assess in 4 months to examine functional and physiologic changes

AO – Follow Up VFSS

- Patient attended all scheduled therapy sessions (once weekly for four consecutive weeks, then once a month for three consecutive months)

- Patient reports complete adherence to swallowing therapy recommendations but reports no changes in swallow function

AO – 4-month Follow-Up VFSS



AO – Follow Up VFSS

- Does the patient appear functionally and/or physiologically improved?

- If not, why?

  – Right exercises, but patient just hasn't improved "enough" within each exercise yet?

  – Wrong exercises all together?

  – How can we help answer this?

AO – Follow Up VFSS

Objective Oral-Motor and Head & Neck Examination revealed:

Lingual Strength:

Maximal Isometric Press: 34 kPa (1.5-2 SD) - *up from 26 kPa (>2 SD)*
Mean Swallow: 10 kPa (1-1.5 SD) - *up from 12 kPa (WNL)*
Maximal Endurance @ 50% Max Strength: 17 seconds (~1 SD) - *up from 8 seconds (>2 SD)*

Respiratory-Swallowing Pattern:

Inhale-swallow-exhale (suboptimal) – consistent with initial evaluation

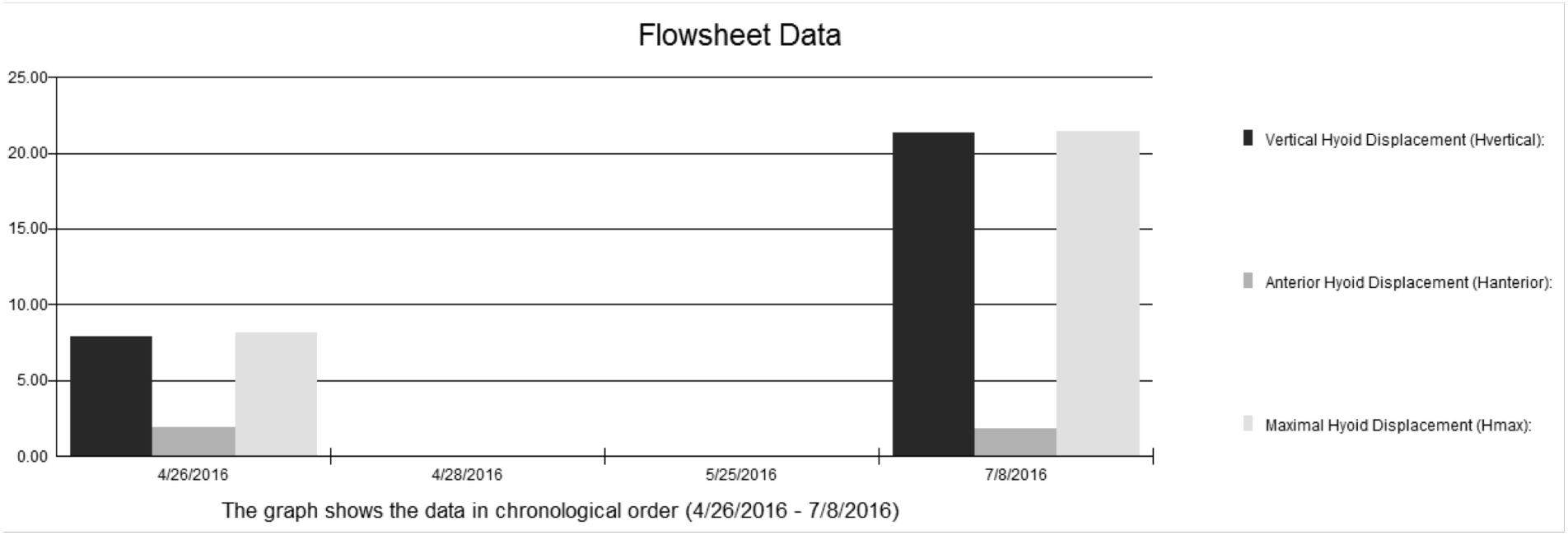
Maximal Expiratory Pressure:

~100 cmH_20 (1.5-2 SD) – up from *65 cmH_20 (>2 SD)*

Voluntary Cough Airflow Measures:

Peak Expiratory Flow Rate: 4.79 L/s (>2 SD - 87.5% sensitivity & 97.06% specificity for penetration/aspiration) - *stable from 5.07 L/s at initial measurement intake*

AO – Follow Up VFSS



AO – Follow Up VFSS

- Everything targeted in therapy actually responded well to rehab exercises, though given persistent dysphagia, these impairment may not have been the main contributing factors to the dysphagia

- This provides good evidence that continued therapy is warranted given his responsiveness, but that perhaps the therapy targets should change (or change once “WNL”)

- What should we consider targeting?

Treatment/Management Process - Case

- 29-year-old male with history of myotonic muscular dystrophy

- 4 year history of swallowing difficulty characterized by:
  - Food sticking in his throat
  - Intermittent choking (Heimlich required 2x within last year)
  - Increased effort swallowing (solids > liquids)
  - Increased meal lengths

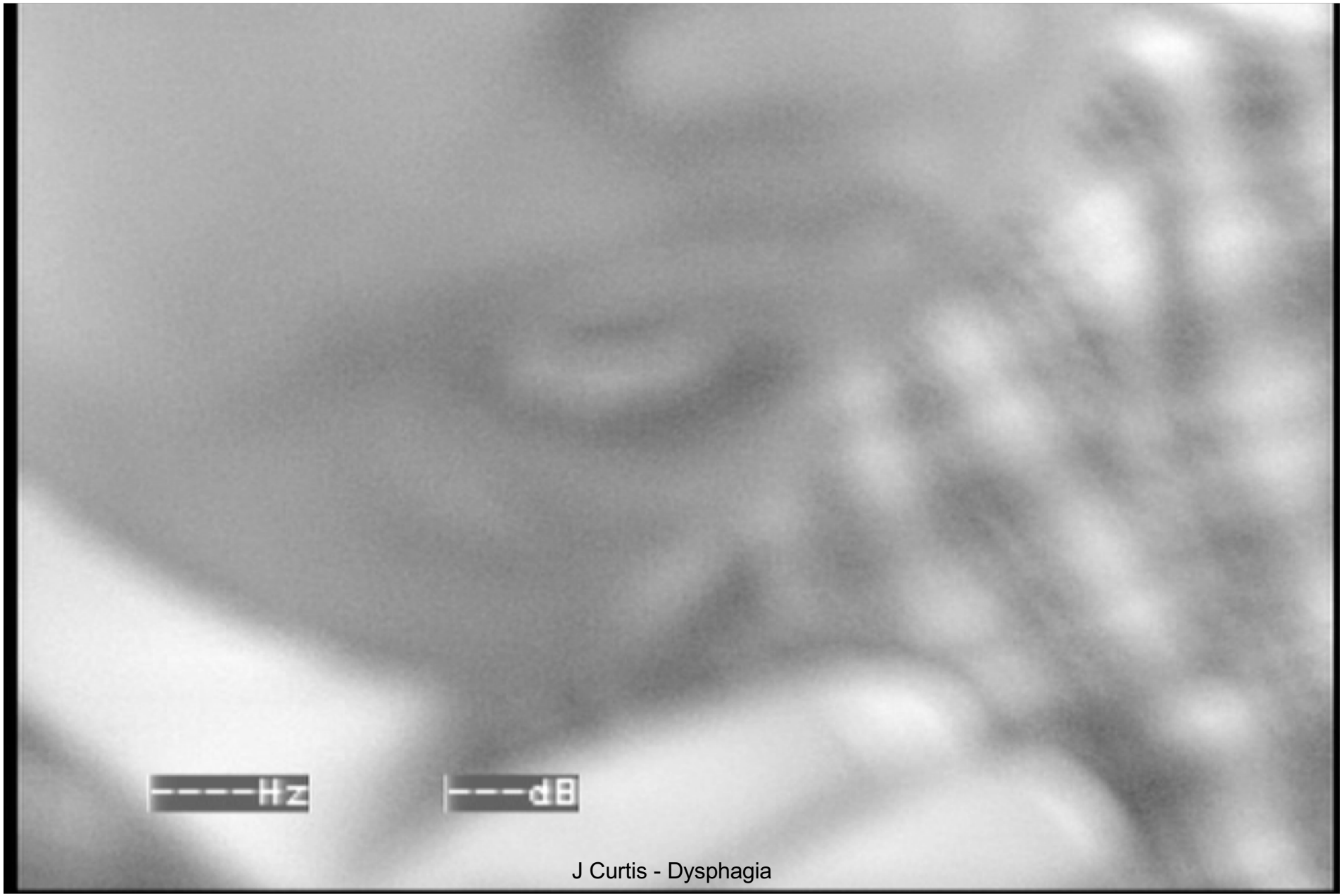
- Avoiding hard solids; liquid washes help with soft solids

- History of 20 lbs unintended weight loss; no recent PNAs, URIs or chest infections, or reflex

Treatment/Management Process - Case

- Cognitively, patient was alert, oriented, and cooperative
- Physically, patient presented ambulatory though subjectively appearing thin and weak
- Clinical observations revealed flaccid dysarthria characterized by consistent asthenic and breathy voice quality, hypernasality and intermittent nasal air emissions, and consistent mildly distorted articulation with all sounds

Treatment/Management Process -



J Curtis - Dysphagia

Treatment/Management Process - Case

- Clinical swallow evaluation with saltine cracker and sips of water revealed >ONL oral residue but did not reveal any coughing, throat clearing, or wet voice quality

- SEES revealed:
  - Reduced pharyngeal squeeze
  - Significant amount of frothy secretions within the pharynx and larynx
  - Minimal clearance of graham cracker (single bite), resulting in bilateral vallecular residue and left piriform/lateral channel residue

J Curtis - Dysphagia

Treatment/Management Process

- Instrumental findings:
  - What are the physiologic impairments?
  - What are the signs of dysphagia?

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Treatment/Management Process

- Instrumental findings:
  - What are the physiologic impairments?
  - What are the signs of dysphagia?
- Clinical findings:
  - What is the likely pathophysiology?
  - What is the progression of the condition?
- Treatment plan:
  - What kinematic impairment are possible targets?
  - Would you target strength or skill?