MUSC MEDICAL UNIVERSITY of SOUTH CAROLINA

The Charleston Pharyngoesophageal Manometry Program • April 7-8, 2023 • Charleston, SC

Therapeutic Applications of Pharyngeal Manometry

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Therapeutic Intervention

Appropriate diagnostics yield specific therapeutic targets

Targeted intervention

Ongoing Assessment

Evaluate Efficacy of Intervention with Measurable Outcome

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Behavioral Retraining Approaches

"When behavioral re-training approaches ***are appropriate for a specific patient*** *(and* ***his/her pathophysiology****)* ***AND they are implemented using principles of exercise physiology, motor learning, and neuroplasticity****, patient outcomes will very likely be positive"*

"Not only the specific exercises, but more importantly ***the way*** *these exercises and programs are implemented is key to the success of the patients."*

~Georgia Malandraki, SIG 13 List Serve

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Principles of Activity-dependent Neuroplasticity

Table 1. Principles of experience-dependent plasticity.

Principle	Description
1. Use It or Lose It	Failure to drive specific brain functions can lead to functional degradation.
2. Use It and Improve It	Training that drives a specific brain function can lead to an enhancement of that function.
3. Specificity	The nature of the training experience dictates the nature of the plasticity.
4. Repetition Matters	Induction of plasticity requires sufficient repetition.
5. Intensity Matters	Induction of plasticity requires sufficient training intensity.
6. Time Matters	Different forms of plasticity occur at different times during training.
7. Salience Matters	The training experience must be sufficiently salient to induce plasticity.
8. Age Matters	Training-induced plasticity occurs more readily in younger brains.
9. Transference	Plasticity in response to one training experience can enhance the acquisition of similar behaviors.
10. Interference	Plasticity in response to one experience can interfere with the acquisition of other behaviors.

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Kleim & Jones, 2008

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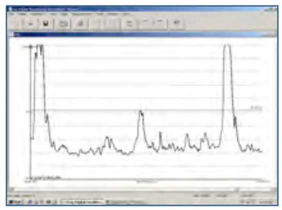
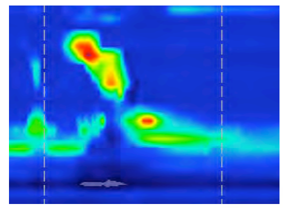
Specificity & Biofeedback

- Swallowing produces limited external movement patterns and intrinsic feedback systems are likely impaired in the presence of dysphagia. (Huckabee & Macrae, 2014)
- Improved performance is heavily influenced by the presence of guidance and feedback. (Salomi, Schmidt, & Walter, 1984)

Endoscopy



Electromyography



Manometry

Modalities
- Fluoroscopy
- Electromyography
- Endoscopy
- *Manometry*

Paradigm shift to strength AND skill training
- Athukorala et al., 2014
- Huckabee et al., 2013

Maximizes rehabilitation & improves outcomes
- Azola et al., 2016
- Martin-Harris et al., 2015
- Macrae et al., 2014
- Humbert & Joel, 2012
- Crary et al. 2004
- Kahrilas et al. 1993

Utility of Biofeedback

- Adjunct tool for proprioceptive training
  - Not a stand-alone therapy
  - Utilize with traditional and/or novel therapies
- Demonstrate and train targeted interventions
- Monitors adherence and progress
- Provides quantitative, objective outcome data
- Evaluates efficacy of interventions

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Utility of Biofeedback

- Education and shaping of desired response
  - Educate the patient regarding the nature of their swallowing disorder
  - Dependent on cognitive ability
- Targeted intervention training
  - Demonstrate and train targeted treatment
  - Goal is patient understanding of exercises and strategies

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HRM Facilitated Biofeedback

- Precedence
  - Anorectal biofeedback for fecal incontinence
    - Norton et al., 2012, Markland et al., Mazor et al., 2016
  - Volitional control of UES pressure (n=10)
    - Nativ-Zeltzer et al., 2019
  - LES in reflux patient (n=1)
    - Gordon et al., 1984
- Increased number of sensors enhance the biofeedback potential for pharynx

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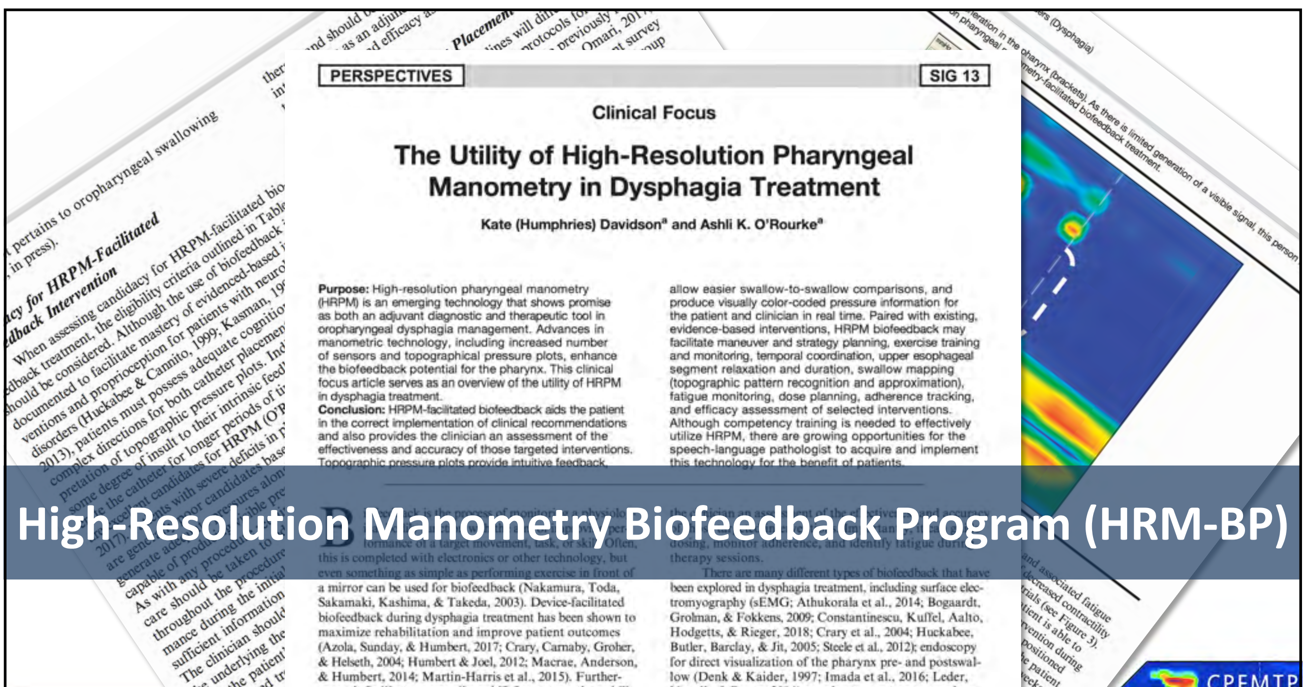

PERSPECTIVES SIG 13

Clinical Focus

The Utility of High-Resolution Pharyngeal Manometry in Dysphagia Treatment

Kate (Humphries) Davidson[a] and Ashli K. O'Rourke[a]

Purpose: High-resolution pharyngeal manometry (HRPM) is an emerging technology that shows promise as both an adjuvant diagnostic and therapeutic tool in oropharyngeal dysphagia management. Advances in manometric technology, including increased number of sensors and topographical pressure plots, enhance the biofeedback potential for the pharynx. This clinical focus article serves as an overview of the utility of HRPM in dysphagia treatment.
Conclusion: HRPM-facilitated biofeedback aids the patient in the correct implementation of clinical recommendations and also provides the clinician an assessment of the effectiveness and accuracy of those targeted interventions. Topographic pressure plots provide intuitive feedback, allow easier swallow-to-swallow comparisons, and produce visually color-coded pressure information for the patient and clinician in real time. Paired with existing, evidence-based interventions, HRPM biofeedback may facilitate maneuver and strategy planning, exercise training and monitoring, temporal coordination, upper esophageal segment relaxation and duration, swallow mapping (topographic pattern recognition and approximation), fatigue monitoring, dose planning, adherence tracking, and efficacy assessment of selected interventions. Although competency training is needed to effectively utilize HRPM, there are growing opportunities for the speech-language pathologist to acquire and implement this technology for the benefit of patients.

... this is completed with electronics or other technology, but even something as simple as performing exercise in front of a mirror can be used for biofeedback (Nakamura, Toda, Sakamaki, Kashima, & Takeda, 2003). Device-facilitated biofeedback during dysphagia treatment has been shown to maximize rehabilitation and improve patient outcomes (Azola, Sunday, & Humbert, 2017; Crary, Carnaby, Groher, & Helseth, 2004; Humbert & Joel, 2012; Macrae, Anderson, & Humbert, 2014; Martin-Harris et al., 2015). Furthermore, it facilitates a paradigm shift from strength to skill

... therapy sessions.

There are many different types of biofeedback that have been explored in dysphagia treatment, including surface electromyography (sEMG; Athukorala et al., 2014; Bogaardt, Grolman, & Fokkens, 2009; Constantinescu, Kuffel, Aalto, Hodgetts, & Rieger, 2018; Crary et al., 2004; Huckabee, Butler, Barclay, & Jit, 2005; Steele et al., 2012); endoscopy for direct visualization of the pharynx pre- and postswallow (Denk & Kaider, 1997; Imada et al., 2016; Leder, Novella & Patwa, 2004); accelerometry to measure hyo-

High-Resolution Manometry Biofeedback Program (HRM-BP)

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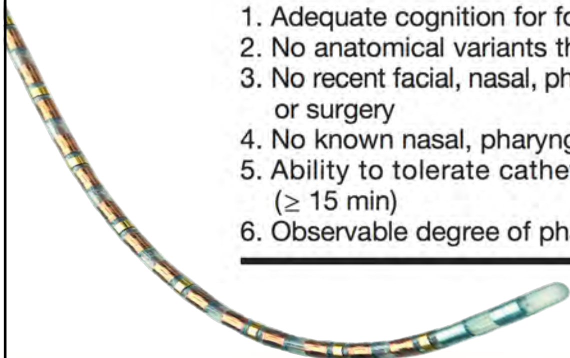
Candidacy for HRM-BP

Table 1. Eligibility criteria for high-resolution pharyngeal manometry–facilitated biofeedback therapy.

1. Adequate cognition for following complex directions
2. No anatomical variants that would prohibit catheter placement
3. No recent facial, nasal, pharyngeal, laryngeal or esophageal trauma or surgery
4. No known nasal, pharyngeal, or esophageal obstruction
5. Ability to tolerate catheter placement for extended periods (≥ 15 min)
6. Observable degree of pharyngeal contractility



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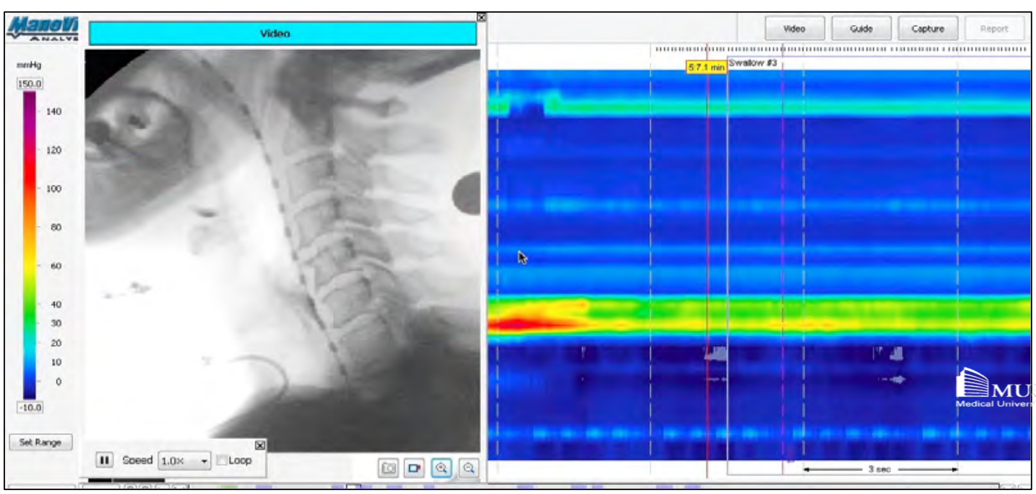
Candidacy for HRM-BP



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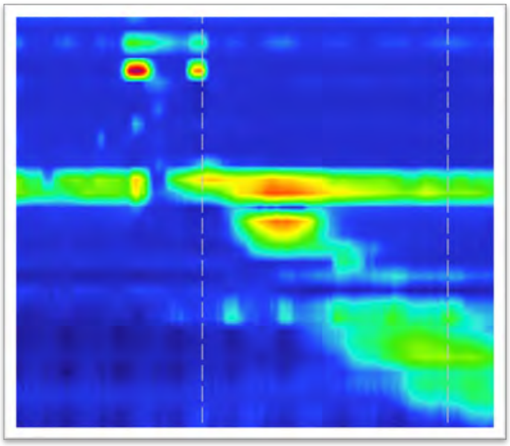
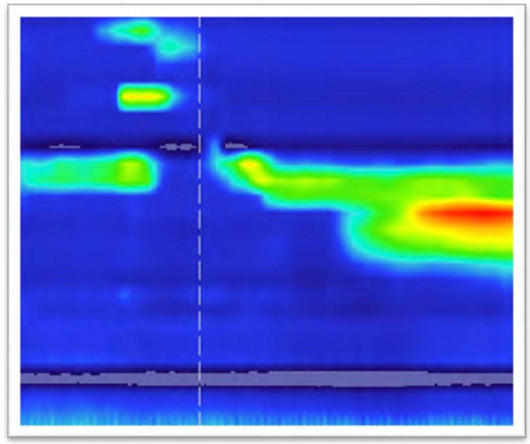
Candidacy for HRM-BP

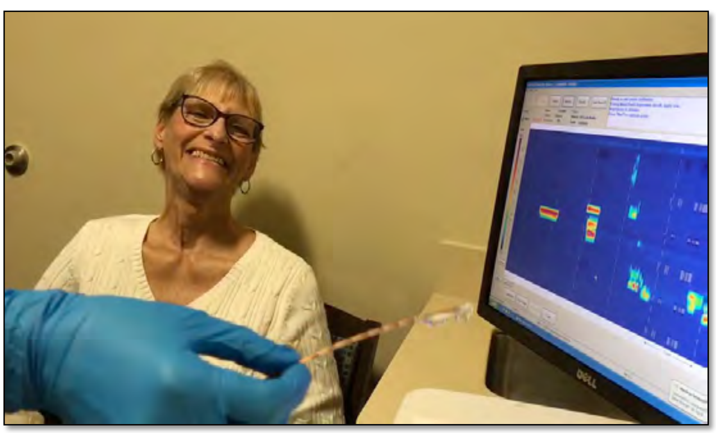


Pre-tx (session 1)



Post-tx (session 6)

HRM-BP Protocol



1. Topical vs spray anesthesia
2. Catheter placement
   - Physician assistance?
   - Visualization?
   - 2.7mm
   - Chin tuck, water swallows
3. Acclimation period
4. Calibration
5. Baseline swallows
6. Targeted Treatment

HRM-BP Protocol

Module	Goal Description	Criteria Level (%)
Identification	Identification of target PhCI during effortful swallow (based on age criteria) (Goal 1) and swallow event (Goal 2) relative to baseline PhCI (non-effortful swallows) using simulated topographic pressure plots.	80
	Identification of target PhCI during effortful swallow (Goal 3) and swallow event (Goal 4) relative to baseline PhCI using visually guided feedback during self-swallowing.	80
Acquisition	Effortful swallow at target PhCI using visually guided feedback for thin (Goal 5), nectar-thickened (Goal 6), and pudding (Goal 7) during swallowing.	80
Mastery	Effortful swallow at target PhCI without visually guided feedback for thin (Goal 8), nectar-thickened (Goal 9), and pudding (Goal 10) during swallowing.	90

EXAMPLE

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Adapted: Martin-Harris et al., 2015

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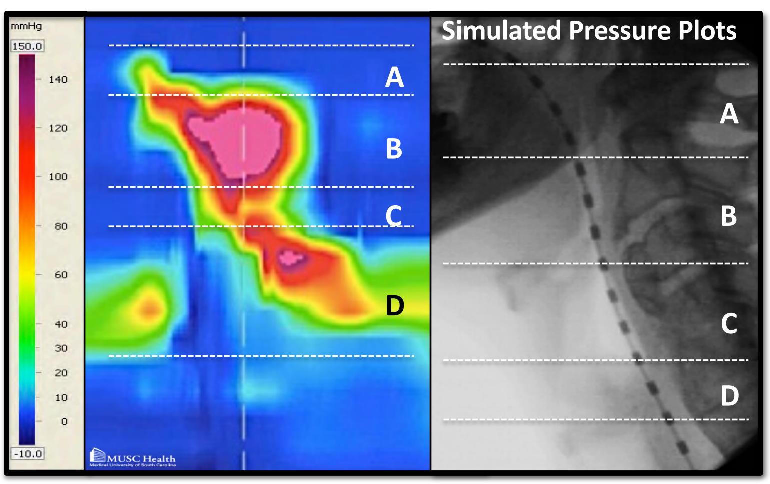
Identification - Simulated



A) Velopharynx Region
- Soft palate
- Superior pharyngeal constrictors

B) Mesopharyngeal
- Tongue base
- Inferior pharyngeal constrictors
- Middle pharyngeal constrictors

C) Hypopharynx Region
- Inferior pharyngeal constrictors

D) UES Region
- Pharyngoesophageal segment

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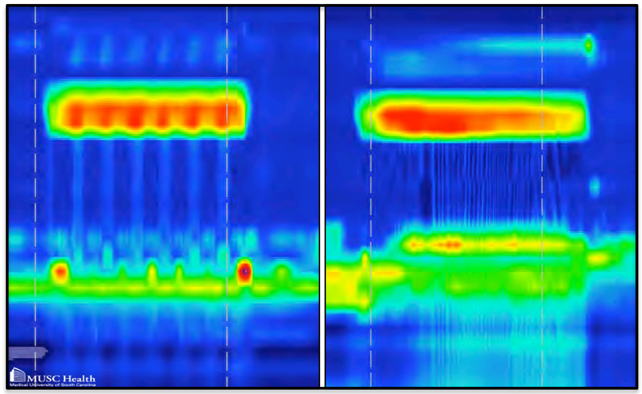
Identification – Self-generated Pressures

Train relationship between observable movement and changes in pressure:

- palpate catheter -> voiced velars -> pharyngeal glide -> swallow
- Goal for observation of the signal to become associated with proprioceptive biofeedback of movement.

Voiced velars Pharyngeal glide



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Acquisition – Visually Guided

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Mastery – No visual feedback

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HRM-BP Applications

- Maneuver/strategy planning & training
- Exercise training & monitoring
- Temporal coordination
- PES relaxation & duration
- Swallow mapping (pattern recognition)
- Dosing & adherence

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Intervention Planning

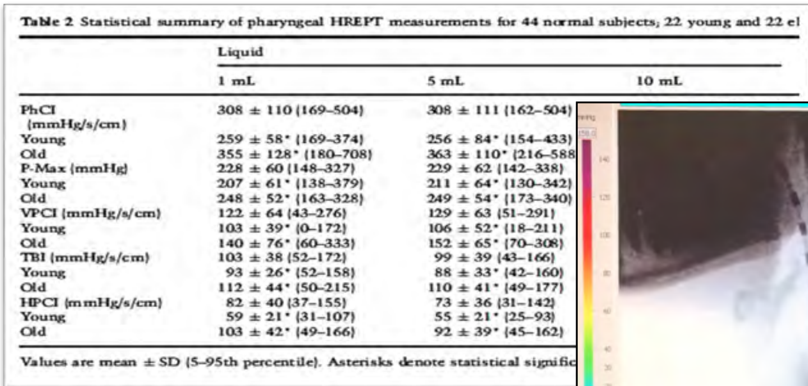
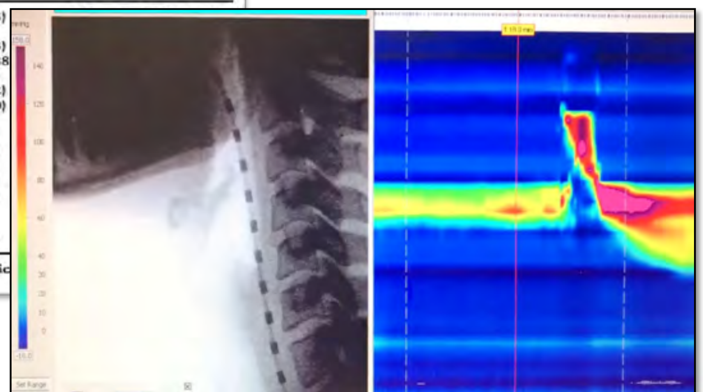


Table 2 Statistical summary of pharyngeal HREPT measurements for 44 normal subjects; 22 young and 22 el

	Liquid		
	1 mL	5 mL	10 mL
PhCI (mmHg/s/cm)	308 ± 110 (169–504)	308 ± 111 (162–504)	
Young	259 ± 58* (169–374)	256 ± 84* (154–433)	
Old	355 ± 128* (180–708)	363 ± 110* (216–588	
P-Max (mmHg)	228 ± 60 (148–327)	229 ± 62 (142–338)	
Young	207 ± 61* (138–379)	211 ± 64* (130–342)	
Old	248 ± 52* (163–328)	249 ± 54* (173–340)	
VPCI (mmHg/s/cm)	122 ± 64 (43–276)	129 ± 63 (51–291)	
Young	103 ± 39* (0–172)	106 ± 52* (18–211)	
Old	140 ± 76* (60–333)	152 ± 65* (70–308)	
TBI (mmHg/s/cm)	103 ± 38 (52–172)	99 ± 39 (43–166)	
Young	93 ± 26* (52–158)	88 ± 33* (42–160)	
Old	112 ± 44* (50–215)	110 ± 41* (49–177)	
HPCI (mmHg/s/cm)	82 ± 40 (37–155)	73 ± 36 (31–142)	
Young	59 ± 21* (31–107)	55 ± 21* (25–93)	
Old	103 ± 42* (49–166)	92 ± 39* (45–162)	

Values are mean ± SD (5–95th percentile). Asterisks denote statistical signific



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Targeted Intervention

- Patient-specific:
    - ***underlying impairment,***
    - medical diagnosis,
    - cognitive status,
    - medical status,
    - patient/caregiver preferences
- Evidence-based (literature, expertise, preference)
- Based on observations of ***pathophysiology*** during instrumental assessment

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Targeted Intervention

- **Compensation:** improve safety and efficiency of swallowing ***without*** directly targeting swallowing physiology; "adapt" to impairment → maneuvers & strategies
- **Retraining:** improve safety and efficiency of swallowing by ***directly*** targeting swallowing physiology; "repair" impairment → strength & skill training

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Maneuvers & Strategies

- **Omari et al., 2019** (working group lit review)
- **O'Rourke et al., 2014** (effect on esophageal physiology, n = 10, normals)
- **Balou et al., 2014** (head rotation, chin tuck, n = 10, normals)
- **Hammer et al., 2014** (tongue hold maneuver, n = 6, normals)
- **Hoffman et al., 2012** (Mendelsohn, effortful, n = 14, normals)
- **Doeltgen et al., 2011** (tongue hold maneuver, n = 68, normals)
- **Takasaki et al., 2011** (effortful swallow, n = 18, normals)
- **Takasaki et al., 2010** (head rotation, n = 18, normals)
- **McCulloch et al., 2010** (chin tuck, head turn, n = 7, normals)
- **Umeki et al., 2009** (tongue hold maneuver, n = 33, normals)

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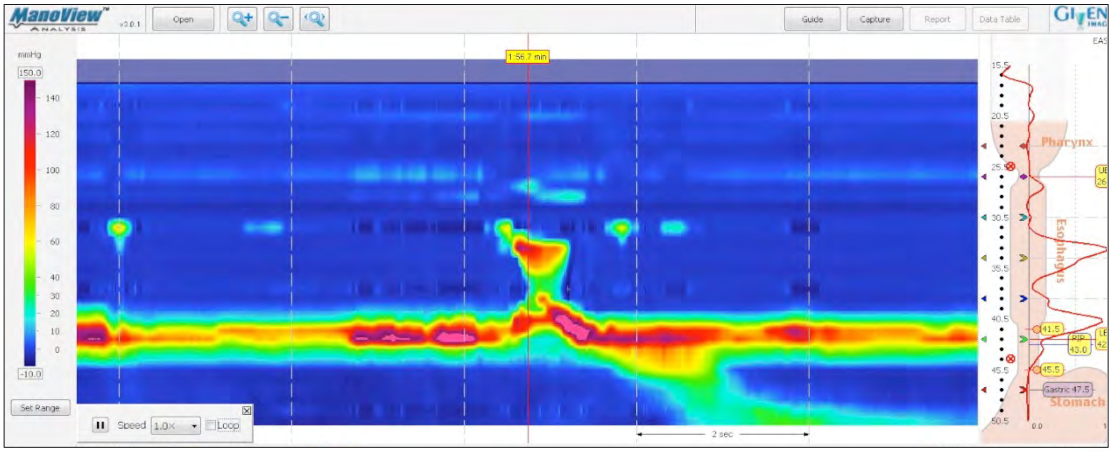
Maneuver & Strategy Planning



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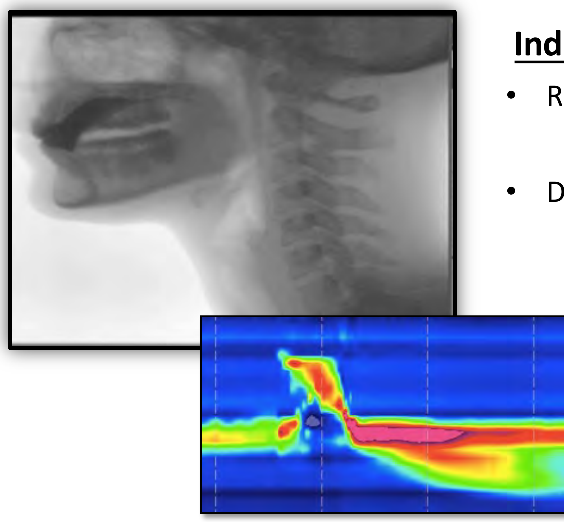
Chin Tuck



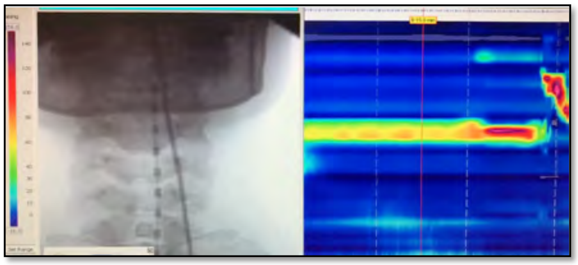
Indications/Rationale

- Reduced or delayed laryngeal vestibular closure
  - Approximates arytenoids to epiglottic petiole
- Delayed initiation of the pharyngeal swallow
  - Widens valleculae (timing)
  - Brings pharyngeal wall closer to tongue base

- ↑ duration of pharyngeal pressures
- Min change in pharyngeal pressures
- ↓ UES residual pressures
- ↓ post-closure UES pressures

MUSC McCulloch et al., 2010; Balou et al., 2014; Omari et al., 2019 CPEMTP

Head Turn



- ↑pharyngeal pressures (min)
- ↓ duration pharyngeal contraction
- ↓ UES residual pressures
- ↑ duration of UES relaxation
- ↓ UES resting pressures
- ? Impact of catheter placement

- Unilateral pharyngeal bulging/paresis
  - Eliminates damaged side from bolus path
  - Decreases loss of cavity pressure
- Decrease PES opening
  - Pulls cricoid away from posterior pharyngeal wall
- Unilateral laryngeal dysfunction
  - Extrinsic pressure to thyroid cartilage, increases adduction

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McCulloch et al., 2010; Takasaki et al., 2010; Balou et al., 2014 Omari et al. 2019

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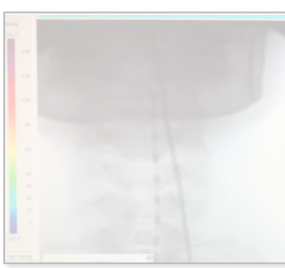
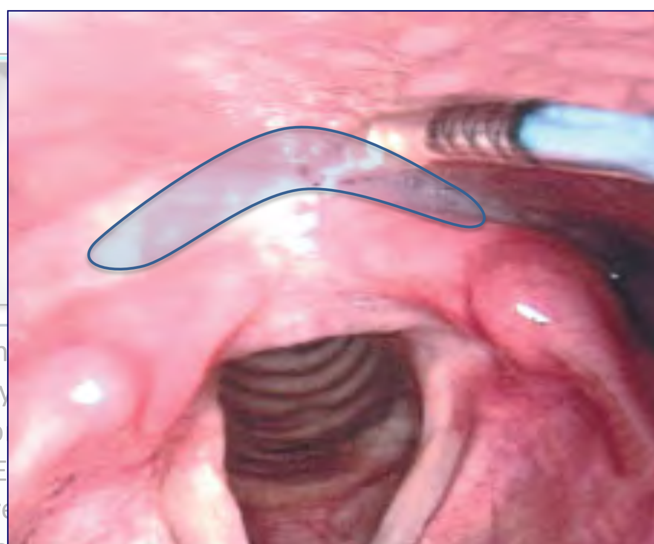
Head Turn





- Min change in ph
- ↓ duration phary
- ↓ UES residual p
- ↑ duration of UE
- ↓ UES resting pr
- ? Impact of cathe

l bulging/paresis

ed side from bolus

cavity pressure

ng

from posterior

dysfunction

to thyroid cartilage,

on

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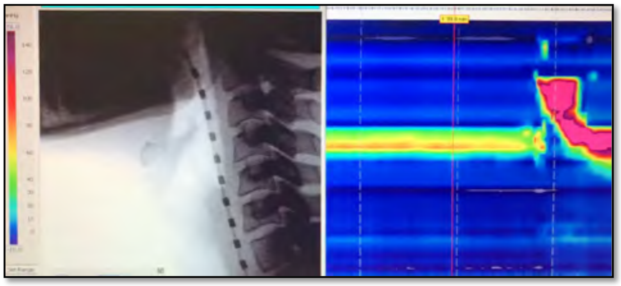
Effortful Swallow



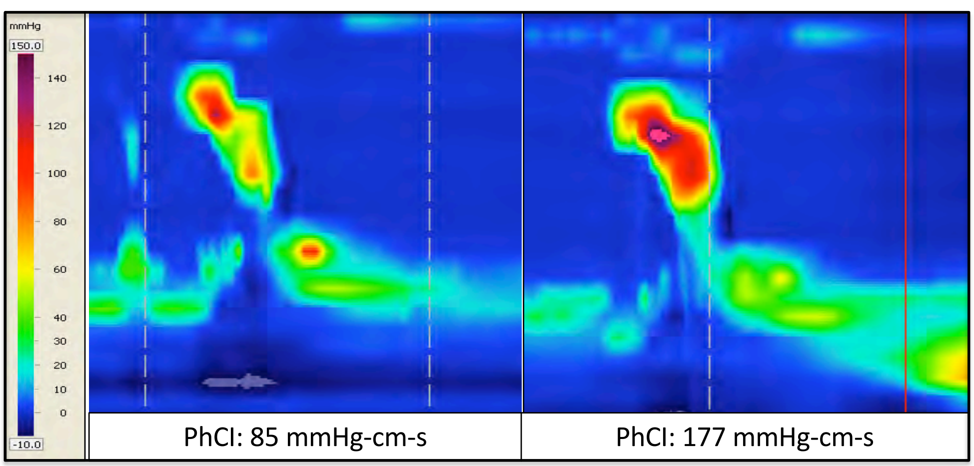
- ↓ tongue base pressure (? increased hyoid)
- ↑ velopharyngeal pressure
- ↓ pre-opening UES pressure (less resistance)
- ↑ post-closure UES pressure (prevents reflux)
- ↑ UES Nadir relaxation pressure
- ↑ UES relaxation duration

Indications/Rationale

- Reduced tongue base retraction
  - Shields laryngeal inlet
- Reduced pharyngeal stripping
- Decreased pharyngeal contraction
  - Effort increase posterior tongue base and pharyngeal movement (Pouderour & Kahrilas, 1995)

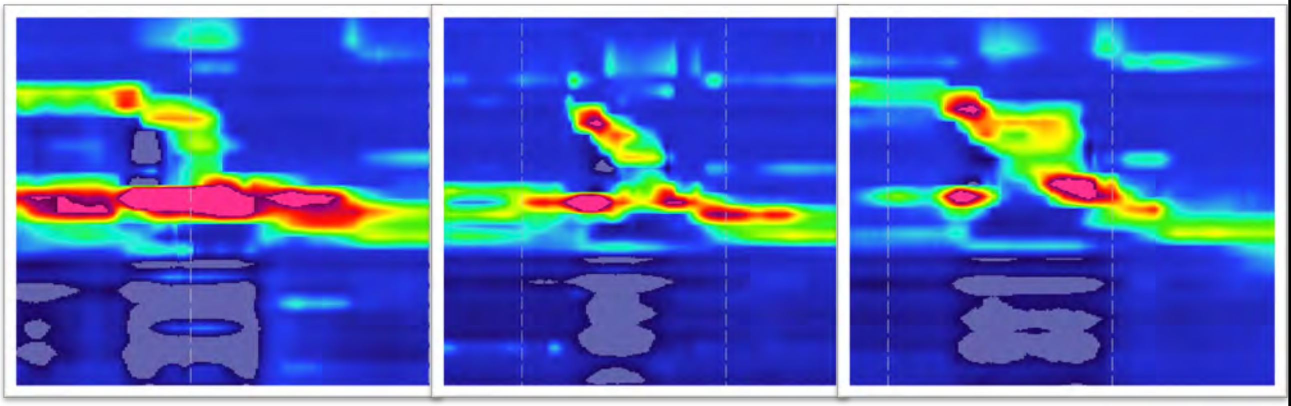
Takasaki et al., 2011; Hoffman et al., 2012; Omari et al., 2019

Effortful Swallow



Effortful Swallow

Training & Monitoring



Trial 1 | Trial 8 | Trial 12

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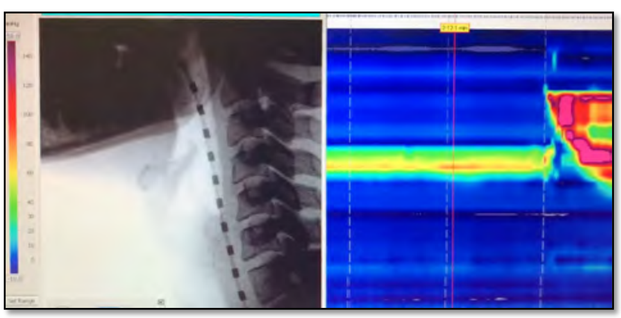
Mendelsohn Maneuver



- ↑ tongue base pressure
- ↑ velopharyngeal pressure and duration
- ↓ pre-opening UES pressure (less resistance)
- ↑ post-closure UES pressure (prevents reflux)
- ↑ UES Nadir relaxation pressure
- ↑ UES relaxation duration

Indications/Rationale

- Reduced hyolaryngeal motion
- Reduced laryngeal vestibular closure
- Reduced PES Opening
  - Facilitates and sustains laryngeal closure and PES opening (Cook et al., 1989; Jacob et al., 1989)
  - Facilitates and sustains contraction of oropharyngeal muscles (Kahrilas et al., 1991)

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Hoffman et al., 2012

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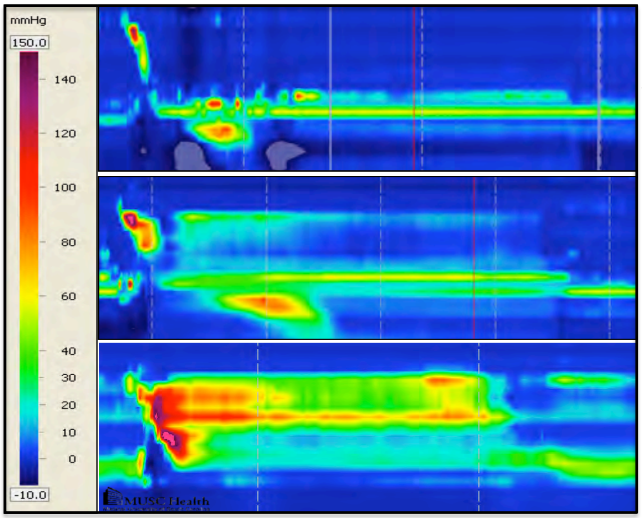
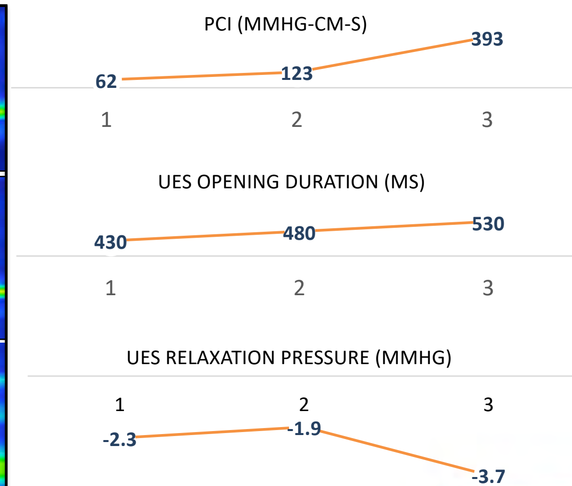
Mendelsohn Maneuver

Training & Monitoring





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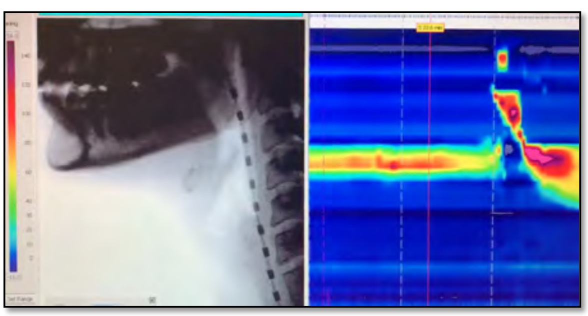
Tongue Hold Maneuver



Indications/Rationale

- Decreased pharyngeal stripping wave
  - Increases contraction of superior pharyngeal constrictor (Fuji et al., 1996)
  - Anterior tongue movement pulls pharygneal wall forward (Saigusa et al., 2004)

- ⊘ mesopharyngeal pressures (? offset anterior movement TBR PPW)
- ↓ peak pressure amplitudes in hypopharynx
- ⊘ duration of pressures
- ↑ UES peak relaxation pressures in elderly (? hyolaryngeal complex)
- ↓ UES peak relaxation pressures in young

MUSC Umeki et al., 2009; Doeltgen et al., 2011; Hammer et al., 2014; Omari et al., 2019 CPEMTP

Table 3. Summary of trends seen in HRPM metric classes in relation to a range of different effects documented in the literature

Main Effect Assessed (Outcome Topic)	Metric Class (↑↓ indicate direction of effect)					
	Pharyngeal Lumen Occlusive Pressure	Hypopharyngeal Intrabolus Pressure	Upper Esophageal Sphincter			
			Pre-Deglutitive Pressure	Relaxation Pressure	Opening Admittance	Post-Deglutitive Pressure
Bolus Volume (B)	↑ with Vol.	↑ with Vol.		↑ with Vol.	↑ with Vol.	↑ with Vol.
Pen-Aspiration on VF (F)	↓ with Asp.	↑ with Asp.		↑ with Asp.	↓ with Asp.	
Control vs. Patients (E)	↓ in Pat.	↑ in Pat.	↓ in Pat.	↑ in Pat.	↓ in Pat.	↓ in Pat.
Bolus Consistency (B)	↑ with Cons.	↑ with Cons.		↑ with Cons.		
Ageing (D)	↑ with Age		↓ with Age	↑ with Age	↓ with Age	↑ with Age
Clinical Symptom Scores (G)	↓ with Sx.	↑ with Sx	↓ with Sx	↑ with Sx	↓ with Sx	
Effortful Swallow (I)	↑ with ES					↑ with ES
Chin tuck (C)						↓ with Tuck
Ipsilateral Head Turn (C)	↑ with Turn		↓ with Turn			↑ with Turn
Mendelsohn Swallow (I)	↑ with MS					↑ with MS
Opioid Agonist (J)	↓ with Opi.	↑ with Opi.		↑ with Opi.		
Neuro or muscular stimulation (K)	↑ with Stim.				↑ with Stim.	
Artificial UES restriction (C)		↑ with Restrict		↑ with Restrict		

Cells highlighted grey when ≥3 studies report the effect. Abbreviations: penetration (pen), videofluoroscopy (VF), upper esophageal sphincter (UES), volume (vol), aspiration (asp), patient (pat), consistency (cons), symptoms (sx), effortful swallow (ES), Mendelsohn swallow (MS) stimulation (stim), opioid (opi).

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MUSC HRPM International Working Group, Protocols & Metrics, Omari et al., 2019

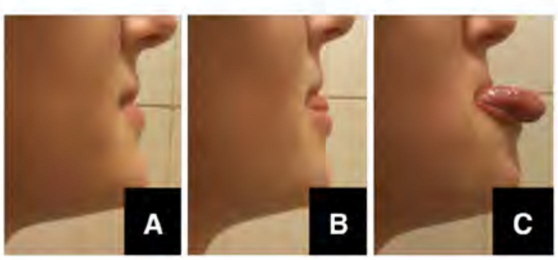
Tongue Hold Maneuver

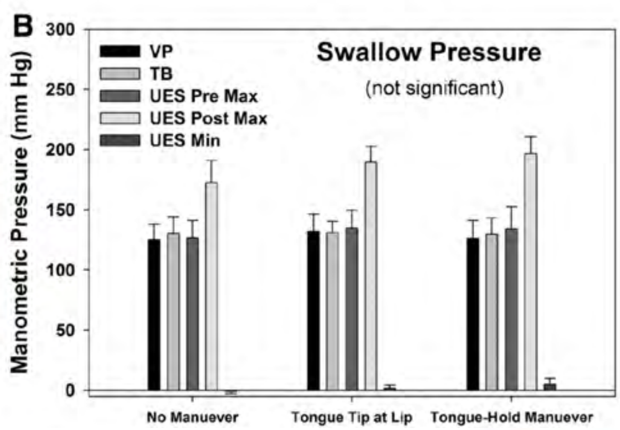
Dysphagia (2014) 29:564–570
DOI 10.1007/s00455-014-9545-6

ORIGINAL ARTICLE

Evaluating the Tongue-Hold Maneuver Using High-Resolution Manometry and Electromyography

Michael J. Hammer · Corrine A. Jones · Jason D. Mielens · Chloe H. Kim · Timothy M. McCulloch





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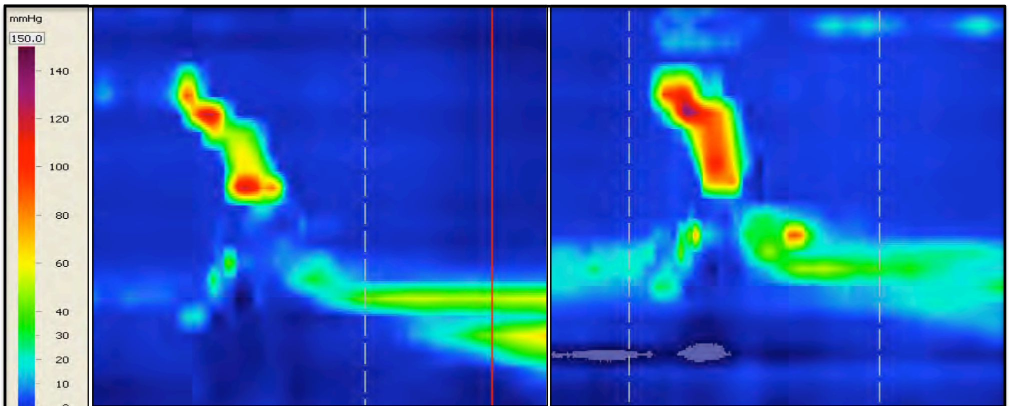
Tongue Hold Maneuver

Training & Monitoring

Session 1 | Session 5



PhCI: 77 mmHg-cm-s | PhCI: 154 mmHg-cm-s

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Maneuvers - Summary

- **Chin Tuck**
  - Duration pharyngeal pressure ↑
  - UES residual/closing pressure ↓
- **Head Turn**
  - Pharyngeal driving pressure ↑
  - UES resting/residual pressure ↓
  - UES opening duration ↑
- **Effortful**
  - Pharyngeal driving pressure ↑
  - UES opening duration ↑
  - UES closing pressure ↑
- **Mendelsohn**
  - Pharyngeal driving pressure ↑
  - UES opening duration ↑*
  - UES closing pressure ↑
- **Tongue Hold**
  - Pharyngeal driving pressure ⊘

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Temporal Coordination

- After a minimum of one-week intensive rehabilitation (n=16, Huckabee et al., 2014)

	Normative data (95% confidence interval)	Pre-treatment baseline averages (95% confidence interval)	Post-treatment averages (95% confidence interval)
Temporal data			
Peak 1–Peak 2	239 ms (215–263 ms)	15 ms (− 2 to 33 ms)	137 ms (86–187 ms)
Swallowing duration	479 ms (409–549 ms)	620 ms (469–770 ms)	536 ms (454–617 ms)
Pressure / Amplitude data			
Proximal pharynx	114.7 mm Hg (104.1–125.4 mm Hg)	46.4 mm Hg (25.1–67.6 mm Hg)	46.6 mm Hg (31.1–62.1 mm Hg)
Distal pharynx	114.9 mm Hg (104.9–124.9 mm Hg)	39.7 mm Hg (23.8–55.6 mm Hg)	47.1 mm Hg (29.7–64.5 mm Hg)
UES nadir pressure	− 9.7 mm Hg (− 11.0 to − 8.5 mm Hg)	0.2 mm Hg (− 7.0 to 7.5 mm Hg)	− 3.5 mm Hg (− 7.9 to 0.9 mm Hg)

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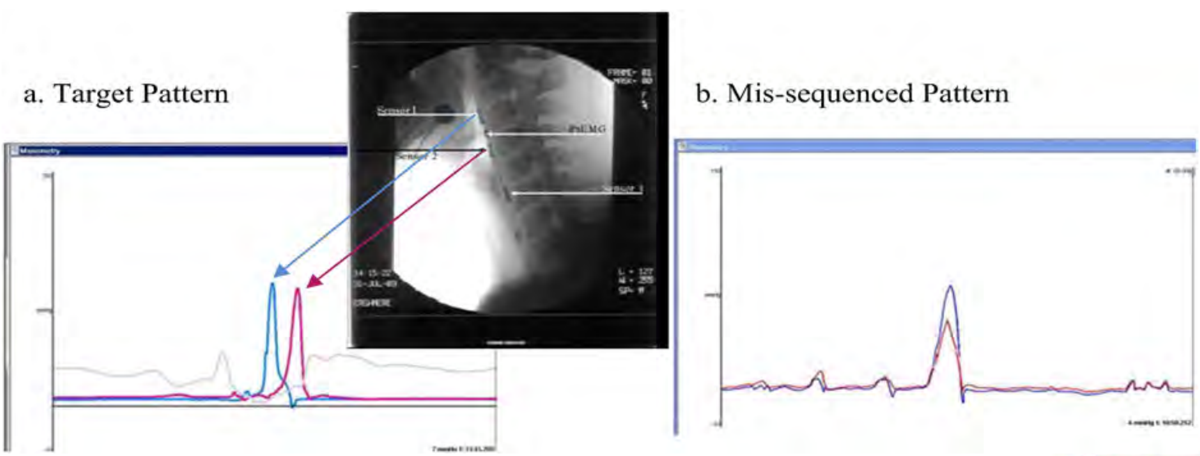
Swallow Duration

Pharyngeal Mis-sequencing

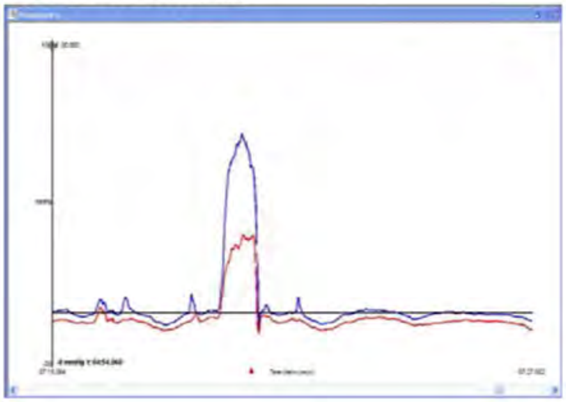


MUSC Huckabee et al., 2014 CPEMTP

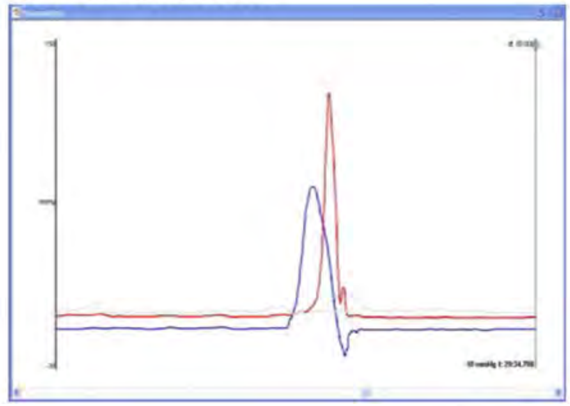
Swallow Duration

Pharyngeal Mis-sequencing

a. Pre-treatment



b. Post-treatment



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Huckabee et al., 2014

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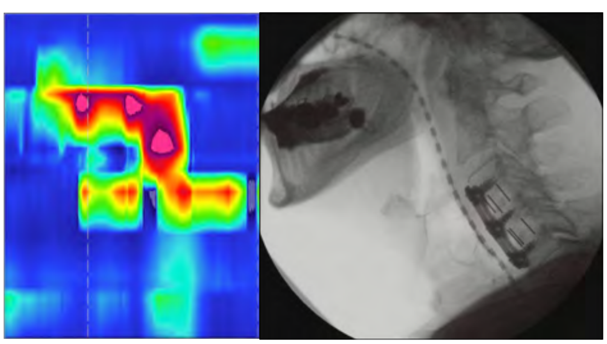
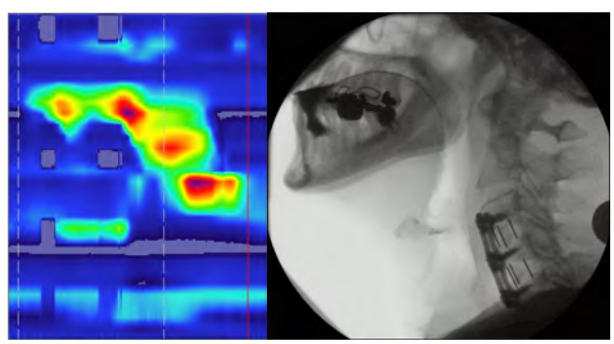
Temporal Coordination

Simultaneous Contraction

Pre-tx (session 1)



Post-tx (session 5)



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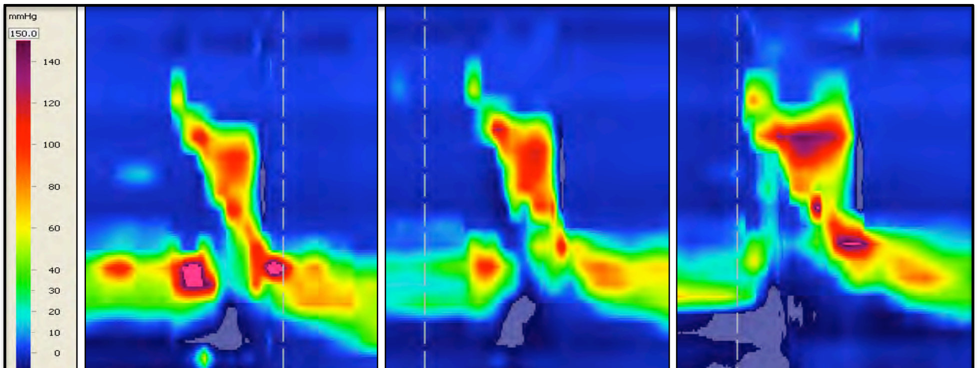
PES Relaxation & Duration

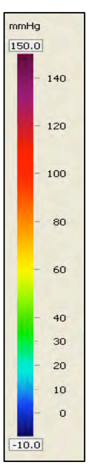
Trial 1 → Trial 20

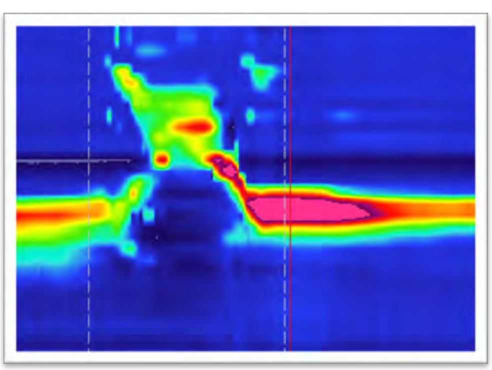


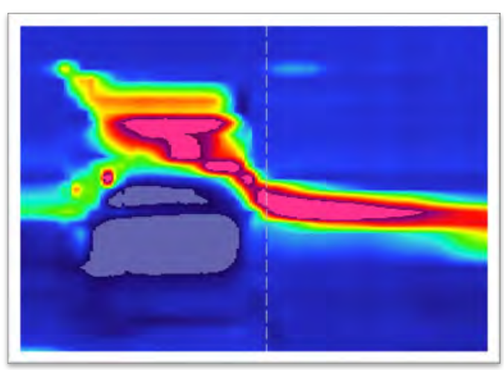
Duration:	130ms	150ms	550ms
Pressure:	1.0mmHg	5.3mmHg	-3.2mmHg

Swallow Mapping

Pharyngeal Contractility

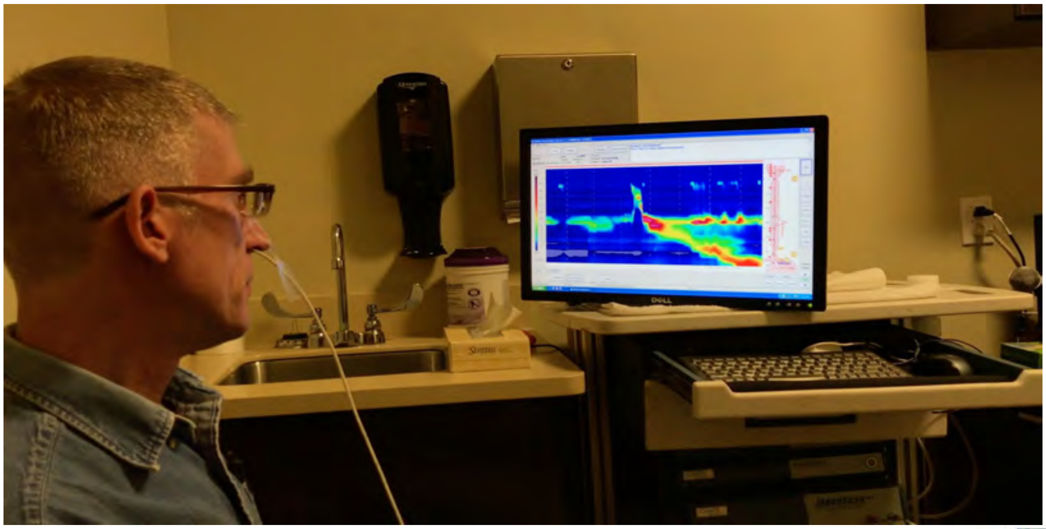






Trial 1 Effortful Swallow Trial 15

"Swallow Mapping"



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Principles of Activity-dependent Neuroplasticity

Unexplored **BUT** emerging exploration of influences on swallowing exercises

Repetition

Time

Intensity

How Much?

How Often?

How Intense?

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Evidence Behind Current Clinical Practice

"While exercise techniques and maneuvers are available to the dysphagia clinician, the optimal dose (i.e. number of sets and repetitions over a set amount of time) has not been determined."

Burkhead et al (2007), p. 258

"The field is still unclear on how much, how often, and how intense the exercises should be. An expert panel at the 2011 ASHA conference clearly stated, 'We don't know!'"

Langmore & Pisegna (2015), p. 224

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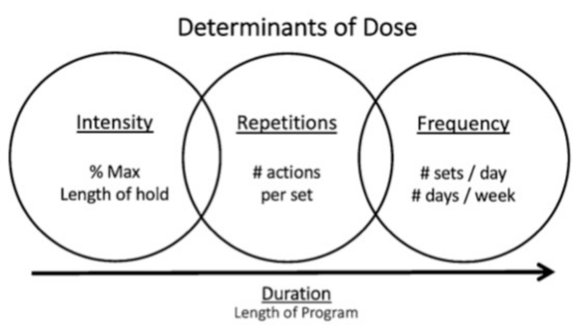
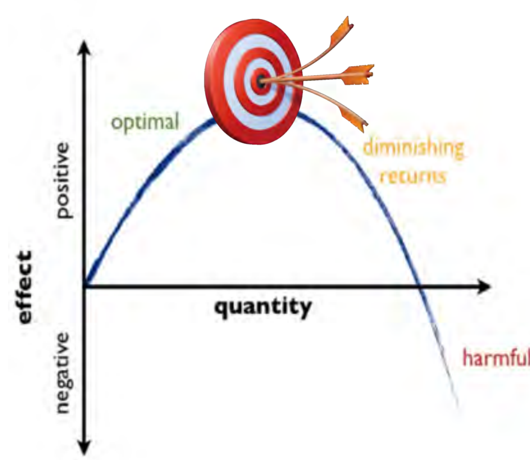
Progressive Resistance Training

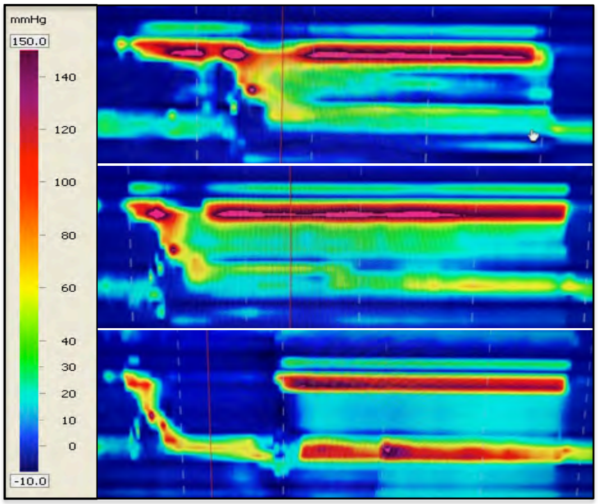
Identification of minimal dose needed for biological/physiological change.





MUSC Krekeler, Rowe & Connor, 2021 CPEMTP

Indicators of Fatigue



Trial 1

PCI: 551 mmHg-cm-s
UES Opening Duration: 430 ms
UES Nadir Relaxation Pressure: -1.8

Trial 6

PCI: 620 mmHg-cm-s
UES Opening Duration: 430 ms
UES Nadir Relaxation Pressure: -2.3

Trial 10

PCI: 62 mmHg-cm-s
UES Opening Duration: 430 ms
UES Nadir Relaxation Pressure: -2.3

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Adherence

Tracking adherence is essential to successful rehabilitation

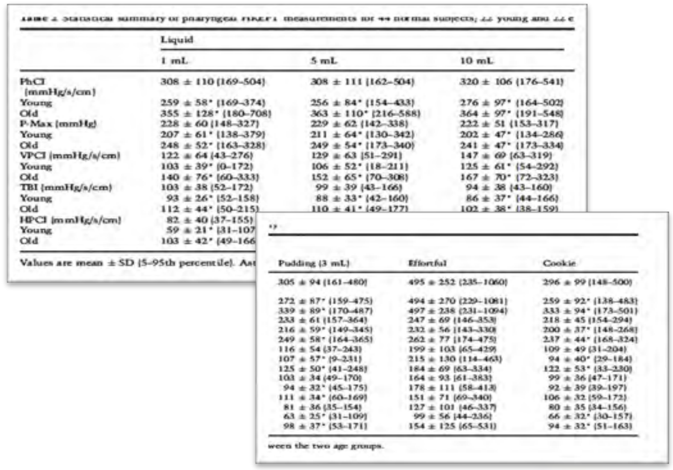
Methods for Tracking Adherence

Continuous: Reports on adherence across multiple categories or a using a gradient of	Dichotomous: Dividing level of participation into two categories
Examples: Low, moderate, high adherence; percentage of prescribed dose completed; number of sessions attended	Example: Using a predetermined level of participation to determine patient "adherent" vs "non adherent"

MUSC Krekeler et al., 2018 CPEMTP

Reporting/Outcome Tracking

- Normative data
  - Measurable goals
    - Nativ-Zeltzer et al., 2016
- Tracking progress
  - Data of interest
    - Pressure (PhCI, UES-IRP)
    - Duration (UES-RT)
  - Ongoing assessment
    - Efficacy



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Reporting/Outcome Tracking

- Normative data
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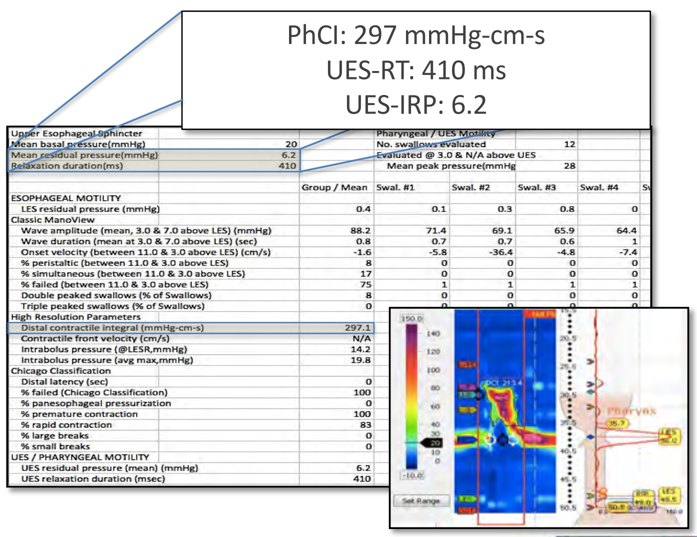

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High-Resolution Manometry Biofeedback Program (HRM-BP)

Catheter Placement

Anesthesia: ☐NO ☐YES Type/Method:____________
Nare: ☐LEFT ☐RIGHT
Positioning: ☐Head Turn (☐RIGHT ☐LEFT) ☐Chin Tuck ☐Chin Up ☐Other:____________
Visualization: ☐Fluoroscopy ☐Videoendoscopy ☐None

Baseline Swallows (indicate swallow #/time)

Baseline Swallows	1	2	3	4	5
☐ Saliva ☐ Ice Chips ☐ 5mL Thin					
Bolus Trial: ________					

Targeted Intervention

Biofeedback: ☐Patient view ☐Clinician view

Exercise/Strategy	Trials	Bolus	% Acc.	VPCI	MPCI	HPCI	PhCI
Marker:							
Marker:							
Marker:							
Marker:							
Marker:							

Dosing & Fatigue

Fatigue Marker: ☐VPCI ☐MPCI ☐HPCI ☐PhCI ☐UES-RT ☐UES-IRP ☐PTT

Exercise/Strategy	Fatigue Onset (Trial)	Fatigue Onset (Metric)	Recovery Time	Recovery Target (Metric)

HRPM Findings

	Baseline 1	Baseline 2	Baseline 3	Baseline 4	Baseline 5	Average
VPCI						
MPCI						
HPCI						
PhCI						
UES-RT						
UES-IRP						
PTT						

Session Notes: ____________________

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of South Carolina

The Application of High-Resolution Pharyngeal Manometry for Biofeedback in Dysphagia Therapy

Humphries K, Blair J, O'Rourke A DRS Poster Abstract # 2845274 March 2018

- **Aim:**
  - Identify changes in pharyngeal pressures and quality of life parameters in patients undergoing HRPM biofeedback dysphagia therapy.
- **Hypothesis:**
  - Use of HRPM for biofeedback therapy will improve pharyngeal contractility, improve QOL and improve pharyngeal swallowing physiology.

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Methods

- 10 patients underwent a pilot program of HRPM biofeedback dysphagia therapy in addition to a daily home therapy program.
- Pre- and post-treatment MBSS were obtained and compared using MBSImP and PAS scores.
- Differences in pharyngeal (PhCI), velopharyngeal (VPCI), mesopharyngeal (MPCI), and hypopharyngeal (HPCI) contractile integrals were evaluated.
- Pre- and post-treatment FOIS, Eating Assessment Tool (EAT-10) and Dysphagia Handicap Index (DHI) were compared

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Demographics

Table 1. Subject Demographics

Subject	Sex	Age	Race	Diagnosis	Sessions
1	F	74	White	Neurologic NOS	5
2	M	66	White	SCCa BOT	4
3	M	46	White	Parkinson's	5
4	M	71	White	ACDF	4
5	M	64	White	Parkinson's	3
6	M	68	White	ACDF	3
7	M	58	White	CVA	4
8	M	68	White	SCCa BOT (fibrosis)	10
9	M	54	White	Muscular Dystrophy	4
10	M	61	Black	CVA	5

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Results

Table 2. Change in QOL Scores Pre- to Post Treatment

Subject	EAT-10	DHI-P	DHI-F	DHI-E	DHI -T	FOIS
1	- 1	- 2	0	0	- 2	- 1
2	- 9	- 10	- 2	- 8	- 20	0
3	- 11	- 10	- 6	- 6	- 22	- 1
4	- 5	- 8	- 4	0	- 12	- 1
5	- 5	- 4	- 2	- 4	- 10	- 4
6	- 8	- 4	- 4	0	- 8	- 3
8	- 1	- 8	- 4	- 8	- 20	0
9	- 1	- 2	0	- 8	- 10	+ 1
10	- 5	- 4	- 8	+ 2	- 10	0
Mean	- 5	- 6	- 3	- 4	- 13	- 0.9

* Missing Pre-Tx scores for subject 7 = Improved = Worse

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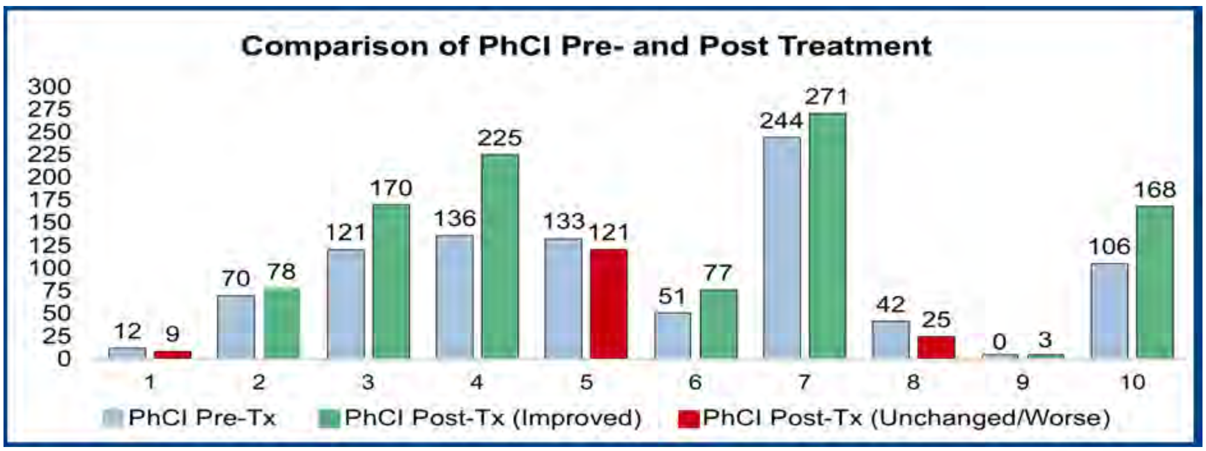
Resuts



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Results

Table 3. Change in MBSImP & PAS Pre- to Post Treatment		
MBSImP Component*	Pre-Tx Impaired (n = 10)	Post-Tx Improved (n = pre-tx imp)
1-Lip closure**	1 (10%)	1 (100%)
2-Bolus hold	7 (70%)	1 (14%)
4-Bolus transport/lingual motion	2 (20%)	1 (50%)
5-Oral residue**	10 (100%)	6 (60%)
6-Initiation pharyngeal swallow	10 (100%)	3 (30%)
7-Soft palate elevation	3 (30%)	1 (33%)
8-Laryngeal elevation	9 (90%)	4 (44%)
9-Anterior hyoid excursion	10 (100%)	2 (20%)
10-Epiglottic movement	9 (90%)	4 (44%)
11-Laryngeal vestibular closure	10 (100%)	6 (60%)
12-Pharyngeal stripping wave	8 (80%)	2 (25%)
14-PES opening	10 (100%)	3 (30%)
15-Tongue base retraction**	10 (100%)	4 (40%)
16-Pharyngeal residue**	10 (100%)	5 (50%)
Penetration Aspiration Scale**	9 (90%)	6 (67%)

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Summary

- Seven of ten patients (70%) showed improvement in HPRM parameters
- Average increase of
  - 87.1 mmHg-cm-s in PhCI
    - 37.1 in VPCI
    - 45.1 in MCI
    - 7.5 in HPI
- EAT-10 scores 25.7 → 21.6
- DHI total scores 64.2 → 57.1
- No adverse events.

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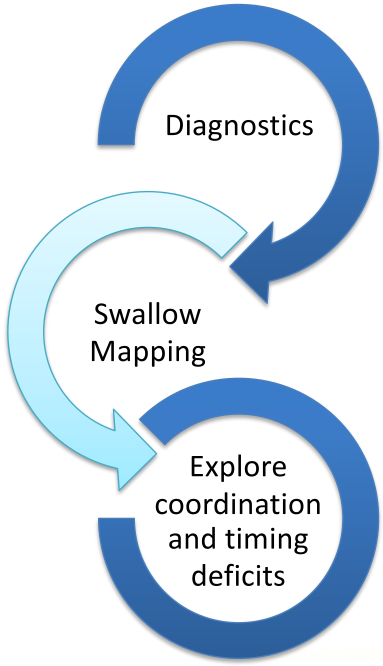

Benefits of HRM-BP

- Train targeted interventions
- Education and shaping of desired response
- Establish efficacy of interventions and compensatory strategies
- Monitor adherence and progress
- Provide quantitative, objective outcome data

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