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ORIGINAL ARTICLE

SLP-Perceived Technical and Patient-Centered Factors Associated with Pharyngeal High-Resolution Manometry

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Abstract

High-resolution manometry (HRM) objectively measures swallowing-related pressures in the pharynx and esophagus. It has been used in many research applications, but it is unclear how HRM is perceived amongst speech-language pathologists (SLP) as it enters into clinical practice. The purpose of this study was to explore SLP perceptions of clinical HRM use. Based on qualitative data collected at four focus groups held at two national conferences and a survey based on open-ended questions, we found broad consensus among those queried regarding how HRM's objective and targeted data could enhance diagnosis and drive treatments. However, we found less consensus among SLPs regarding which patients may and may not benefit, as well as when in the clinical process HRM would best supplement existing technologies, showing a need for further research. These findings highlight how SLPs can be motivated to adopt new clinical technologies if they see a patient-centered benefit and underscore the need for continued SLP education on pharyngeal HRM.

Keywords Deglutition · Deglutition disorders · High-resolution manometry · Speech-language pathologist · Qualitative research · Focus group · Survey

Introduction

High-resolution manometry (HRM) is a novel technology used to objectively measure pressures along the pharynx and esophagus. Most systems rely on 20–36 solid-state sensors spaced approximately 1 cm apart that capture pressure circumferentially [1]. Pressure data are typically displayed in a colorful, spatiotemporal plot in real time and allow for exporting of raw pressure data for offline analysis. Esophageal HRM has revolutionized the field of gastroenterology (cf., [2]). Pharyngeal HRM is gaining popularity amongst speech-language pathologists (SLP) and physicians involved in management of oropharyngeal dysphagia. Pharyngeal HRM has been used in healthy individuals to show pressure differences with changes in bolus size [3–8] and during compensatory swallowing maneuvers [9–16]. Furthermore, deviations in pharyngeal swallowing-related pressures have been described using

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HRM in patients with a variety of dysphagia etiologies [17–24].

Despite a growing body of literature on pharyngeal HRM, clinical adoption of the technology has not kept pace. Although pharyngeal manometry is an emerging area of SLP practice according to the American Speech-Language-Hearing Association (ASHA) [25], there is one published description of routine clinical use of pharyngeal by SLPs [26]. For SLPs to adopt pharyngeal HRM into their regular clinical practice, they must knowledgeable about the technology and believe in its potential to improve their clinical practice. However, it is unclear how SLPs perceive clinical use of pharyngeal HRM. Improved understanding of SLP perspectives on HRM use can benefit clinical translation of and implementation of research findings as well as clinician education and training.

The purpose of this study was to use focus groups and an open-ended survey to explore perceptions of SLPs on clinical use of pharyngeal HRM through inductive qualitative methods. The present analysis focuses on SLP perspectives of benefits, clinical practices, and patient populations relevant to pharyngeal HRM.

Methods

Both survey and focus group methodology were used in the completion of this work. Participants were SLP members of both the ASHA and the Dysphagia Research Society (DRS). Focus group participants were also Board Certified Specialists in swallowing and swallowing disorders (BCS-S). Demographic data for participants in each phase of the study are found in Table 1. The sequence of survey and focus group deployment is found in Fig. 1. Survey and focus group methods were approved by the local Institutional Review Board and were carried out according to the principles of the Declaration of Helsinki. All participants provided informed consent prior to participating.

Focus Groups

Focus group participants were recruited from respondents to a brief survey, distributed electronically using Qualtrics software (Qualtrics, Provo, UT), on exposure to HRM administered in September of 2015 to SLP ASHA members. Respondents included 78 SLPs who hold the BCS-S credential. Of these 78 BCS-S SLPs, we recruited 18 who were planning to attend the 2015 ASHA Convention in Denver, CO and/or the 2016 DRS Annual Meeting in Tucson, Arizona. Two focus group sessions (5–8 participants each) were held at each of the two national meetings. During the focus groups, SLPs viewed a presentation on HRM as a diagnostic and treatment tool, participated in a hands-on demonstration of HRM data analysis (lead by authors CAJ and TMM), and discussed the clinical viability of HRM in a focus group led by a trained facilitator with no previous exposure to HRM (CLM). An additional aim of the focus groups, unrelated to the present analysis, was to understand and improve user experience of an HRM data analysis software program in development by the senior authors' research team. One of the focus groups at the DRS meeting was comprised entirely of SLPs who had participated in a focus group at ASHA, in order to get feedback on software improvements. Comments from these SLPs regarding the themes explored in this study were not likely impacted by repeat exposure to HRM and thus were not analyzed separately from those participating in a focus group for the first time.

The focus group scripts were created following Casey and Krueger's design principles [27] and were pre-tested by a group of local SLPs prior to implementation at the national meetings. Questions elicited participant reflections on the hands-on HRM data analysis experience, on their views on how and why they might use HRM in clinical practice, and on barriers to clinical adoption of HRM. All focus group participants stated that they would like to include HRM in their clinical practice, but raised several concerns about the feasibility of clinical adoption, which the team incorporated into a survey of a broader group of SLPs, discussed below.

Survey with Open-Ended Response Format

Open-ended survey questions were based on the main areas of enthusiasm and concern raised by focus group participants. Of the 87 SLP members of DRS who responded to this electronic survey, 9 currently use HRM, 55 reported that they do not, but would like to, and 16 reported that they did not and would not be interested in adopting. All 18 focus group participants stated that they were interested in adopting HRM for clinical use. Although two of the focus group participants at ASHA and DRS reported some previous exposure to HRM in clinical practice, none were regular users. The full survey transcript can be found in electronic supplemental material.

Data Analysis

The research team analyzed the first wave focus group responses line-by-line, using NVIVO 11 software (QSR International, Burlington, MA), finding several major themes that pointed to enthusiasm for clinical adoption, including the objectivity of HRM data, the potential to compare HRM data in patients with dysphagia to that of normal swallowers of the same age and demographic profile, and the potential for use as a teaching tool in clinic,

Table 1 Demographic information for survey respondents

	Number of responses (n = 87)
Years in practice	
0–5	19
6–10	11
11–15	12
16–20	14
21–25	11
26+	15
Unanswered	9
Dysphagia caseload (%)	
0–24	3
24–49	10
50–74	21
75–100	46
Instrumentation training[a]	
Videofluoroscopy/MBSS	80
Nasal endoscopy/FEES	58
Oral/rigid endoscopy	33
Pharyngeal or esophageal manometry	17
Insufflation	17
Tracheoesophageal voice prosthesis placement	33
Speaking valve placement with tracheostomies or ventilators	58
Nasometry	8
Ultrasonography	8
Electromyography	38

MBSS modified barium swallow study, *FEES* fiberoptic endoscopic evaluation of swallowing

[a]Categories are not mutually exclusive

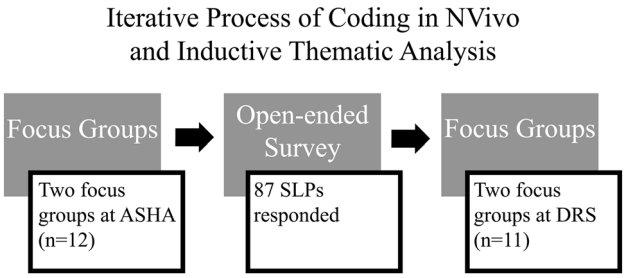

Fig. 1 Sequence of focus groups and surveys. The first set of focus groups occurred at the American Speech-Language-Hearing Association (ASHA) Convention in November 2015. The open-ended survey was sent out in February 2016. The second set of focus groups occurred at the Dysphagia Research Society (DRS) Meeting in February 2016; one focus group at DRS was composed of participants from one of the ASHA focus groups

particularly with biofeedback. Concerns elicited during these focus groups included cost and billing concerns, scope of practice concerns, and related concerns regarding how HRM could fit into existing workflows, and concerns about which patient populations might benefit from the addition of HRM to existing diagnostic and treatment modalities and possible contraindications to HRM instrumentation.

We explored the representativeness of these perceived barriers and facilitators to clinical adoption of HRM by designing a survey with open-ended response format distributed to SLPs who were members of DRS (n = 300). To explore these initial themes in greater depth, the team invited both new and returning BCS-S SLPs to participate in two focus groups at the 2016 DRS meetings in Phoenix Arizona. Two study team members (CLM and ALF) performed open- and focused-coding processes on the focus groups convened at DRS and the survey of DRS members. Once the codebook was inductively developed, a team of trained coders applied those thematic codes to all narrative survey responses and focus group transcripts using NVivo 11. Descriptive statistics were generated from the closed-ended segment of the survey. Both subsequent waves of data collection confirmed our initial findings of areas of both enthusiasm and concern regarding clinical adoption of HRM.

The discussion below draws on the four focus groups (n = 18) and the responses to open-ended survey questions

from SLPs who received the survey through their membership in the DRS (n = 87), and focuses on respondents' perspectives of patient-centered facilitators and barriers to clinical adoption of HRM.

Results

In evaluating the ways in which SLPs are both interested in and concerned about clinical adoption of HRM, two areas of broad consensus and two areas of disagreement emerged. SLPs agreed that technological advantages of HRM stem from the objectivity of the data and how HRM data could effectively supplement that produced using existing evaluation technologies. Most SLPs explained how these advantages ultimately lead to better diagnosis and patient care. However, there was a lack of consensus in both the survey and the focus groups concerning which patient populations would be best served by HRM and when in the evaluation and treatment process HRM would be best suited. Representative quotes highlighting these areas of consensus and contention are in Tables 2 and 3.

Objectivity of HRM Data

The most frequently stated advantage among respondents to the survey and participants in the focus groups involved the objectivity of HRM data. For SLPs, the objective nature of swallowing pressures produced by HRM is beneficial for understanding the effects of treatment as well as communicating clearly with patients and their families, other physicians and clinicians, and insurers. Survey respondents and focus group participants pointed to the vivid visual and numeric displays of swallowing pressure data that would illustrate both swallowing pathologies and improvements in swallowing function to patients and family members.

SLPs further recognized that the objectivity of the data might allow for valid and reliable data that could be automatically processed with a quick turnaround time. They added that the benefits of quick and objective data analysis would enhance the capacity to compare data to healthy swallowers in the same age and demographic groups.

HRM as an Addition to Existing Technologies

Participants agreed that HRM could be used in conjunction with more familiar technologies [e.g., videofluoroscopy, fiberoptic endoscopic evaluation of swallowing (FEES)] to facilitate diagnosis and drive treatment—especially in cases where traditional methods produced unclear results or when HRM may have fewer contraindications. SLPs argued that HRM would enhance or confirm findings from videofluoroscopy or FEES, and could add diagnostic data when other modalities prove inconclusive. SLPs agreed that HRM is a complementary evaluation, and saw HRM as part of a *"swallowing assessment package alongside endoscopy and videofluoroscopy"* (Survey respondent). No participants discussed using HRM as a standalone evaluation or to replace other instrumented evaluations.

Patient-Centric Benefits of HRM

Often, SLPs linked the advantages of HRM to improvements to patient care. Many SLPs in the focus groups and surveys commented on HRM's potential applicability for improved diagnosis and treatment planning, as a teaching and motivational tool for patients, for direct use in biofeedback therapy, and as a method to measure treatment progress. These patient-centric benefits are a direct result of the technical benefits described above and seems to drive SLPs' enthusiasm the most. Explanatory quotes for each of these subthemes are in Table 3.

The objective nature of HRM was perceived to contribute to improved differential diagnosis of dysphagia. With more objective information about swallowing physiology coming from HRM, clinicians can improve treatment selection when faced with a patient with complex dysphagia. Additionally, objective HRM data were proposed for use in development and evaluation of novel dysphagia treatments. As a direct result from HRM supplementing other evaluation techniques, SLPs expressed that HRM could augment dysphagia diagnosis and better characterize

Table 2 Representative quotes: SLP-perceived benefits to high-resolution manometry

Theme	Example quotes
Objectivity	I like the objectivity because I don't think we're getting that with the [videofluoroscopy] study right now … [I can explain that] 'This isn't just my subjective interpretation of what's happening' (FG)
Supplementation of other technology	[HRM] provides additional info about the swallow that may help explain why traditional treatments sometimes aren't effective for our patients (FG)

FG focus group participant, *HRM* high-resolution manometry

Table 3 Representative quotes: perceived patient-centered benefits of high-resolution manometry

Theme	Example quotes
Diagnosis	In an ideal world, I would use HRM as an adjunct to the videofluoroscopic study/modified barium swallow (MBS) especially for clients who demonstrate pharyngeal residue that can't be explained by the physiology during the MBS (S)
Treatment planning	… you can have hypopharyngeal residue for a multitude of reasons. Is it pharyngeal weakness? Is it a hypertonic cricopharyngeus muscle? Is it reduced hyoid elevation excursion or anterior displacement? [And]…with data and with numbers, treatment-wise, you have a high-pressure zone, and you can do all the Mendelsohns that you want, but it's not going to fix the CP, something that could be amenable to Botox. So I think driving treatment, [HRM] is huge (FG)
Patient teaching and motivation	[HRM] changes how therapy goes because all of a sudden [the patient] says, 'what are my numbers? Am I getting better?' It's something they can see and they understand (FG)
Monitoring of treatment progress	So I can compare, you know, pre- and post-treatment or that I can have that objective data and say, 'oh, we have improvements in these areas' (FG)
Biofeedback therapy	And the reason why biofeedback is because you [can] say, see this? This needs to be red, you know, kind of thing. And then once the, and so the patient is looking at it, and then if you're doing effortful, you know… they can see that. And then… if they do it again, you're like, see? That's not red as it was last time. What did you do differently? And it kind of trains them. And then you can take away that biofeedback, and then they become more independent. We already use it as a biofeedback tool for our swallowing treatments (FG)

FG focus group participant, *S* survey respondent, *HRM* high-resolution manometry, *MBS* modified barium swallow, *CP* cricopharyngeus

specific swallowing deficits. This was mentioned especially when results of more traditional diagnostic methods were inconclusive, which could benefit patients by providing greater depth of information to use in treatment planning and in translation of findings to the bedside.

Once swallowing deficits are diagnosed and characterized, SLPs can develop a treatment plan that is targeted to the specific needs of each patient. For example, SLPs stated that residue seen on videofluoroscopy can have many potential causes, and the supplementary nature of HRM can better identify the cause of such a finding and thus target the deficits of the swallow that need treatment. SLPs believe that objective data from HRM can also help guide what aspects of the swallow can be best targeted, specifically in cases when videofluoroscopy and FEES outcomes are unclear.

After the swallowing deficit is properly diagnosed and a treatment plan is developed, SLPs noted that HRM could be used in setting treatment goals with patients and maintaining patient motivation. Patients are thought to be motivated by the objective nature of HRM; numbers can be more inherent and thus motivating than a description of movement of a particular structure seen on videofluoroscopy, which is unfamiliar and may be confusing to patients. One SLP in a focus group remarked that, from her experience, improved understanding of the deficit had improved patient compliance with therapy recommendations.

SLPs also saw patient-centered benefits in using HRM to compare pressure values from baseline to track and monitor the improvement or decline in swallowing. In particular, the availability of pre-treatment and post-treatment measurements was viewed as being specifically beneficial. These objective data can additionally help to *"explain why treatments **are or aren't effective*** [emphasis added]*"* (Survey respondent).

Finally, focus group participants were particularly excited about the possibility of using HRM as a biofeedback method. Participants raised the potential of using HRM for biofeedback in the focus groups without any prompting. SLPs expressed interest in using HRM in swallowing therapy to provide visual biofeedback to patients regarding biomechanics of their swallow, both for training of therapeutic maneuvers and for direct biofeedback therapy. However, there was some disagreement about whether patients would tolerate passage of the catheter multiple times. Those comments highlight the need to consider multiple factors when developing a treatment plan, for example, how a specific patient tolerates passage of the catheter and whether they are motivated to overcome the discomfort in order to participate in a biofeedback therapy program.

Disagreements and Concerns: Which Patients would Benefit and When?

Despite the widespread agreement on the patient-centered benefits of HRM, SLPs disagreed on which patients may benefit or be contraindicated from HRM and where in the treatment process HRM would fit best. In the four focus groups, participants spontaneously suggested a wide range of patient populations that might benefit from the use of

HRM in diagnosis and treatment of dysphagia and those who would not benefit or would be contraindicated for HRM. To follow up on these suggestions, we specifically asked respondents to our survey which patients they imagine would benefit most from HRM as an adjunct to videofluoroscopy. The list of patient diagnoses that SLPs perceived to benefit mainly included those who were post-acute and ready for rehabilitation or those with characteristics as seen in Table 4. Overall, there was more consensus among SLPs on which patient groups could benefit from HRM and more disagreement about those for whom HRM use would be contraindicated.

SLPs saw HRM as a technique that could augment diagnosis and treatment planning, especially in complex cases. Compounding complexity, respondents noted that HRM would be useful in patients with several swallowing deficits, as HRM allows for *"measurement of various pressures when multiple levels of deficits are noted"* (Survey respondent). On the other hand, one respondent typical of those hoping to use HRM as an adjunct to videofluoroscopy expressed that HRM could be used in the case where the patient has relatively functional swallowing on videofluoroscopy, but information about strength would be helpful in identifying underlying causes of swallowing complaints. In addition, SLPs saw a potential advantage in the diagnosis and treatment of patients whose dysphagia is not limited to pharyngeal deficits, specifically when pharyngeal dysphagia is accompanied by esophageal dysphagia.

Although SLPs seem enthusiastic about the promises of improving their practice with HRM, concerns about tolerability of the procedure, instrumentation, and other patient factors (e.g., patient age, cognitive ability, facial and pharyngeal anatomy, clinical setting) were perceived to preclude some patients from being recommended for HRM. Many SLPs made comparisons to FEES as a reference point for their argument.

There was general consensus that HRM is more invasive than other swallowing evaluations, such as videofluoroscopy and FEES. This may prohibit routine use and may

Table 4 Patient categories to benefit most from pharyngeal high-resolution manometry

Theme	Examples
Underlying diagnosis/condition	Neurological disorders, including neurodegenerative diseases, brain stem defects, and stroke
	Myopathies, including inclusion body myositis, myotonic dystrophy, and oculopharyngeal muscular dystrophy
	Critical illness myopathy
	Trauma, including high spinal cord injury and/or suspected cranial nerve injury
	Head & neck cancer, following chemotherapy, radiotherapy, and/or surgery
	Infants, children, and teenagers with feeding concerns
	Frail elderly
	Following cardiothoracic surgery
	Following anterior cervical disc fusion
	Immobile patients, not easily transported
Dysphagia sign/symptom	Vague food sticking complaints/unexplained pharyngeal residue
	Weakness
	Reduced tongue base retraction/pharyngeal constriction
	Poor coordination
	Upper esophageal sphincter dysfunction
	Aspiration due to post-prandial reflux
	Esophageal dysphagia, including combined oropharyngeal and esophageal dysphagia
	"*Most patients with pharyngeal dysphagia I suppose*" (S)
Perceived contraindications	Unable to tolerate catheter placement
	Potential for adverse events
	Unsuitable anatomy
	Pediatrics (contested)
	Severe dysphagia (contested)
	Cognitive and/or neurological dysfunction (contested)
	Located in a skilled nursing facility
	Located in acute care (contested)

S direct quote from survey

cause anxiety in patients who will undergo the procedure. A number of SLPs also addressed concerns about how patients may tolerate the HRM catheter once it has been placed; tolerability is believed to be patient-specific. These sentiments come in direct contrast to enthusiasms for use in biofeedback therapy. Biofeedback used to alter swallowing pressure patterns, not for teaching of maneuvers, requires repeated placement of the catheter with longer time periods in which the HRM catheter is in place.

Instrumentation was a further area of confusion regarding clinical adoption of HRM. A few SLPs expressed concerns about appropriate instrumentation of HRM, especially with ensuring correct and comfortable placement of the HRM catheter. Some believe that patients with severe dysphagia will have difficulty with instrumentation, while others argued that HRM catheter placement in healthy swallowers is more difficult. This disagreement among SLPs on which patients could benefit from HRM is problematic. Those who believe that a patient with severe dysphagia would not tolerate passage of the HRM catheter would exclude those patients who may benefit from the technical and clinical use aspects described above. Additionally, these patients likely belong to the very classes of patients identified that would benefit from the additional information gained by HRM (Table 4).

As for the pediatric population, some focus group participants remarked that the HRM catheter would be too large to place in an infant. On the other hand, multiple survey respondents who mentioned HRM use in the pediatric population seemed to think it appropriate.

There were other disagreements in *when* in the evaluation and treatment process to use HRM. Some SLPs argued that it would only be used following videofluoroscopy or FEES to address unanswered questions, while others mentioned using it as a screening tool to use at the bedside before performing other instrumented studies. Additionally, some SLPs considered the possibility of using HRM specifically for tracking progress over time, in order to avoid repeated exposure to radiation, such as with oculopharyngeal muscle dystrophy. On the other hand, one focus group participant was concerned that HRM would not be indicated for patients with progressive disease, envisioning that patients would not want to undergo the procedure multiple times because of the discomfort associated. However, this sentiment contradicts the general agreement that HRM is indicated for use in tracking treatment progress.

Finally, there was a lack of consensus in the best settings in which to use HRM. Some SLPs indicated that the acute inpatient setting may not be preferable for HRM use while others attested to the potential benefit of performing HRM at bedside as a predictor of patients who would benefit and the ability to repeat HRM exams without repeated exposure to radiation, as with videofluoroscopy.

Discussion

Results of our focus groups and open-ended survey reveal that SLPs are generally enthusiastic about the prospects of clinical HRM use. There was broad consensus around the patient-centered benefits that arise from the objective nature of HRM data as well as agreement that the data obtained from HRM are not obtainable through any other current evaluation technique. The objective and unique data that come from HRM can be used along the clinical continuum, from screening through outcome measurement. Benefits expressed ranged from improved diagnostics, treatment planning specific to deficits, and outcome measurement that is discrete and easy to understand for patients, physicians, and insurers. SLPs focused directly and without prompt on the manner in which HRM could improve clinical service and patient care, rather than individual personal or professional benefits, such as time-saving, revenue-generating, or intellectually stimulating uses.

The enthusiasm for HRM for biofeedback is a testament to SLPs' desire to incorporate patient participation in the rehabilitation process. SLPs envisioned using HRM both to train maneuvers for use without the HRM catheter in place and also for direct biofeedback training, where the patient would have the catheter in place and figure out how they can generate swallowing pressures that resemble those of healthy individuals. It is not clear from these data whether SLPs' enthusiasms for HRM will lead to clinical adoption. However, SLPs formulating plans for biofeedback is illustrative of an established acceptance of clinical HRM use. The clinician questioning whether HRM has a place in their clinical practice would not likely be planning for a future using HRM as biofeedback.

Key areas of disagreement were not in *how* HRM could be used, but *when* and *for whom*. Certainly, there are patients who would not benefit or would not tolerate placement of the HRM pressure catheter. On the other hand, many SLPs had reservations about using HRM in the pediatric population. However, there is a growing body of research using HRM technology in the pharynx and esophagus in pediatric patients with valid and reliable results [28–35]. Some concerns about indications for HRM seemed to stem from a generalization of patient-specific factors. While it is key to assess a patient's tolerability of a certain procedure on an individual basis, the potential for anxiety or discomfort should not preclude HRM's careful use. Other disagreements may have stemmed from a lack of training or experience from the procedure. With

continued research, training, and exposure to HRM, these concerns and disagreements will likely dissipate.

Some limitations exist in the present study. The qualitative nature of this study may be seen as a potential limitation. However, qualitative research provides a necessary first phase in mapping domains of interest and generating hypotheses that can be tested with larger datasets in the future. The response rate for the survey was less than 30% (87/300), which is a standard response to a large survey using open-ended questions [36]. Because of the nature of our research question, we sought in-depth answers rather than breadth across respondents. Additionally, the focus groups were limited to only SLPs who carried the BCS-S distinction, as we targeted thought leaders in the field. It may have been that these clinical experts had background knowledge of pharyngeal HRM, which lead to their enthusiasms for its use. Finally, as with any focus group or survey on a narrow topic such as pharyngeal HRM, participants with prior knowledge and opinions on HRM may have self-selected to participate, whereas less knowledgeable SLPs did not.

As qualitative research methods are hypothesis-generating instead of hypothesis-testing, there were some unresolved questions that arose from our data that can be the inspiration for future research. From the areas of disagreement come clear research questions, notably: *What patients are best suited to benefit from HRM?* and *When in the clinical care process will HRM bring the most benefit?* Additionally, areas of research need can also stem from SLPs' enthusiasms: *What biofeedback protocols can result in improved swallowing function?* or *What objective parameters best capture improvement in function following therapy?* Additionally, it is of interest for future research how clinician demographics (e.g., age, experience, practice setting) and level of training or exposure to HRM influence responses analyzed in the present study. Given the nascent state of clinical use of pharyngeal HRM, there are many questions waiting to be investigated. However, for HRM to come into regular, widespread clinical use, SLPs must be willing to use the technology before all unknowns are addressed in the literature. New insights about swallowing physiology and pathophysiology continue to come to light more than 30 years after the introduction of the videofluoroscopic swallowing study, but clinicians still use this technology to the best of their ability for the benefit of their patients. For pharyngeal HRM to blossom, SLPs will need to be well-read, critical, and flexible with their clinical use of HRM.

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