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Speech and Swallowing in Parkinson's Disease

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Abstract

Dysarthria and dysphagia occur frequently in Parkinson's disease (PD). Reduced speech intelligibility is a significant functional limitation of dysarthria, and in the case of PD is likely related articulatory and phonatory impairment. Prosodically-based treatments show the most promise for addressing these deficits as well as for maximizing speech intelligibility. Communication-oriented strategies also may help to enhance mutual understanding between a speaker and listener. Dysphagia in PD can result in serious health issues, including aspiration pneumonia, malnutrition, and dehydration. Early identification of swallowing abnormalities is critical so as to minimize the impact of dysphagia on health status and quality of life. Feeding modifications, compensatory strategies, and therapeutic swallowing techniques all have a role in the management of dysphagia in PD.

Keywords

Parkinson's disease; dysarthria; dysphagia; speech and swallowing treatment

I. Introduction

Dysarthria is a disorder of spoken communication due to central or peripheral nervous system damage that is associated with disturbance in muscular control for speech. This speech motor control disorder may affect any or all of the respiratory, phonatory, resonatory, or articulatory components of the speech production mechanism. Prosody also may be affected. Reduced intelligibility is arguably the most significant functional limitation of dysarthria, but voice, speaking rate, and other prosodic abnormalities also may limit a person's ability to communicate in a manner or range considered normal, even in the face of largely preserved intelligibility.^{1,2} Dysphagia may be defined as inefficient or unsafe transfer of food, liquid or saliva from the mouth into the stomach. Complications of dysphagia include aspiration pneumonia, malnutrition, and dehydration. Early identification and management of swallowing abnormalities is critical for minimizing the likelihood of these and other complications that negatively impact health status and quality of life.

Both dysarthria and dysphagia are common in idiopathic Parkinson's disease (PD), with dysarthria typically preceding the emergence of dysphagia.³ Approximately 90% of persons with PD will develop dysarthria during the course of the disease, although individuals with PD themselves may be unaware of problems with spoken communication.^{2–5} Voice abnormalities tend to be the first indication of dysarthria followed by articulation and fluency abnormalities.² Dysarthria severe enough to cause functional limitation in the form of reduced intelligibility tends to occur later in the disease course, although the relationship between overall disease severity and number of voice and speech abnormalities or dysarthria severity is not particularly strong.^{1,2,6} Estimates of the proportion of persons with PD experiencing dysphagia vary, with

the available research suggesting that anywhere from 40% to 95% of persons with PD have dysphagia.^{3,7,8} As with dysarthria, persons with PD may be unaware of swallowing difficulties, even in the presence of weight loss, dehydration and pneumonia. There also is no strong evidence of a relationship between severity of dysphagia in PD and overall disease severity.^{7–10}

In the remainder of the paper, characteristics of dysarthria and dysphagia in PD are summarized followed by a consideration of behavioral management strategies. Behavioral treatments for dysarthria and dysphagia are of foremost interest, as pharmacologic and neurosurgical treatments for PD are known to have more consistently positive effects on limb motor symptoms as compared to speech and swallowing symptoms.^{11,12} That being said, behavioral treatments for dysarthria or dysphagia designed to enhance function or compensate for lost function are best undertaken in patients who are optimally medicated.² Swallowing material in the current review focuses on oropharyngeal dysphagia, as evaluation and management of the oral and pharyngeal stages of the swallow are within the scope of practice of speech language pathology. Contributors to this special issue were further asked to emphasize treatment material of highest relevance to later-stages of PD. As previously noted, however, overall disease severity in PD is not strongly correlated with dysarthria or dysphagia severity. The approach taken here is to emphasize management material most relevant to dysarthria and dysphagia that are at least moderately severe. Moderate dysarthria in PD is operationally defined as a dysarthria severe enough to cause reduced speech intelligibility.^{1,2} As such, dysarthria management material focuses on strategies for maximizing intelligibility and achieving mutual understanding between the speaker and listener. Moderate dysphagia in PD is operationally defined as the potential for aspiration that is minimized by swallowing techniques and diet modification.^{2,13} Dysphagia management material therefore reviews compensatory and therapeutic swallowing strategies as well as feeding modifications. Finally, dysarthria in PD and to a lesser extent dysphagia have been considered in a number of recent chapters, books and review articles.^{11,12, 14–21} Readers are encouraged to consult these sources for a comprehensive consideration of dysarthria and dysphagia in PD.

II. Characteristics of Dysarthria in Parkinson's Disease

PD, which is the result of basal ganglia control circuit pathology, is most often associated with hypokinetic dysarthria, although it has been estimated that 10 to 20% of patients with PD have a mixed hypokinetic-hyperkinetic dysarthria.²⁰ The label “hypokinetic” derives from the notion that decreased range of motion in the speech mechanism is presumed to be the primary factor contributing to the speech disorder in PD. The label “hyperkinetic,” in contrast, refers to the effects of involuntary movements on the speech mechanism due to basal ganglia control circuit pathology. In the case of PD, involuntary movements affecting the speech mechanism occur in the form of dyskinesias that are related to long-term levodopa usage. Labels notwithstanding, dysarthria secondary to PD is most obvious in voice, articulation and prosody. Prominent, deviant perceptual characteristics include monopitch, monoloudness, reduced overall loudness, short rushes of speech, short phrases, variable rate, overall increased rate, inappropriate silences, repeated phonemes, reduced stress, and imprecise consonants.²¹ Dysphonia, in the form of phonatory harshness and breathiness, also is commonly perceived in the speech of persons with PD. Although anywhere from 10 to 40% of patients are perceived to be mildly hypernasal, hypernasality and nasal emission are not usually perceptually prominent.^{5,22} Auditory-perceptual judgments continue to be the “gold standard” for guiding clinical dysarthria decisions. As discussed below, however, instrumental studies have helped to elaborate the nature of the speech mechanism impairment in PD.

Speech breathing studies indicate that persons with PD produce more variable and less efficient movements of the chestwall for speech compared to neurologically normal talkers. Inefficient

usage of the mechanism by speakers with PD is further suggested by reports of lowered lung volume initiations for speech and a tendency to continue speaking below end expiratory level.²³ Lung volume initiations also tend to be more variable in PD as does the amount of time per breath group actually spent speaking.^{23,24} Speakers with PD further tend to over-rely on the abdomen to produce lung volume change for speech, possibly owing to ribcage rigidity.²⁴ Vocal fold bowing as well as incomplete vocal fold closure during phonation have been observed in the laryngeal mechanism^{26,27}. Whether these findings are attributable to reduced effort, weakness, and reduced muscle activation or excessive laryngeal muscle activity as well as muscular rigidity in the larynx is unclear.¹⁷ Acoustic studies further indicate a tendency toward reduced sound pressure level (SPL), reduced voice pitch variability, and phonatory instability, as suggested by increased noise and cycle to cycle variability during phonation.^{28,29} Movement velocities and displacements of the velum also tend to be reduced for speech, and acoustic studies suggest increased nasal airflow for speech in as many as 70% of individuals with PD.^{22,30} Peak movement velocities and amplitudes of the lips and jaw also tend to be reduced during speech production for persons with PD.^{31–33} Acoustically, reduced movement displacements and velocities of the oral articulators are evidenced by reduced vowel formant transition extents and slopes, a collapsed vowel acoustic working space, and a trend toward reduced consonant spectral distinctiveness.^{34,35}

Speech rate characteristics as well as dysfluency in PD also deserve comment. Speech rates vary widely in persons with PD. Instrumental measures suggest that some speakers with PD have a normal rate, other individuals have a speech rate that is slower than normal and other persons have a speech rate that is faster than normal. In fact, hypokinetic dysarthria, which is the type of dysarthria most often associated with PD, is the only dysarthria for which rate may be faster than normal.²¹ Perceptual impressions of rate in PD must be confirmed with instrumental measures, as listeners' perception of the rate of Parkinsonian speech grows abnormally rapidly.³⁶ That is, for a sentence produced at the same physical rate (i.e., 5 syllables per second) by a speaker with PD and a neurologically normal speaker, the sentence produced by the speaker with PD will be perceived by listeners to be faster. Imprecise articulation and monopitch or reduced variation in voice fundamental frequency (F0) in the acoustic speech signal of PD have been proposed as potential explanations. Dysfluency occurs in approximately 15 to 45% of persons with PD, typically at the beginning of utterances or after a pause.³⁷ The dysfluency is typically mild in severity and is characterized by rapid, blurred phoneme repetitions.

Finally, a variety of studies suggest that at least some individuals with PD exhibit deficits in perceiving speech. Select examples from the literature help to illustrate the range of deficits that have been observed. In one recent study, a subgroup of individuals with PD was unable to use temporal cues in the acoustic speech stream to perceive the t/d contrast in the German words "Boden" and Boten."³⁸ Another study found that word identification scores for some individuals with PD were reduced for stimuli presented at a slow speech rate.³⁹ Yet another study suggests that persons with PD demonstrate abnormalities in perceiving speech intensity.⁴⁰ The existence of production-perception linkages in neurologically normal speakers suggests that these and other perceptual abnormalities likely contribute to dysarthria or speech impairment in PD.^{41,42} Nonetheless, the nature of sensory or perceptual deficits in PD and their contribution to dysarthria is a topic in need of further study.

III. Oropharyngeal Swallowing Abnormalities

Swallowing impairment in PD may be apparent in any or all of the oral, pharyngeal, and esophageal stages of deglutition, although only oral and pharyngeal stage deficits are considered as part of the current review. Oral stage deficits probably occur most frequently in PD and usually are the first indication of dysphagia in PD.^{2,7,43} Limited excursion of the

mandible contributes to increased time for oral preparation or chewing.⁴⁴ Repetitive, backward and forward rocking motion of the tongue termed “tongue pumping” has been widely observed in PD, and is considered by some to pathognomonic of the disease.^{43, 45, 46} To elaborate, tongue pumping refers to an inefficient, non-propulsive, back and forth motion of the tongue which prevents material from leaving the oral cavity. The back and forth motion may be repeated several times for a bolus before the back of the tongue eventually lowers to allow the passage into the pharynx. Liquid or saliva escaping through the lips (i.e., drooling) also occurs fairly often in persons with PD.⁴ Drooling does not appear to be the result of increased saliva production per se, as saliva production is actually decreased in PD.⁴⁷ Rather, a reduction in the frequency of spontaneous swallows as well as an anteriorly flexed neck position are likely responsible for drooling in PD.⁴⁷ As many as 55% of patients with PD report xerostomia or dry mouth.⁴⁸ Xerostomia follows from reduced saliva production and also is related to levodopa dosage, such that higher doses of levodopa therapy increase the problems of xerostomia.⁴⁷

Some persons with PD also exhibit a delay in triggering the pharyngeal swallow.^{2, 43} Although the delay is usually mild, any delay in triggering the pharyngeal swallow is associated with increased risk of aspiration.⁴³ Once the pharyngeal swallow triggers, pharyngeal wall contraction and posterior tongue base retraction may be reduced, resulting in residue in the valleculae and pyriform sinuses after the swallow.^{8, 10} Just as a delay in triggering the pharyngeal swallow is associated with increased risk of aspiration, pharyngeal residue also increases the likelihood of aspiration, as the residual material may fall into the open airway after the pharyngeal swallow is complete. Decreased laryngeal elevation coupled with poor tongue base and pharyngeal wall motion can result in cricopharyngeal dysfunction wherein material is unable to pass into the esophagus.⁴³ Laryngeal closure also may be incomplete during the pharyngeal stage of the swallow, and cough – which is crucial for clearing the airway of foreign material – is frequently impaired in PD.⁴⁹ Cognitive impairment, upper extremity impairment, and impulsive feeding behavior sometimes apparent in persons with more advanced PD also can exacerbate oropharyngeal dysphagia.⁵⁰ Finally, while there is a great deal of variability in the nature and severity of dysphagia PD, it is important to reiterate that oral and pharyngeal stage impairments and even aspiration are frequently observed in patients who have no complaints of dysphagia.²

IV. Treatment of Dysarthria

Dysarthria treatment techniques in the current review may be broadly categorized as either speaker-oriented strategies or communication-oriented strategies. Low-tech augmentative and alternative communication (AAC) options also are briefly considered. Speaker-oriented strategies focus on altering a talker’s speech by remediating the underlying impairment in the speech mechanism or by teaching speech strategies aimed at compensating for the impairment, whereas communication-oriented strategies are more generally concerned with modifying aspects of the communicative interaction. Low-tech AAC options are appropriate for individuals unable to use speech to meet some or all of their communication needs. Absent from the current review is an in-depth consideration of the Lee Silverman Voice Treatment (LSVT)[®], an intensive, speaker-oriented voice treatment for dysarthria directed at increasing respiratory-phonatory effort. LSVT[®] aims to modify laryngopathophysiology in dysarthria using exercises designed to increase loudness and decrease breathiness with the ultimate goal of maintaining or even restoring normal speech. Several recent review articles and chapters provide a comprehensive summary of LSVT[®] and its application to dysarthria in PD.^{14, 16, 17} The benefit of LSVT[®] has been demonstrated for both perceptual and instrumental measures of speech in an impressive number of treatment studies, although the impact on quantitative, objective measures of intelligibility in PD has not been widely reported. This treatment program further appears particularly well suited for addressing reduced quality or naturalness of speech in persons with mild dysarthria secondary to PD.² Readers interested in dysarthria treatment

are further encouraged to consult recently published practice treatment guidelines.^{51–56} These papers evaluate the strength of the research evidence and state of the knowledge base for dysarthria intervention.

A. Speaker-Oriented Treatments

Speaker-oriented treatments for moderate dysarthria secondary to PD are typically compensatory in nature and require individuals to learn to implement different behavioral strategies to enhance intelligibility.² Thus, treatment candidates must be sufficiently motivated to learn new approaches to speaking and also be willing to practice outside of the clinic setting. The importance of practicing new approaches to talking away from the formal clinic setting is especially important for persons with PD, as poor generalization from the clinic to more naturalistic, conversational situations has long been a concern in this population. This transfer of treatment problem may reflect a cognitive deficit in learning new procedures as well as greater reliance on the prevailing context when learning new motor behaviors.¹⁷ In lieu of the possibility of these underlying deficits, clinicians are advised to require clients to complete homework activities, and as possible, to incorporate simulations of naturalistic environments and contexts during speech therapy sessions. Using multi-talker background noise in the clinic to simulate communicating in an environment like a restaurant is one such example.¹⁷ Including a spouse or caregiver as part of treatment activities in the clinic would be another way to provide more naturalistic contextual cues. Finally, there is evidence that when behavioral treatment for dysarthria in PD is accompanied by instrumental feedback, improvements in speech are superior to those obtained for behavioral treatment alone.¹⁷ Instrumental feedback regarding speech prosody can be accomplished fairly easily using clinic-friendly instrumentation such as the Visivox, Visipitch, a sound level meter, or the Motor Speech Profile of the Computerized Speech Lab, as just a few examples,

Before considering specific compensatory strategies for maximizing intelligibility in dysarthria, factors predicting intelligibility should be briefly considered. Both supralaryngeal and phonatory variables have been shown predict intelligibility or perceived speech severity in dysarthria. These variables include vowel acoustic distinctiveness or instrumental measures reflecting range of articulatory motion for vowels, consonant acoustic distinctiveness, sentence-level F0 range, and voice quality or “noisiness” of the glottal source.^{29,57–59} In general, reduced vowel and consonant acoustic distinctiveness, reduced sentence-level F0 range, and increased noise in the glottal source are associated with reduced intelligibility, although there is a good deal of variability across studies in the strength of the relationship between these variables and intelligibility and not all studies report a relationship between these variables and intelligibility. Nonetheless, reduced acoustic-phonetic distinctiveness, reduced sentence-level F0 range, and a noisier glottal source all have been reported in PD.^{29,35,57} Prosodically-based treatment approaches show the most promise for addressing both supralaryngeal and phonatory deficits in PD as well as maximizing intelligibility and speech naturalness. Furthermore, a focus on utterance or phrase-level quality via prosodic modification, as opposed to a focus on segmental quality (i.e., articulatory precision of vowels and consonants), will have the most beneficial impact on a listener’s ability to apply his or her perceptual strategies to connected speech.⁶⁰

Rate reduction is one treatment technique widely used to improve intelligibility in dysarthria.^{1,2,21} Rate reduction is not only appropriate for speakers with PD exhibiting a rapid or accelerated rate, but also may be appropriate for those individuals who have a slower-than-normal rate or even a normal speech rate, providing speakers are willing to trade at least some reduction in speech naturalness for improved intelligibility. Rate reduction can be achieved using computerized pacing software, a pacing board, portable delayed-auditory feedback (DAF) or even general verbal directions. Gains in intelligibility related to slowing of rate appear

to be related to changes in speech output as well as listener variables. That is, there is a tendency for at least some speakers with dysarthria to use vocal tract shapes more like those for neurologically normal talkers when rate is slowed.^{35,61} A slower-than-normal speech rate further provides the listener with more time to process the signal, and pauses between words may facilitate lexical segmentation.

Increasing prosodic variation in speech also may improve intelligibility. Activities that aim to increased phrase or sentence-level F0 modulation as well as tasks encouraging a more general exaggeration of prosodic contour during speech may help increase prosodic variation and thus intelligibility.⁵⁶ Contrastive stress, which focuses on heightening syllabic strength contrastivity, is another possible therapy strategy.⁶² Contrastively stressing words in an utterance involves training speakers to emphasize a content word by making it longer, louder, and higher in pitch than surrounding words. Contrastive stress further has been shown to increase articulatory excursions for some speakers with dysarthria.⁶³ Teaching appropriate use of breath-groups to increase prosodic variation in speech is further appropriate for some patients. For example, for speakers who only produce a few words per breath, increasing the length of breath groups and pause without inhaling can produce meaningful clinical changes in F0 for patients perceived to be monotonous.⁶⁴

Speaking louder also has the potential to improve intelligibility owing to improved audibility of speech as well as segmental and suprasegmental adjustments in speech output. For example, increasing vocal loudness increases F0 range and improves phonatory stability.^{14,16} Segmental improvements in the form of increased acoustic-phonetic distinctiveness and increased articulatory excursions also have been reported when speakers with PD use an increased vocal loudness.^{35,65} Finally, clear speech shows much promise as a therapy technique for maximizing intelligibility in dysarthria. Clear speech may be accomplished in a variety of ways but instructing talkers to speak clearly generally stimulates both increased loudness and a slower-than-normal rate, which in essence is a combination of the therapeutic techniques of increased loudness and rate reduction. Indeed, the few studies investigating clear speech in dysarthria report increased SPL, increased articulatory excursions, reduced articulatory rate, and improved intelligibility.^{65–67}

B. Communication-Oriented Strategies

Communication-oriented treatment strategies derive from the notion that a variety of factors, other than the acoustic signal produced by a talker, contribute to mutual understanding between a speaker and listener. Communication-oriented strategies are often considered as complimentary to the speaker-oriented strategies previously discussed, but also may be used as a “stand-alone” approach to treatment. Several strategies may be employed or strategies can be used in isolation.

a. Prepare Communication Partner, Monitor Comprehension, use Active Listening—Speakers with dysarthria should make sure their communication partner is attending and listening. Saying the communication partner’s name, establishing eye contact and gesturing are ways a speaker can alert that an interaction is starting. Asking if the message was understood further will allow a repair to be initiated immediately, if a breakdown in communication occurs. Listeners should bring their full attentional resources to the communication exchange and maintain eye contact with the speaker. Indeed, for at least some speakers with dysarthria, auditory-visual information improves sentence-level intelligibility as compared to auditory-only information.⁶⁸ Listeners also need to be prepared to work at listening and understanding a speaker with dysarthria. Active training and practice listening to dysarthric speech – with knowledge regarding the “target” message – may be an appropriate therapeutic technique for spouses of some patients.²¹ This suggestion follows from research

indicating that listeners who receive prior familiarization to the speech of a person with dysarthria have higher intelligibility scores than listeners who do not receive prior exposure to dysarthric speech.^{69–71}

b. Identify the Topic and Use Grammar to Enhance the Message—Identification of the topic prior to beginning conversation facilitates mutual understanding. The topic can be established verbally, in writing, or even with a communication book or device that provides topic choices in the form of words, phrases or pictures. Topic cues can increase intelligibility in dysarthria, on average, by 10% although some studies have reported that topic cues can increase intelligibility by as much as 50%.^{66,72,73} Utterance length and complexity also influence intelligibility. Speakers with severe dysarthria tend to be most intelligible at the single-word level, but speakers with more moderate dysarthria tend to be more understandable when speaking in sentences.⁷⁴ Sentences that are semantically and syntactically predictable also help to maximize intelligibility.

c. Gestures—Iconic hand gestures can illustrate or add meaning to content words of a spoken message when performed concurrently with speech. An example would be putting a hand up to signal “stop” while simultaneously verbalizing the word “stop”. For predictable sentences, the addition of these kinds of gestures can increase intelligibility by an average of 25%.^{75,76} Upper extremity control and the resulting quality of the gesture produced are important considerations, as speakers who are motorically capable of producing better gestures are likely to benefit most from this strategy.

d. Resolving Communication Breakdowns—A variety of strategies may be used to repair a communication breakdown including complete repetition, partial repetition of a phrase, partial repetition with elaboration or total repetition with elaboration.²¹ Rephrasing, using synonyms, and spelling difficult words either verbally or in writing also can be used to repair a communication breakdown. Given the abundance of repair strategies, speakers with dysarthria and their communication partners may wish to establish what method will be used first, if communication fails. It also may be useful in certain circumstances for partners to provide explicit cues as to what the speaker with PD can do to help ensure the message is understood (i.e., use a slow rate, say it clearly, stress the important word).

C. Low-tech AAC

Low-tech AAC may be appropriate for individuals with severe dysarthria secondary to PD who are only able to use speech to partially meet their communication needs or for whom speech is no longer functional. Alphabet supplementation, wherein a speaker points to the first letter of each word on an alphabet board as it is spoken, not only provides the benefits of a slower-than-normal rate but also provides the communication partner with orthographic cues. Studies suggest these types of alphabet cues improve intelligibility, on average, by 25%.⁷⁷ An alphabet board also can be used to spell-out whole words for a communication repair. Other examples of low-tech AAC that may be appropriate for persons with severe dysarthria include portable typing devices as well as paper based communication books and boards.⁷⁷ These low tech solutions typically require persons to select a picture or letter by pointing. Thus, large pictures or symbols may be needed for persons with impaired upper extremity control.

V. Management of Dysphagia

Because lack of awareness of swallowing difficulty as well as silent aspiration are not uncommon in PD, it is critical to monitor weight and provide counseling regarding signs and symptoms of swallowing difficulty even to individuals who report no swallowing difficulties.

² For patients with documented swallowing difficulty, regular evaluation should help to

anticipate problems and put strategies in place to reduce the likelihood of malnutrition, dehydration, and pulmonary problems.

A. Swallowing and Medication

As previously mentioned, levodopa treatment tends to have the most predictable effects on limb symptoms in PD. Nonetheless, certain aspects of eating and swallowing may be enhanced by medication.⁴³ It therefore is recommended that patients time their meals and medication in such a way that they receive maximum medication effect during meals so as to facilitate upper extremity control and possibly oral and pharyngeal function.² Similarly, some patients may show improvement in swallowing when medication is changed.⁴³ Thus, in patients who have changed medication, the clinician may opt to wait several weeks to begin swallow therapy – especially in the form of active range of motion exercises – to determine whether the medication benefits the patient's swallow. Some patients experience xerostomia as a side effect of pharmacologic treatment for PD. Depending on the existence of other swallowing and eating difficulties, taking frequent sips of water, throat lozenges or lemon drops, as well as synthetic saliva may prove helpful.

B. Feeding Modifications and Drooling

Adaptive utensils may be helpful for promoting and extending independent eating. Later-stage PD may be accompanied by dementia, which complicates management of feeding and swallowing, as patients may be unable to follow directions for some compensatory strategies. Patients also may be unable to feed themselves, necessitating a trained feeder. Feeders should be trained to monitor the safety of each swallow as well speed and duration of meal. Because patients with PD may take longer to swallow, a longer mealtime should be allowed.² Relatedly, for patients with reduced pharyngeal wall contraction and posterior tongue base retraction or who demonstrate impulsive feeding behavior, taking too much food too rapidly can result in increased risk of aspiration owing to collection of food in the pharynx. Smaller bites at a slower rate should be encouraged. Enteral feeding by means of a percutaneous endoscopic gastrostomy (PEG) may improve quality of life by providing nutritional support.^{2,43} For patients who are able, PEG does not preclude some nutrition by mouth for pleasure or nutrition.

For patients who drool, wiping the mouth and chin with a cloth, maintaining an upright posture, and even consciously thinking about swallowing more frequently or having a spouse or caregiver give reminders to swallow may be helpful. Patients with severe drooling should discuss medical options with their physician. It is important not to reduce liquid intake, as this may contribute to dehydration and constipation.

2. Compensatory and Therapeutic Swallowing Techniques

Compensatory strategies control the flow of food and help to eliminate symptoms, but do not alter the swallow physiology. Compensatory strategies used in the treatment of PD to be discussed include postural changes, increasing sensory input, and altering food consistencies. Eating while upright with the chin tucked to the chest or the head tilted forward at a 45 degree angle may be helpful for patients with a delay in triggering the pharyngeal swallow, reduced tongue base retraction, or reduced airway entrance closure or protection.⁴³ Increasing sensory input may benefit patients who are delayed in triggering the pharyngeal swallow. Foods that help to increase sensory input include highly seasoned food, cold foods, sour foods, and possibly carbonated beverages. Altering food consistencies or elimination of consistencies from the diet should be explored only after other compensatory strategies have been examined.⁴³ In general, thick viscous consistencies will be difficult for patients with PD to swallow who experience reduced tongue base retraction and pharyngeal contraction. Emphasizing foods that are moist and form a cohesive bolus has been suggested for patients with poor pharyngeal contraction, and blenderized food that requires minimal chewing may be necessary for patients

with severe dysphagia.² Similarly, thin liquids are typically the most difficult consistency for patients with reduced laryngeal closure.

Therapeutic procedures are designed to alter swallow physiology. Some patients with moderate dysphagia may benefit from active range-of-motion exercises for the tongue, lips, and falsetto exercises to facilitate laryngeal elevation.⁴³ Effortful swallow may be useful for patients with reduced posterior movement of the tongue base, while the Mendelsohn maneuver may be appropriate for patients with reduced laryngeal movement.⁴³ Effortful swallow simply involves instructing the patient to squeeze hard with their muscles as they swallow, while the Mendelsohn maneuver requires patients to hold up their Adam's apple for several seconds as they swallow. Airway protection techniques may include a double swallow followed by a cough as well as the supraglottic swallow.^{2,43} This latter technique may be helpful for persons who aspirate during the swallow. Supraglottic swallow involves having the patient inhale, swallow, and then cough.

Finally, the application of expiratory muscle strength training (EMST) and LSVT[®] to the treatment swallowing abnormalities in PD deserves comment. The effects of LSVT[®] on swallowing function have been described for eight patients with PD using a pre-post treatment design.⁷⁸ Post-treatment changes in swallowing included improved bolus control of the tongue, reduced oral transit time, improved tongue base function, reduced oral residue, and improved oral-pharyngeal swallow efficiency. EMST involves exhaling into a pressure-threshold device wherein patients must generate sufficient expiratory pressure to open a spring-loaded valve.⁷⁹ The device provides a consistent pressure load against exhalation as a means of improving respiratory muscle strength which may be important for cough and swallow. Published research for three patients with PD suggests that patients who underwent four weeks of EMST demonstrated improvements in expiratory muscle strength. Studies are underway to evaluate how these improvements may translate to cough and swallow and even speech.⁷⁹

VI. Conclusion

Reduced speech intelligibility is a significant functional limitation associated with dysarthria, and in the case of PD is likely related to both articulatory and phonatory impairment. Prosodically-based treatment approaches show the most promise for maximizing intelligibility and speech naturalness. Communication-oriented strategies also may help to enhance mutual understanding between a speaker and listener. Complications of dysphagia in PD can include aspiration pneumonia, malnutrition, and dehydration. Early identification of swallowing abnormalities is critical for minimizing the likelihood of these and other complications that negatively impact health status and quality of life. Feeding modifications, compensatory strategies, and therapeutic swallowing techniques all have a role in management of dysphagia in PD.

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