The Role of Therapeutic Exercises in the Treatment of Dysphagia

Note: Nancy B. Swigert was the Division 13 Coordinator at the time the content of this self-study was first published in Perspectives on Swallowing and Swallowing Disorders. For current information on ASHA’s special interest divisions, visit the division pages on the ASHA Web site (http://www.asha.org/about/membership-certification/divs/) or call the ASHA Action Center at 1-800-498-2071.

Contents

Lingual Strengthening and Swallowing ................................................................. 3

The Role of Oral Sensorimotor Therapy in the Treatment of Pediatric Dysphagia .......... 9

Perspectives on Swallowing Disorders and Their Treatment in Parkinson’s Disease With Emphasis on the Lee Silverman Voice Treatment .............................................. 15

Facial Neuromuscular Retraining ........................................................................... 23

Therapeutic Exercise in Dysphagia Management: Philosophies, Practices, and Challenges .............................................................................................................. 31
The Role of Therapeutic Exercises in the Treatment of Dysphagia
The Role of Therapeutic Exercises in the Treatment of Dysphagia

Lingual Strengthening and Swallowing

Cathy L. Lazarus
Department of Otolaryngology, New York University School of Medicine
New York, NY


The tongue plays a major role in propulsion of the bolus of food or liquid through the oral cavity into the pharynx and through the pharynx (Cerenko, McConnel, & Jackson, 1989). Once a bolus of food or liquid is sealed against the palate, the midline portion of the tongue elevates to contact the palate in a sequential anterior to posterior fashion to provide a driving force for bolus propulsion into the pharynx (Kahrilas, Lin, Logemann, Ergun, & Facchini, 1993). The lingual driving force creates pressure on the bolus (Pouderoux & Kahrilas, 1995). Increased muscular activity is required to propel firmer food boluses through the oral cavity in healthy individuals (Reimers-Neils, Logemann, & Larson, 1994).

Tasks used to investigate non-speech performance of the tongue in normal and abnormal populations have included maximum isometric pressure or force generation (i.e., strength). In healthy individuals, tongue strength has been found to decline with age (Crow & Ship, 1996; Nicosia et al., 2000; Robbins, Levine, Wood, Roecker, & Luschei, 1995). Reduced tongue strength has been found in individuals with Parkinson’s disease (Solomon, Robin, Rodnitzky, & Luschei, 1994) and stroke (Goodell, Shaker, Bowser, & Zamir, 1992; McNeil, Weismer, Adams, & Mulligan, 1990; Robinovitch, Hershler, & Romilly, 1991). Reduced fine force stability for tongue strength tasks has been observed in patients with amyotrophic lateral sclerosis (ALS), Parkinson’s disease, ataxic dysarthria, spastic cerebral palsy, and closed head injury (Barlow & Absb, 1983; McHenry, Minton, Wilson, & Post, 1994; McNeil et al., 1990; Meyers, 1986). Reduced tongue strength has also been observed in patients with oral and oropharyngeal cancer treated with radiotherapy (Lazarus et al., 2000, 2001). In addition, pilot data by this author (Lazarus, 2005) examining tongue strength in patients with head and neck cancer long after treatment has found impairment in tongue strength following chemo-radiotherapy to the head and neck for tumor sites other than oral or oropharyngeal. Radiation treatment volume in these patients included the oropharynx because of neck disease. Therefore, it is not surprising to see decrements in lingual strength, as radiotherapy likely resulted in lingual tissue fibrosis.

Oral phase swallowing impairment has been observed in a number of patient populations, including the neurologically impaired (Dworkin & Hartman, 1979; Lazarus & Logemann, 1987; Robbins & Levine, 1993; Robbins, Logemann, & Kirschner, 1986; Veis & Logemann, 1985), who often demonstrate impairment in tongue strength, as described previously, as well as in individuals treated with radiotherapy for oral and oropharyngeal cancer (Lazarus et al., 2000). Meyers (1986) found that tongue weakness correlates with increased oral transit times during paste swallows in individuals with ALS. In addition, these same patients demonstrated adequate tongue-to-palate contact during the swallow, but demonstrated oral residue after the swallow (Meyers). Lazarus and colleagues (2000, 2001) found that tongue strength correlates with temporal measures of oral
and pharyngeal stage swallowing, including oral and pharyngeal transit times and percentage of oral residue. Tongue strength has also been observed to be a good predictor of oral phase swallowing impairment, including bolus manipulation and clearance (Clark, Henson, Barber, & Stierwalt, 2003). Kays and colleagues (2004) found tongue strength impairment to correlate with maximal swallow pressures and impairment of swallow function, as measured by Penetration/Aspiration Scale scores (Rosenbek, Robbins, & Roecker, 1996) in a group of patients with stroke.

Muscle strengthening programs, including isokinetic, isotonic, and isometric, have been found to improve muscle strength in skeletal (i.e., limb) muscles in healthy individuals and in individuals with neurological impairment (Fiatarone et al., 1990; Frontera, Meredith, O’Reilly, & Knutgen, 1988; McCartney, Hicks, Martin, & Webber, 1995; Milner-Brown & Miller, 1988; Phillips & Hazeldene, 1996). In addition, muscle strengthening programs have resulted in muscle hypertrophy, increased muscle mass, increased neural activation, and increases in the number of muscle fibers (Fiatarone et al., 1990; Frontera et al., 1988; Häkkinen, Alén, & Komi, 1985; McCartney et al., 1995; Phillips & Hazeldene, 1996). Muscle exercise programs have resulted in significant increases in muscle strength after 6 weeks of exercise (Frontera et al., 1988; Kauffman, 1985).

Few studies have examined the effects of tongue strengthening programs on tongue strength in healthy populations, including healthy young and elderly populations (Lazarus et al., 2003, Hind & Robbins, 2004). Lazarus and colleagues (2003) examined the effects of tongue strengthening exercises in a group of 31 healthy young subjects. Subjects were randomized to one of three groups, including: (a) no-exercise group; (b) exercise group using a tongue depressor and; (c) exercise group using the IOPI—an instrument designed to assess tongue pressure, but that can also be used as an exercise tool, as this tool provides visual feedback on generated pressure (Robin, Goel, Somodi, & Luschei, 1992; Robin, Somodi, & Luschei, 1991). Results revealed no significant differences in maximum tongue strength when comparing the two exercise groups’ baseline to one month post-baseline. Therefore, the groups were combined for further statistical analysis. Examination of change in mean maximum strength from baseline to one month post-baseline for the two exercise groups combined revealed a significant increase in tongue strength from baseline to one month post-baseline. No significant differences were found when examining change in mean maximum tongue strength from baseline to one month post-baseline for the no-exercise group. Significant improvement in tongue strength in the exercise groups provides support for the theory that tongue strengthening exercises improve tongue strength in healthy young adults.

Hind and Robbins (2004) examined the effects of tongue strengthening exercises on tongue strength and swallowing in healthy elderly subjects. All subjects underwent an 8-week tongue resistance training program. Subjects showed significant improvement in maximal isometric lingual pressures and swallowing pressures post-exercise. These data provide support for the use of tongue resistance exercise programs with older individuals with dysphagia.

Although isometric tongue strengthening exercises (i.e., lingual resistance against a tongue blade) have been advocated for individuals with tongue weakness and dysarthria (Rosenbek & LaPointe, 1978), only recently have studies begun to examine the effects of tongue strengthening exercises on tongue strength and swallowing in populations demonstrating reduced tongue strength. A case study examined the effects of exercise on tongue strength in a single surgically treated patient with oral cancer and found that exercise improved tongue strength (Sullivan et al., 2001). A recent study examined the effects of isometric tongue strengthening exercises on tongue strength and swallow functioning in six patients with cerebrovascular accident (CVA) and found that patients demonstrated significantly improved maximum isometric tongue pressures, maximum swallow pressures, Penetration/Aspiration Scale (Rosenbek et al., 1996) scores (i.e., improved swallow function), and swallow quality of life (McHorney et al., 2000) following an exercise program (Kays et al.,
The Role of Therapeutic Exercises in the Treatment of Dysphagia

Recent studies have examined the effects of other types of strengthening programs on swallow functioning, including voice and respiratory and hyolaryngeal muscle strengthening. Sharkawi and colleagues (2002) found improvement in oral phase swallowing with use of the Lee Silverman Voice Therapy (LSVT®) program in Parkinson’s patients. Specifically, significant improvement in oral transit times, triggering of the pharyngeal swallow, and reduction in percentage oral residue were observed. Palmer and colleagues (2004) found at the LSVT® program resulted in improved lingual strength and endurance and swallow quality of life, as measured by the SWAL-QOL (McHorney et al., 2000) in patients with Parkinson’s disease. Sapienza (2004) found improvement in swallowing, specifically, a reduction in pharyngeal delay time, and improvement in speed and extent of hyolaryngeal motion during the swallow, in patients with Parkinson’s disease following a respiratory strength training program. The Shaker exercise program, designed to improve hyolaryngeal muscle strength and thereby increase the extent and duration of laryngeal elevation and width and duration of upper esophageal opening for swallowing, has shown to be effective in healthy normal subjects and patients with dysphagia (Shaker et al., 1997, 2002). A reduction in pharyngeal residue and elimination of post-deglutitive aspiration have also been observed following the Shaker exercise program in these patients.

In summary, there are exciting new studies being conducted on techniques to improve swallowing, based on strengthening of the tongue as well as other vocal tract and respiratory muscles. It is hoped that future studies will gain insight into the effectiveness of strength training on swallow functioning in a variety of dysphagic population.

Cathy Lazarus, PhD, is associate professor in the Department of Otolaryngology, New York University School of Medicine and director of hearing and speech, Bellevue Hospital Center. Dr. Lazarus has been conducting research in swallowing for over 20 years and has published several articles and book chapters. She has given numerous workshops and presentations on diagnosis and management of swallowing disorders. Her areas of interest include swallowing disorders in the head and neck cancer population and treatment of swallowing disorders. She may be contacted at cathy.lazarus@med.nyu.edu.

References


The Role of Therapeutic Exercises in the Treatment of Dysphagia


The Role of Therapeutic Exercises in the Treatment of Dysphagia
The Role of Oral Sensorimotor Therapy in the Treatment of Pediatric Dysphagia

Justine Joan Sheppard
Program in Speech and Language Pathology and Audiology, Department of Biobehavioral Sciences, Teachers College, Columbia University

Sensorimotor therapy was the first exercise system proposed for treating pediatric dysphagia in children with neuromuscular disorders such as cerebral palsy. Simply stated, the oral sensorimotor therapy approach provided structured sensory and movement experiences needed by the child to facilitate improved feeding and swallowing function and acquisition of new feeding and swallowing skills. The purposes of this article are to review the origins and theory of the oral sensorimotor approach (OST) and its theoretical foundation, to review research on the use of OST, and to present research problems and needs.

Historically, the term “Sensorimotor Therapy” has been used to describe a therapeutic approach that provided a structured sensory environment (input). The aim of the sensory structure is to modify specific abnormalities in the movement patterns exhibited by the patient during a particular functional task—the target task—and, in children with disability, to facilitate acquisition of more mature developmental skills. Structured sensory inputs are continued throughout the activity in a manner that is responsive to the changing postural adjustments and task-oriented movements of the patient. That is to say, the sensory strategies are used to structure and enhance the sensations associated with initiation of the task (feed forward) and with the ongoing performance of the task (feedback). Strategies are selected to influence both the exteroceptive (distance and contact sensations) and interoceptive (kinesthetic and proprioceptive) components of the task. The interventions are used to improve task efficiency and quality of performance, reduce the movement errors and involuntary movements that interfere with task performance or inhibited acquisition, and elicit new movement components. The sensory modalities include exteroceptive input that is associated typically with the task, such as food taste and temperature and contact sensations and resistance provided by utensil and bolus, as well as novel modalities, such as vibration and massage, that are selected to alter muscle tone for initiation and performance of the target task. In addition, assistance strategies are implemented for their potential to enhance or alter feed forward and feedback for joint stabilization, body position, movement of structures, and correction of movement errors.

In selecting the particular type and manner of sensory input and assistance, the therapist is to consider both the reflexive “sensorimotor” systems that regulate muscle tone, stabilization of joints, reflexive movement synergies, body postural alignment and balance, as well as the voluntary components of the target task, including the underlying postural adjustments needed for the target task. The purpose of this approach is to use the sensory input to “activate movement and sensory responses of the patient in the same automatic manner as they occur in the normally functioning individual, without need for conscious attention to the response itself” (Stockmeyer, 1967, p. 900). The patient’s attention can be focused, therefore, on the desired task outcome. This is a particularly useful concept in pediatrics, as infants and children respond more readily to sensory mediation than to verbal mediation of task performance and orient naturally to task outcomes.

The term “Sensorimotor” Approach to treatment was first used by Stockmeyer (1972) in her discussion of a therapy approach for improving gross and fine motor skills in infants and children with developmental disability. This approach derived primarily from the work of Margaret Rood (1952, 1962), who focused on the use of structured exteroceptive sensory input to facilitate changes in functional adequacy of movement behaviors. Stockmeyer was also influenced by other contemporaries, particularly Karel and Berta Bobath (B. Bobath, 1967; Bobath & Bobath, 1972), who focused on modification of the abnormal primitive reflexes seen in cerebral palsy as a means for improving performance of movement behaviors, and Kabat, Knott, and Voss (Kabat & Knott, 1953;
Knott & Voss, 1968), who focused on facilitating the automatic coordination of movement components of the task.

Although application of these approaches to feeding was mentioned by Rood, the Bobaths, Kabat and colleagues, and Stockmeyer, it was Crick-may (1966) and Mueller (1972), both speech-language pathologists, who adapted these therapy approaches to feeding, swallowing, and speech disorders in the child with cerebral palsy. Mueller presented a model for the oral “sensorimotor evaluation” (p. 267) of feeding behaviors that included observation of oral reflexes, “oral tactile sensitivity,” oral movement coordination, and body postural control during eating. The treatment strategies that Mueller advocated included careful attention to positioning for eating, “normalizing oral tactile sensitivity” before eating (p. 267), and hands-on assistance during eating that was withdrawn gradually as the child demonstrated the ability to maintain adequate function in the eating task.

In complex therapy approaches, such as OST, there are optional components of the approach that may be selected for clinical practice and for research. The interests of the clinician/researcher, the characteristics of the patient population, and the environment in which the interventions are to be used may determine the selection. However, the seminal contribution of sensorimotor therapy was the assimilation into clinical practice of five basic treatment principles considered to be essential for successful habilitation or rehabilitation of functional motor disability associated with neuromuscular impairments. These are:

1. Therapy strategies are selected to address the specific neuromuscular impairments, which are judged to be interfering with each individual’s function. Therefore, use of those strategies requires detailed dysphagia assessments—including the functional adequacy of the structures involved in bolus motility, respiratory support for swallowing, and postural control for eating behaviors, and identification of the related, underlying, neuromuscular abnormalities. Clark (2003) provides an excellent review of the various neuromuscular strategies and the specific impairments for which they are considered applicable.

2. Optimum postural alignment and postural control are essential facilitators for optimum performance.

During OST, assistance is provided as needed to maintain upright sitting with appropriate support for hips and feet, stability in neck, shoulder girdle and upper extremities and, to the extent possible, moment-to-moment adjustments of upper body balance and movement as the child is engaged in the eating task.

3. Therapy strategies are applied just prior to or during the performance of the target task. For example, therapy to improve drinking from a cup is conducted during cup drinking. The task might be simplified by modifying the viscosity of the liquid, the contours of the cup, and the pacing of drinking. The task may be practiced in a therapy session instead of a meal. However, the strategies to facilitate learning or improve quality of performance are applied just before or during the actual drinking practice. This attention to “specificity of training” (Clark, 2003; Schmidt & Lee, 1999) is central to applications of oral sensorimotor therapy. It is worth noting that this principle is rooted in substantial research that has found minimal transfer of positive practice effects between movement tasks and, in some instances, reduced adequacy of performance of a target task when similar tasks are used in training (i.e., “negative transfer”). Simulations of the target task may help in training task sequences at early stages of practice, but do not help train the complex movement patterns that are characteristic of the actual task (Schmidt & Lee). Ultimately, the best practice task for acquiring and improving eating skills is a natural eating practice task.

4. It is beneficial to train developmental skills in the sequence in which they are typically acquired in infants and young children. Developmental sequences, as seen in the typical acquisition of functionally related skills, facilitate emergence of skills and sub-skills in the sequence. For example, experiences with foods of increasing viscosity and texture that lead to acquisition of capabilities for eating chewable foods provide a foundation of sub-skills that make it easier for a child to learn to chew. Furthermore, the developmental sequence of mastery for chewable food types facilitates the eventual achievement of mature chewing skill in the typically developing child.

5. During the treatment program, task demands are increased and facilitation strategies are reduced in response to advances in capability demonstrated by the patient. Likewise, task conditions and use of strategies are modified if there is regression. Therefore, the therapy approach requires clinical attention to changes in performance and well-developed clinical skills for selecting new treatment targets and making transitions in therapy routines.
The Role of Therapeutic Exercises in the Treatment of Dysphagia

There has been some research interest in the efficacy of OST for children with cerebral palsy and other developmental disabilities. Two of the research models are discussed here to examine the evidence provided and illustrate use of OST.

Helfrich-Miller, Rector, and Straka (1986) reported on a descriptive study of OST to improve feeding and swallowing skills in six individuals with severe developmental disability. Two were young adults, and the remaining four were 10-19 years old. A treatment program, individualized for each subject’s needs, was implemented three times daily, before each meal. Treatment consisted of considered postural alignment, changes in food consistencies for the meals, thermal stimulation to the anterior faucial arches before meals, assisted lip closure during eating, holding of bite-sized pieces on molars until chewed, and spooning techniques that specified placement and resistance/pressure to be applied. Subjects were evaluated at baseline and at 4-, 8- and 12-months by modified barium swallow (MBS), direct laryngoscopy and a clinical oral-motor examination. At 4- and again at 8-months, gains were seen in pharyngeal transit times (PTT), and in reduction of amount of aspiration, amount of residue in valleculae and pyriform sinuses, and number of swallows needed to clear the oropharynx of paste consistencies. On laryngoscopy, glottic closure and gag reflex improved. It is worth noting that no changes were seen in any of the non-feeding areas of oral motor function as tested by the clinical examination. In the third 4-month phase, thermal stimulation was discontinued for 3 of the subjects while all other strategies were continued. MBS results following this interval revealed increase in PTT and number of swallows to clear paste bolus from the pharynx for 2 of the subjects. Gains in other areas continued. The third subject demonstrated normal swallow dynamics for both liquids and paste. The 3 subjects who continued with thermal stimulation improved in PTT, had decreased pharyngeal residue as compared to the 8-month measures, and fewer swallows needed to clear the pharynx. During post-treatment, there was a reduction in mealtime duration of 33-55% in the 3 subjects who continued with thermal stimulation. The 3 subjects in whom thermal stimulation was withdrawn showed increased meal duration, no change in meal duration, and a 20% decrease in meal duration, respectively.

Gisel and colleagues (Gisel, 1994; Gisel, Applegate-Ferante, Benson, & Bosma, 1995) tested the efficacy of OST for improving feeding and swallowing in children with cerebral palsy who exhibited moderate eating disability. In the first study, 35 children, ages 4 to 13 years, were assigned randomly to one of three groups. Group A received OST, Group B received functional chewing practice, and Group C, the control, experienced the regular school routine for the first 10 weeks and OST for the second 10 weeks. Clinical assessments of nutritional status, duration of meal, and feeding and swallowing skills were conducted at baseline, 10 weeks and 20 weeks. Treatments were 5 to 7 minutes in duration, 5 days weekly prior to the lunch meal. The OST program was individualized based on clinically observed deficiencies for each child in the domains of spoon feeding, biting, chewing, cup drinking, straw drinking, swallowing, and oral and pharyngeal clearing of the bolus. OST focused on tongue lateralization, lip control, and vigor of chewing. Exercises were graded for difficulty and modified in response to the child’s changes in skill. Strategies included considered postural alignment, changes in lunchtime food consistencies, using tongue to retrieve and swallow small drops of peanut butter, lip closure on a licorice stick—advancing to straw, and chewing of biscuits placed on the molars. Subjects in Group B were offered pieces of chewable food during the treatment interval. Foods used in chewing practice and in the lunch meal were graded for difficulty throughout the study period depending on observed baseline abilities and changing skill. Overall, improvements in spoon feeding, chewing, and biting skills were statistically significant and improvement trends were seen in the remaining domains measured in the study. Group A showed more improvement in spoon-feeding, and Group B showed greater improvement in chewing. There was more improvement at 20 weeks than at 10 weeks. Group A exceeded their expected growth trajectory after 10 weeks but not after 20 weeks. There was a trend toward decreased mealtime du-
The Role of Therapeutic Exercises in the Treatment of Dysphagia

The role of therapeutic exercises in the treatment of dysphagia was evaluated. Gisel, Applegate-Ferante, Benson, & Bosma (1995) conducted a study in which they observed a trend in Groups A and B and an increase in Group C. The authors concluded that "...the benefit of [oral] sensorimotor therapy may be greater efficiency for manipulating foods during the oral stage of eating" (Gisel, 1994, page 189).

In a subsequent study (Gisel et al., 1995) using the same treatment model, 27 children, age range 2.5 to 10 years, were examined with videofluoroscopy (VFSS) and assigned to Group A if they demonstrated aspiration or penetration of bolus and Group B if they did not. Both groups received 10 weeks of OST following a 10 week control period. The children maintained their percentile rank for growth. Severity of bolus penetration was reduced in 2 of the 4 subjects examined by VFSS pre- and post-intervention. Statistically significant improvement was seen in clinical measures of spoon feeding, chewing and swallowing, and consistent improvement trends in the other oral motor competencies were noted. Children who aspirated were more deficient in the measures of eating function, however, they improved in all the competency measures over the 10-week treatment period, as did those who did not aspirate (Gisel & Applegate-Ferante, 1996).

The results of the work of Helfrich-Miller and Gisel and colleagues suggest that an OST program may promote functional improvement in feeding and swallowing in children with neuromuscular impairments. The study results are informative about two of the OST strategies. Helfrich-Miller and colleagues examined the contribution to, and retention of, treatment effects for thermal stimulation by withdrawing that treatment for half of the subjects in phase 3 of the study. Results suggest a specific, positive contribution by thermal stimulation to treatment effects and weak retention of effects. Gisel and colleagues tested the practice effect of simulated, functional, chewing task embedded in the more complex OST routine (Group A). She compared that to practice of only a natural chewing task (Group B). For both groups, attention was paid to position and postural control during eating; food consistency was advanced as gains were noted, and the practice time was the same. Gains in acquisition and quality of chewing skills were better in subjects in Group B for whom the treatment time was devoted to chewing practice and the chewable pieces were fed in a typical manner.

Clearly, there is much to learn about the use of exercise treatments for habilitation of pediatric dysphagia, and much research is needed to provide an evidence base that may demonstrate efficacy. OST is one of a number of treatment approaches intended to improve the quality of motor performance of existing skills and to facilitate the acquisition in children with disability in developmental feeding and swallowing skills. Currently, the evidence base is weak and the literature limited.

Clinicians and scientists are aware of the potentially significant complexities of outcomes research in pediatric dysphagia. Sub-populations to be considered vary by age (premature infant to young adult) and by treatment setting (the Neonatal Intensive Care Unit, home, therapy service and classroom), by etiology, and by severity of involvement. The mechanisms inherent in developmental acquisition of skills and in improving quality of performance of existing skills cannot be assumed to be similar. Learning to acquire new skill may advance through different sensory-motor processes than learning to perform an existing skill better and may require different treatment strategies. Treatment outcomes measures also need to be better defined.

What then can we conclude about the role of OST in habilitation of pediatric dysphagia? The research suggests that oral preparation, oral initiation, and pharyngeal phases of swallowing may be improved by OST. However, treatment effects appear to be specific for individual strategies. The patient population is limited to children (and adults) with neuromuscular disorders. This includes disorders of muscle tone and movement. In cases of multiple disability, OST has advantages for working with children with cognitive and language limitations. It appears that improvements from OST are dose-dependent for both frequency of practice and duration of the treatment program. OST is, therefore, appropriate for use in settings in which involvement of the speech-language pathologist and the interventions can be continued over relatively long periods of time. Using OST
effectively requires substantial skills on the part of the clinician. In this, as in other areas of dysphagia therapy, continuing education is the essential ingredient for success.

Justine Joan Sheppard, PhD, CCC/SLP, Board Recognized Specialist in Swallowing and Swallowing Disorders and ASHA Fellow, is associate professor of speech pathology, adjunct, at Teachers College, Columbia University. She is a principal in Nutritional Management Associates, a private practice specializing in services for children and adults with developmental disability. She may be contacted at jjsheppard@worldnet.att.net.
References


The Role of Therapeutic Exercises in the Treatment of Dysphagia

Editor’s Note: Publication of this paper does not constitute an endorsement of the Lee Silverman Voice Treatment by ASHA or by Special Interest Division 13.

Perspectives on Swallowing Disorders and Their Treatment in Parkinson’s Disease With Emphasis on the Lee Silverman Voice Treatment

Leslie A. Will
Department of Speech, Language, Hearing Science
University of Colorado
Boulder, CO
National Center for Voice and Speech, Denver Center for the Performing Arts
Denver, CO

Lorraine O. Ramig
Department of Speech, Language, Hearing Science, University of Colorado, Boulder
National Center for Voice and Speech, Denver Center for the Performing Arts
Denver, CO
Department of Biobehavior, Columbia University
New York, NY

Introduction
As many as 95% of people with Parkinson’s disease (PD) have a swallowing disorder (Eadie & Tyrer, 1965; Hunter, Crameri, Austin, Woodward, & Hughes, 1997). These disorders have been reported to affect all phases of swallowing and are more prevalent in the advanced stages of PD (Ali et al., 1996; Lieberman, 1980; Monte, da Silva-Junior, Braga-Neto, Nobre & Souza, & Sales de Bruin, 2004; Robbins, Logemann, & Kirshner, 1986). The potential impact of swallowing disorders in PD can include discomfort, difficulty taking oral medications, inability to maintain hydration and nutrition, and a high incidence of bronchopulmonary pneumonia as a cause of death (Bushmann, Dobmeyer, Leeker, & Perlmutter, 1989). Synthetic dopamine is the traditional pharmacological agent for management of PD symptoms; however, the effects of dopamine on improving swallowing have not been clearly demonstrated (Calne, Shaw, & Spiers, 1970; Hunter et al., 1997; Robbins et al., 1986). Traditional behavioral swallowing treatment techniques have focused on postures, maneuvers, and diet modifications to maximize safe and pleasurable oral intake for people with PD. More recently, a preliminary study of the effect of intensive voice treatment, Lee Silverman Voice Treatment (LSVT®), has provided evidence for improved swallowing as well as improved functional communication in people with idiopathic PD (Sharkawi et al., 2002).

Swallowing Changes
Disordered swallowing was identified as a common sequela of Parkinson’s disease by James Parkinson in his original essay on PD (1817). He described difficulty with ingesting solid food and subsequent weight loss as being associated with PD. The neuropathology of PD involves the progressive degeneration of neurons in subcortical and brainstem regions. The degeneration of the basal ganglia and brainstem, specifically the medulla, may account for oral and pharyngeal phase swallowing changes (Groher, 1997). People with PD also demonstrate an abnormal presence of Lewy bodies in the basal ganglia following neuronal loss and in the dorsal motor nucleus of the vagus and the medullary reticular formation (Dickson, 2002). The dorsal motor nucleus and the medullary reticular formation are known to be important in swallowing, and damage to these areas may contribute to changes in the pharyngeal phase of swallowing (Robbins et al., 1986). The involvement of the dorsal vagal nuclei may account for esophageal swallowing changes seen in PD (Groher, 1997).

The most common motor symptoms of PD are rigidity, bradykinesia, and tremor. Pharmacological treatment of these symptoms includes the use of L-dopa, but it has had inconsistent effects on speech
The Role of Therapeutic Exercises in the Treatment of Dysphagia

(Larson, Ramig, & Scherer, 1994; Schulz & Grant, 2000). There have been inconsistent findings for the effects of medications on swallowing as well. Because it is possible for people with PD to have tremor in the oral structure without apparent limb tremor, it has been suggested that basal ganglia mechanisms of tremor may have distinct effects on the corticobulbar and corticospinal pathways and that non-dopaminergic dysfunction underlies disordered speech and swallow in PD (Hunter et al., 1997; Nagaya, Kachi, Yamanda, & Igata, 1998; Robbins et al., 1986). Some authors have found a benefit of pharmacological treatment to swallow function (Fonda & Schwarz, 1995; Fuh et al., 1997; Monte et al., 2004), whereas others have not (Bushman et al., 1989; Hunter et al., 1997; Robbins et al., 1986).

While PD may occur in individuals at any age, the incidence of PD increases with age, with the average age of diagnosis being 60. The prevalence of PD in the United States is expected to triple over the next 50 years (Tanner, Goldman, & Ross, 2002), so it is critical that we understand the underlying mechanisms of swallowing disorders in PD and the appropriate treatment strategies. Changes in swallowing due to PD will be overlaid on changes associated with normal aging because the incidence of PD increases with age. Therefore, normal aging effects on swallowing should be considered in the underlying physiology of swallowing in PD, because the occurrence of swallowing disorders in PD likely results from a combination of these factors.

**Oral Phase Changes**

Swallowing changes associated with normal aging in the oral phase may include reduced labial closure with increased drooling, reduced lingual strength and decreased lingual coordination for bolus formation and control that can result in delayed oral transit time, and changes in dentition that can make chewing and bolus control difficult (Hartelius & Svensson, 1994; Robbins, Hamilton, Lof, & Kempster, 1991). Robbins and colleagues (1986) described five lingual dysphagia characteristics in the oral phase of swallow associated with PD: lingual rocking of the bolus, lingual tremor, repetitive tongue pumping, prolonged ramp-like posture, and piecemeal deglutition. In addition, these authors noted that repetitive tongue pumping and piecemeal deglutition increased as bolus viscosity increased. Oral phase changes in PD that included tongue tremor, piecemeal bolus transit, decreased tongue mobility, and residue in the oral cavity were also described by Hunter and colleagues (1997) and Bushmann and colleagues (1989).

**Pharyngeal Phase Changes**

Changes in the pharyngeal phase associated with normal aging may include delayed initiation in pharyngeal swallow, longer oropharyngeal transit time (Robbins, Levine, Wood, Roecker, & Luschei, 1995), decreased amplitude of pharyngeal contraction, and decreased duration of upper esophageal sphincter (UES) opening (Ali et al., 1996). Logemann and colleagues (2000) compared swallow characteristics of younger and older men and found longer pharyngeal delay in men over 80 years of age as well as significantly reduced maximum vertical and anterior hyoid movement and decreased width of cricopharyngeal opening. Interestingly, in a study that examined swallow characteristics in women over 80 years of age it was found that laryngeal and hyoid elevation were better preserved than in men over 80, suggesting that women maintain muscular reserve for swallowing better than men (Logemann, Pauloski, Rademaker, & Kahrilas, 2002). Decreased muscular reserve could place an individual at greater risk for dysphagia, especially in the presence of a degenerative disease such as PD.

Robbins and colleagues (1986) described a delayed pharyngeal response in all PD subjects studied as well as aspiration in two subjects, neither of whom demonstrated a cough response. Aspiration occurred before the swallow secondary to premature spillage with penetration of the laryngeal vestibule and reduced laryngeal closure. Aspiration after the swallow was secondary to significant amounts of pharyngeal residue that were inhaled after respiration was resumed. The 2 subjects who aspirated in the study by Robbins and colleagues (1986) were both in Stage V of the disease as rated by the Hoehn and Yahr Functional Rating Scale.
The Role of Therapeutic Exercises in the Treatment of Dysphagia

(Hoehn & Yahr, 1967). This rating scale ranges from I to V, with Stage I representing the mildest symptoms and Stage V the most severe symptoms. Ertekin and colleagues (2002) and Potulska, Friedman, Krolicki, and Spychala (2003) noted that patients with Parkinson’s disease exhibited delayed triggering of the swallow reflex and prolonging of laryngeal movements during the swallow, both swallow characteristics that can increase the risk of aspiration.

Leopold & Kagel (1997) studied 71 subjects with PD using videofluoroscopy and found that 69/71 subjects demonstrated changes in the oral phase of swallowing and that 63/71 subjects demonstrated changes in the pharyngeal phase of swallowing. The most frequently occurring changes in the pharyngeal phase included impaired motility, residue in the valleculae and pyriform sinuses, aspiration, and changes in the position of the epiglottis during swallowing.

Esophageal Phase Changes

In the esophageal phase, weak peristalsis may result in food remaining in the esophagus longer or backflow into the pharynx in normal aging. In addition, anatomic and physiologic stores that provide the ability to adapt to stress are reduced with aging, putting older individuals at increased risk for dysphagia (Logemann et al., 2000; Robbins, 1999). In a study comparing a group of 72 subjects with PD with matched controls, Eadie and Tyrer (1965) found a higher incidence of esophageal swallow changes in the subjects with PD than in the age-matched controls. Changes included esophageal spasm, hiatal hernia, and gastroesophageal reflux. Leopold and Kagel (1997) found that 40/71 subjects had gastroesophageal reflux, and ten of those 40 had a hiatal hernia.

Changes With Disease Severity

Because PD is a chronic condition that results in gradual changes in functional status, nutritional status, and the ability to maintain pulmonary hygiene, dysphagia and aspiration are likely complications of PD as the disease progresses. The frequency of occurrence of swallowing disorders in PD has been reported to range from 50% by Lieberman (1980) to as high as 95% by Logemann, Blonsky, and Boshes (1975). The discrepancy in statistics regarding swallowing in PD may be partly accounted for by how researchers define dysphagia. For example, Hunter and colleagues (1997) described swallowing dysfunction in PD as symptomatic in 50% of patients, but identified swallowing dysfunction in 90% of patients on videofluoroscopy. Although the severity of swallowing disorders in PD cannot be predicted by severity of the disease, people with end-stage PD at Stage V of the Hoehn and Yahr scale (Hoehn & Yahr, 1967) have the most significant swallowing disorders (Ali et al., 1996; Fuh et al., 1997; Monte et al., 2004; Robbins et al., 1986).

Sensory Changes and Awareness

Damage to the basal ganglia that causes PD can result in changes in swallowing function that are thought to be caused by not only reduced motor control but impaired sensory feedback as well. The basal ganglia influence sensory components in the trigeminal system and may contribute to abnormalities in sensorimotor responses throughout the swallow (Labuszewski & Lidsky, 1979; Robbins et al., 1986). Therefore, people with PD may have symptoms of dysphagia but be unaware of them.

BUSHMANN and colleagues (1989) studied 20 patients with PD. They asked the patients whether they had any swallowing complaints and analyzed swallow function using videofluoroscopy. They found that the patients’ report of any swallowing difficulties had a poor correlation with findings on videofluoroscopy. Only 7 of 20 patients reported complaints of swallowing difficulties, while videofluoroscopy identified swallowing abnormalities, including silent aspiration, in 15 out of 20 patients. Robbins and colleagues (1986) found that 3 out of 6 subjects studied denied difficulty swallowing, although all 6 subjects had disordered swallowing. The subject with the most disordered swallow was one of the subjects who denied having swallowing difficulties. Potulska and colleagues (2003) studied swallowing in 18 patients with PD and identified swallowing disorders in all patients, although only 13/18 patients presented with swallowing complaints.
Traditional Treatment

Appropriate treatment for swallowing disorders should address the underlying physiology that causes the disorder. Although people with PD share common symptoms of the disease, there could still be a variety of causes for a swallowing disorder. People with PD may demonstrate some or all of the symptoms described in the previous section on swallowing disorders of the various phases of swallowing, and the specific causes for an individual determine the appropriate treatment regimen. Traditional behavioral treatment techniques have focused on environmental modifications, postures, maneuvers, and diet modifications to assist the person with PD in maximizing safe and pleasurable oral intake. For example, it may be beneficial for people with PD to eat smaller portions more frequently if excessive time is needed for oral mastication (Groher, 1997). If anterior to posterior bolus transport is impaired, posterior placement of the food bolus can facilitate swallowing. If there is residue in the oropharyngeal tract, a double swallow may be appropriate, or if there is reduced laryngeal elevation with decreased ability to protect the airway, a supraglottic swallow or Mendelsohn maneuver may be appropriate. If weakness of oropharyngeal musculature is identified as contributing to dysphagia, strengthening exercises may be appropriate, using caution not to fatigue the patient to the point where overall swallow function is reduced.

Treatment With LSVT®

LSVT® is an intensive treatment given four times a week for 4 weeks in 50-60 minute sessions with the focus on increasing vocal loudness. The five essential concepts of LSVT® are (a) focusing on loudness, (b) using increased effort, (c) intensive treatment, (d) calibration of the amount of loudness needed to be understood, and (e) quantification of the patients’ performance (Ramig, Paways, & Countryman, 1995). Each session consists of three daily variables including loud production of “ah” with good voice quality, pitch range exercises, and 10 functional phrases. The daily variables are completed in the first half of each session, and the second half of the session consists of training loudness in a hierarchy that progressively increases the length of material from words and phrases in the first week to conversational speech in the fourth week of treatment (Ramig, Bonitati, Lemke, & Horii, 1994). In addition, LSVT® includes homework and carryover assignments for the generalization of the target loud voice in functional communication situations.

It has been proposed that the reasons for the efficacy of LSVT® for improving voice and speech include:

1. A focus on increasing loudness provides a single motor organizing theme that maximizes generalization of effects to other speech systems such as respiration and articulation (Dromey & Ramig, 1998; Dromey, Ramig, & Johnson, 1995; Fox, Morrison, & Ramig, 2002; Ramig, Countryman, Thompson, & Horii, 1995);

2. The intensive mode of administration is consistent with theories of motor learning and appears essential to obtain optimum treatment results (Fox et al. 2002; Schmidt & Lee, 1999); and

3. In addition to training the motor speech system, LSVT® trains sensory awareness, so that the person with PD understands the level of effort and loudness necessary to produce intelligible speech (Ramig et al., 1994).

At the completion of LSVT®, some patients reported improved swallowing in addition to improved functional communication. Preliminary study was undertaken to investigate the validity of these anecdotal reports (Sharkawi et al., 2002).

The preliminary study to examine the effects of LSVT® on swallowing included 8 subjects, 2 women and 6 men (Sharkawi et al., 2002). Subjects ranged in age from 48 to 77 years old and represented stages II, III, and IV on the Hoehn and Yahr Functional Rating Scale (Hoehn & Yahr, 1967).

Each subject was evaluated immediately before beginning LSVT® and immediately after completion of the treatment. The evaluations included an assessment of speech and voice abilities that were repeated three times before and two times after LSVT®. Swallowing assessment using videofluoroscopy was completed once before and once following LSVT®. The evaluations were done at the same time of day so that subjects would be seen at a consistent time in their medication cycle. Videofluoroscopy included the administration of 14

---

The Role of Therapeutic Exercises in the Treatment of Dysphagia
bolus presentations, two each of 1-ml, 3-ml, 5-ml, 10-ml, and cup drinking of liquid barium, 2-ml of barium pudding (paste), and two presentations of ¼ Lorna Doone cookie coated with barium paste. Subjects were viewed in the lateral plane with the fluoroscopic tube focused on the lips anteriorly, the cervical vertebrae posteriorly, the soft palate superiorly, and the cervical esophagus inferiorly. Swallowing motility disorders were defined, and temporal measures of the swallow were completed using standard procedures at the Swallow Physiology laboratory at Northwestern University directed by Dr. Jeri Logemann. All the raters were blind to the subjects being analyzed.

Results of the Sharkawi et al. (2002) Preliminary Study

Vocal intensity

Vocal intensity significantly increased after LSVT® for all subjects from a group average of 71.6 dB SPL (SD = 1.5) to an average of 77.9 dB SPL (SD = 1.5) with the microphone at a fixed distance of 30 cm from the lips during reading. This improvement is consistent with previously reported outcomes of LSVT® treatment (Ramig et al., 1994, 1995, 1996, 2001).

Oral phase

An improvement in oral transit time and a reduction in the approximate percentage of oral residue were noted in the oral phase of swallowing following LSVT®. The percentage of oral residue was reduced for all swallow volumes and consistencies, except cookie, following treatment. This reduction was significant for 3-ml and 5-ml liquid swallows. Tongue and/or palatal residue after the swallow was reduced by 50% for liquids, 12.5% for paste, and 25% for the cookie swallow following LSVT®. Before LSVT®, subjects demonstrated reduced tongue coordination and reduced tongue lateralization that impaired the ability of the tongue to hold the bolus as a cohesive mass. After LSVT®, these lingual disorders were identified in fewer subjects for all of the seven bolus consistencies. Swallow motility disorders during the oral phase of swallow prior to treatment included the characteristic “rocking-like” tongue motion, which subsequently disappeared after LSVT®, resulting in faster oral transit time.

Pharyngeal phase

One of the consistent characteristics of swallowing changes in PD is a delayed pharyngeal swallow. The study by Sharkawi and colleagues (2002) confirmed this finding by identifying a reduction in delayed triggering of the pharyngeal swallow for all consistencies. After completion of LSVT®, there was no delay for liquid boluses, a 25% reduction in delay for paste boluses, and a 66% reduction for the cookie presentations. Prior to treatment, reduced tongue base retraction and delayed laryngeal vestibule closure were among the most common swallowing changes identified in the pharyngeal phase. After LSVT®, there was a 50% increase in tongue base retraction resulting in a reduction in the amount of residue spilling over the base of tongue and into the valleculae.

Overall efficiency

One of the tools used to assess the swallow before and after treatment is the Oropharyngeal Swallow Efficiency index (OPSE). It was developed as a global measure to reflect the ability of the structures of the oral cavity and pharynx to move food efficiently and safely into the esophagus (Rademaker, Pauloski, Logemann, & Shanahan, 1994). There was an improvement in the OPSE after treatment for all swallow volumes and consistencies, except the cookie. This improvement was statistically significant for cup drinking.

Improvement After LSVT®

Speech and swallowing movements share common neural control elements including voluntary movements and more automatic behaviors. When voice and speech are targeted in LSVT®, there is the potential to have an impact on swallow function as well.

Sharkawi and colleagues (2002) suggested that LSVT® may activate neuromuscular control of the entire aerodigestive tract and improve function in oral tongue and tongue base during the oral and pharyngeal phases of swallowing, which could increase swallow efficiency. The actions of the vocalis muscle are subserved by the nucleus
ambiguous efferents during phonation and deglutition, and the pathophysiological substrate for both these bulbar functions may be similar (Leopold & Kagel, 1997). Therefore, the stimulation of medial compression of the vocalis muscle during LSVT® when the subject is trained to be loud may also stimulate vocal fold closure during swallowing.

Muscle strengthening occurs with an overload of effort (Schmidt & Lee, 1999). Subjects with idiopathic PD who received LSVT® demonstrated improved intelligibility and increased loudness that may reflect improved tongue movement and endurance after intensive treatment at consistently high levels of effort (Ramig, Sapir, Countryman, et al., 2001; Ramig, Sapir, Fox, et al., 2001). Improved tongue movement may contribute to improvement in the oral phase of swallowing, since the tongue is such a key muscle in bolus formation, manipulation, and anterior to posterior oral transport. This spreading of effects of LSVT® to tongue movement may also partially account for the improvement that was measured in OPSE following treatment.

LSVT® trains increased loudness that increases movement of the lateral cricoarytenoid, interarytenoid, and thyroarytenoid muscles (Smith, Ramig, Dromey, Perez, & Samandari, 1995), muscles that contribute to increased medial compression of the vocal folds. Increased medial compression of the vocal folds has the potential to increase swallow function by improving the ability to protect the airway from aspiration. Suprathyroid muscles, including the anterior belly of the digastric, mylohyoid, and geniohyoid, raise the hyoid bone when contracted and secondarily raise the larynx and pull it forward (Colton & Casper, 1996). Increased effort and coordination across speech production subsystems that are trained in LSVT® enhance laryngeal elevation (Dromey et al. 1995), which may be the result of strengthening in these suprathyroid muscles. Increased laryngeal elevation enhances swallow safety by improving protection of the entrance to the airway (Groher, 1997).

LSVT® addresses motor and sensory components of the communication disorder in PD and may, therefore, act as a type of sensory stimulation that increases individuals’ awareness of the overall function of the vocal tract and drive long-term, cross-system change in motor areas of the cerebral cortex that control swallowing. Positron emission tomography (PET) studies demonstrate that voluntary swallowing in healthy controls strongly activates the right anterior insula in addition to the primary sensorimotor cortex (Hamdy, Rothwell, Aziz, & Thompson, 2000). The anterior insula is one of the sites that shows a significant increase in activity following LSVT® (Liotti et al., 2003) and may contribute to the mechanism of improved voluntary control of swallowing.

**Summary**

Swallowing disorders are a significant problem for most people with PD. Disorders can occur in all phases of the swallow, pose potential health risks, and interfere with taking oral medications. It has been suggested that non-dopaminergic dysfunction underlies disordered swallowing in PD, and the ability of synthetic dopamine to improve swallowing function in PD has not been clearly demonstrated. There are a number of behavioral interventions available for ameliorating swallowing disorders in people with PD. The recent findings of Sharkawi and colleagues (2002) suggest that LSVT® may be another tool in the speech-language pathologist’s repertoire for treating swallowing disorders in PD and for treating voice and speech disorders. The original intent of LSVT® was to improve functional communication for people with PD through intensive training of increased vocal loudness. The spreading of effects of treatment to swallowing was an unexpected finding. However, given the interaction of motor aspects of voice, speech, and swallow production, perhaps it is not so surprising. Interpretation of these data must be made cautiously until further research can be completed with additional subjects, including a control group.

Leslie Will, MA, CCC-SLP, MBA, is a speech-language pathologist and research associate at the National Center for Voice and Speech in Denver, CO. She is a member of Dr. Lorraine Ramig’s research team and is a doctoral student at the University of Colorado-Boulder. Prior to joining Dr. Ramig’s team in 2001, she was on the clini-
The Role of Therapeutic Exercises in the Treatment of Dysphagia

Leslie is actively involved in research investigating voice and speech production as well as treatment in Parkinson disease and stroke. Ms. Will may be reached at Leslie.Will@colorado.edu.

Lorraine Ramig, PhD, CCC-SLP is a professor at the University of Colorado-Boulder, a senior scientist at the National Center for Voice and Speech, and an Adjunct Professor at Columbia University in New York City. She received her PhD from Purdue University, her master’s degree from the University of Wisconsin-Madison, and her bachelor’s degree from the University of Wisconsin-Oshkosh. Dr. Ramig may be reached at ramig@spot.colorado.edu.

References


The Role of Therapeutic Exercises in the Treatment of Dysphagia


Facial Neuromuscular Retraining

Joanne Dorion
Ambulatory Rehabilitation Services, Sunnybrook and Women’s College Health Science Center
Toronto, Canada

Facial nerve paresis can result from conditions like Bell’s palsy, herpes zoster, tumors, facial trauma, otitis media, post-surgical trauma, and congenital disorders. Facial nerve dysfunction can lead to problems with physical function, such as excessive tearing of the affected eye, drooling, and difficulties with speech, eating, and drinking. As physical appearance and nonverbal facial expressions can be affected, the psychological effects can be profound (Brach, VanSwearingen, Delitto, & Johnson, 1997).

Synkinesis and weakness can be disturbing sequelae of facial nerve paresis. Synkinesis is defined as involuntary muscle contractions accompanying intended movement (Brach, VanSwearingen, Delitto et al., 1997). Examples of synkinesis are involuntary eye closure associated with lip pucker or involuntary cheek muscle contraction with eye closure.

Facial neuromuscular retraining is a treatment approach based on a comprehensive assessment of a patient’s facial nerve function. Treatment is delivered by physical therapists, occupational therapists, and/or speech-language pathologists who have been specially trained (Diels, 1995). The goal of neuromuscular retraining is to improve symmetry of facial expression and inhibit involuntary muscle contractions. Rehabilitation of abnormal facial movements is based on the concept of neural plasticity, whereby the central nervous system learns to use the recovered facial nerve more appropriately (Balliet, Shinn, & Bach-Y-Rita, 1982; Cronin & Steenerson, 2003).

The purpose of this paper is to provide an overview of facial neuromuscular retraining from a clinician’s perspective, incorporating the research findings and aspects of the clinical assessment and treatment.

Research

Facial neuromuscular retraining has been found to be effective in diminishing the effects of synkinesis and improving voluntary movement. In 1982, Balliet and colleagues described a clinical program for facial nerve retraining that included mirror exercises, electromyography (EMG) biofeedback, and personalized home exercise programs for patients more than 2 years after facial nerve injury. Case reports demonstrated improvements in facial function.

Ross, Nedzelski, and McLean (1991) conducted a prospective controlled trial, randomly assigning patients with long-standing facial nerve paresis to one of two treatment groups: EMG biofeedback with mirror training or mirror training alone. A group of individuals living in a rural community served as a control. After one year of treatment, both treatment groups were found to have made statistically significant improvements with respect to symmetry of voluntary movement and linear measurements of facial expressions. The control group showed no significant changes.

Segal, Hunter, Danys, Freedman, and Black (1995) randomly assigned patients to two treatment groups: specific action exercises stopping when synkinesis occurs and specific action exercises stopping prior to synkinesis. Facial movements in both groups were found to be significantly more symmetrical after treatment.

Brach, VanSwearingen, Lenert and Johnson (1997) reported on 14 patients with unilateral facial nerve paresis in a single treatment group, pre- and post-test design. Treatment consisted of specific retraining exercise strategies in conjunction with EMG biofeedback and a home exercise program, combining movement control exercises, self-stretching, and massages techniques. Quantitative video facial position analysis was carried out. After treatment, synkinesis was found to be diminished.

VanSwearingen and Brach (2003) in a follow-up study, reported on 66 patients who were referred for facial nerve retraining. A reduction in synkinesis and an increase in intended facial movements were demonstrated.
Beurskens and Heymans (2003) conducted a randomized controlled study to evaluate the effect of mime therapy, a form of facial neuromuscular retraining, on patients with longstanding facial nerve paresis. Improvements were seen in facial mobility, lip mobility, and social and physical aspects of facial disability.

Assessment

History

A patient history reviews the mode of onset of the facial nerve dysfunction (insidious, traumatic, etc.) and the clinical course. The beginning of facial movement recovery and clinical course can be correlated to the likely degree of nerve injury. A mild nerve injury can start to improve in a matter of days to a few weeks. More significant nerve injury involves axonal and possibly endoneurial tube damage. Reinnervation can occur over a 3- to 12-month time period (Balliet, 1989).

A detailed enquiry about the patient’s current status could include the following:

- His or her main complaint
- Reports of discomfort and/or muscular tightness or stiffness
- Sensory changes
- Hearing changes (hyperacusis, tinnitus, or loss of hearing)
- Eye lacrimation (dryness or excessive tearing)
- Eye care (drops, ointment, patch, or taping)
- Oral problems (drooling, difficulty with eating, drinking, and speaking).

Muscle Resting Tone

A detailed clinical examination starts with observation of the resting tone of the facial musculature, comparing the involved side to the uninvolved side. Altered muscle activity can change the resting symmetry of the features of the face (Diels, 1995). Paralyzed or weakened facial musculature may appear flaccid and drooped. Facial lines may be absent, decreased or lowered. For instance, if the frontalis musculature is paralyzed, forehead wrinkles may be absent with the eyebrow drooped.

Facial musculature that experiences involuntary muscle contractions (synkinesis) will develop increased resting muscle tone. Heightened muscle tone will produce more pronounced facial lines and/or the appearance that the muscles are partially contracting at rest. The eye may appear narrowed or the corner of the mouth may be pulled up or out (Diels, 1995).

Observation of resting muscle tone, comparing involved side to the uninvolved side, may include the following:

- Brow (drooped, elevated, or symmetrical)
- Eye (narrowed, wide, or symmetrical)
- Nasolabial fold (absent, less or more pronounced, or symmetrical)
- Corner of mouth (drooped, pulled up/out, or symmetrical)
- Chin (asymmetrical lines or dimples or symmetrical) (Balliet, 1989)

Voluntary Movement

Assessment of facial movement includes observation of voluntary facial expressions. An estimate of the amount of voluntary movement can be scored on a scale from 0 to 100%, based on the excursion of the movement and the degree of symmetry, as compared to the uninvolved side. Descriptive comments for each movement are also recorded. The following is a list of standard facial expressions that can be assessed:

- Forehead elevation
- Frown (observing the eyebrow movement)
- Closed mouth smile
- Open mouth smile
- Smirk (moving one corner of the mouth laterally)
- Snarl (lifting the upper lip revealing the teeth)
- Lip compression
- Pucker
- Lip protrusion (flaring lips forward and outward)
- Pout (lower lip moving forward)
- Lip corners down (Balliet, 1989)

Synkinesis, the involuntary movement(s) associated with the voluntary facial expressions,
is also observed. The amount of synkinesis that would occur with the above movements can be graded on a scale of 0 to 3: 0 – none, 1 – mild, 2 – moderate, 3 – severe. The specific facial muscles that experience these involuntary contractions are listed and graded (Coulson & Croxon, 1995; Ross, Fradet, & Nedzelski, 1996).

Eye closure can easily be measured using a linear measurement. If the eye does not close completely, the amount of opening can be recorded in millimeters. The presence of the Bell’s reflex is also noted. Bell’s reflex is a normal protective reflex whereby the eyeball rolls upward behind the eyelid when the eye does not completely close (Balliet, 1989). Any synkinesia present can be graded as above.

Videotape
Videotape evaluation is an excellent means of assessing sequential movement (both voluntary and spontaneous) and observing change over time. A suggested protocol has been described elsewhere (Diels & Coombs, 1997).

Outcome measures
Clinical examination can be strengthened by the use of standardized assessment tools that have been found to be valid and reliable. The Sunnybrook Facial Grading Scale, an impairment measure, and the Facial Disability Index, a disability measure, have proven psychometric properties.

The Sunnybrook Facial Grading System (SB FGS) is an impairment measure used extensively by facial retraining therapists, as well as other health care professionals. The SB FGS incorporates three clinically important components—facial resting symmetry, symmetry of voluntary movement, and synkinesis. A composite score is obtained, with normal facial function measuring 100 and complete facial paralysis measuring 0 (Ross et al., 1996). Reliability and validity of this tool have been shown by many investigators, and the system has been shown to be responsive to clinically important change over time (Beurskens, Munyan, Hankel, & Oostendorp, 2004; Brach, VanSwearingen, Lenert, et al., 1997; Kayhan, Zurakowski, & Rauch, 2000; Ross et al., 1996).

The Facial Disability Index (FDI) is a disease-specific self-report questionnaire that measures disability for patients with facial nerve involvement. Two subscales—physical function and social/well-being—are obtained. The subscale scores range from 0 to 100. A score of 100 indicates normal function. The FDI is easy to apply and score. This measure has proven reliability and construct validity (VanSwearingen & Brach, 1996).

The House-Brackmann Facial Nerve Grading System (House & Brackmann, 1985) is widely used by physicians and frequently reported in the literature. It classifies facial nerve function into six possible grades. It is easy to use, classifying patients into general categories. It is a quick tool that serves the needs of physicians well, but it does not detect subtle clinical changes, rendering it less useful for the rehabilitation professional (Coulson & Croxon, 1995; Ross et al., 1996).

Indications for retraining
There must be evidence of sufficient facial nerve reinnervation before retraining can take place; therefore, voluntary movement must be present. Additionally, the time frame since onset is to be considered. Because approximately 70% of Bell’s palsy cases recover completely within 3 months (Peitersen, 2002), it is advisable to defer intensive neuromuscular retraining until this time period has passed (Diels, 1995).

Onset of synkinesia is another indication to begin facial retraining. Synkinesia will not resolve spontaneously and has been found to diminish with treatment. There is no time limit from the onset of the facial nerve injury for rehabilitation to be considered. Patients many years later may still benefit from retraining (Diels, 1995; Ross et al., 1991). Evidence of muscle hyperactivity on the uninvolved side of face is another indication for therapeutic intervention.

Patient management in acute stage
Education is the most important component of treatment in the early stages of facial nerve paresis and may include the following:

- Expected time frames for nerve healing and muscle reinnervation and possible patterns of recovery are explained (Coulson & Croxon, 1994). Frequently, changes in the resting tone of the face will begin to improve before voluntary muscle contractions
are visible.

- Basic facial anatomy and muscle kinesiology are taught. A diagram of the facial musculature is a helpful tool (Balliet et al., 1982).
- The appropriate time to begin exercise is reviewed. All patients are extensively educated about the risks of performing inappropriate facial exercises. When a complete paralysis is present, gross, nonspecific and maximal effort exercises will involve exclusively the uninvolved side of the face. This can lead to hyperactivity of the uninvolved side. As reinnervation begins, nonspecific, maximal effort exercise still favors the uninvolved side contributing to the muscle imbalance between the two sides of the face. A hyperactive uninvolved side puts a newly recovering weak side at disadvantage (Diels, 1995).
- If hyperactivity of the uninvolved side of the face has developed, relaxation techniques for the facial musculature can be taught.
- Eye care as prescribed by the patient’s physician is reinforced. This may include the application of eye drops and/or ointment and the use of an eye patch or taping the eye closed at night. When eye closure is incomplete and lacrimation is faulty, there is a risk of developing exposure keratitis of the cornea.
- Gentle massage and tapping of the facial musculature with the fingertips by the patient may be helpful. It is thought to promote the blood circulation, improve sensory stimulation and increase the patient’s awareness of his face (Coulson & Croxon, 1994).

**Retraining during the initial recovery**

Once voluntary facial muscle contractions appear, it is appropriate to commence retraining. Slow, gentle movements that are symmetrical are recommended. This allows the patient to practice the best possible repetitions, without the stronger, uninvolved side of the face overpowering the weak side. The patient is instructed to perform the exercises in front of a mirror to ensure good quality of movement (Coulson & Croxon, 1994; Diels, 1995). Visualizing the desired movement prior to starting can promote muscle recruitment.

The patient can also be taught to use various facilitation techniques to assist weak muscles. A quick stretch applied immediately before a movement can be helpful. For instance, a quick downward stretch to the frontalis muscle can assist forehead elevation. Automatic reflex actions, such as sniffing, may stimulate the levator muscle group to begin the lift of the nasolabial fold required for the snarl exercise. Gentle manual assistance to a movement is another beneficial technique. The clinician will assess the effectiveness of all of these strategies for the different muscle groups and advise the patient accordingly.

When eye closure is weak and the Bell’s reflex is present (eyeball rolling upward), a patient often mistakenly thinks that his eyelid is completely closed. As the eyeball rolls upward during eye closure, the patient no longer sees anything. The patient gets the incorrect impression of full eye closure (Balliet, 1989).

Eye closure retraining is a treatment priority and needs to consider the Bell’s reflex. To retrain the orbicularis oculi musculature, the patient is instructed to direct his or her gaze downward at a given target while trying to close his or her eyes. Generally, more eye closure is achieved while looking downward, as the Bell’s reflex is temporarily inhibited. The orbicularis oculi musculature is given the opportunity to contract further into its range. If full eye closure is not obtained, the patient can be instructed in the use of a mirror. A hand mirror is held in the patient’s lap or at chest level. He or she is asked to maintain eye position by looking at the pupil of his eye, while attempting eye closure (Balliet, 1989). If full eye closure still is not achieved, the patient can manually assist the remainder of the movement. The patient is instructed to try to maintain the full eye closure once the manual assistance is removed. The patient then tries to open the eyes slowly, as there is often a tendency for the eyes to open quickly.

The patient is instructed to practice the facial exercises at home on a daily basis. Once the patient demonstrates an understanding of how to perform the exercise program, he/she can be monitored on a monthly basis. On follow-up, exercises can be modified, as necessary. The clinician can also assess the patient for the development of synkinesis (Diels, 1995).

**Retraining for synkinesis**

As facial nerve reinnervation continues, recovery may be impeded by the development
of synkinesis, the unwanted movements associated with various facial expressions. Examples of synkinesis are involuntary eye closure associated with smiling or involuntary cheek muscle contraction with eye closure. As a result of these involuntary muscle contractions, the resting tone of these muscles increases. This often produces feelings of stiffness or tightness in the facial muscles. Many patients report aching or cramping sensations. Synkinesia may cause facial lines to deepen and the muscles to appear partially contracted at rest. There are two important components of treatment: relaxation techniques, to normalize increased muscle tone, and neuromuscular retraining, to improve voluntary muscle control and inhibit synkinesis (Diels, 1995).

Relaxation techniques
Various authors report the following to be beneficial (Balliet et al., 1982; Coulson & Croxon, 1994; Diels, 1995).

- Application of heat
- Self-massage and face tapping
- Sustained manual stretching to the involved musculature
- General body relaxation with an emphasis on the head and neck region. As the patient becomes skilled in achieving muscle relaxation, he or she is cued to recognize increasing muscle tension and incorporate this technique into his or her day

Neuromuscular retraining
Exercises are slow, gentle, and symmetrical movements with a focus on inhibiting the involuntary muscle contractions. The patient receives visual feedback with the use of a mirror. The clinician provides verbal feedback, cuing the patient to the presence of the synkinesis. The patient is instructed to slowly perform the desired movement and to stop the movement before the involuntary muscle contractions in another part of the face begin. For instance, for eye muscle synkinesis with a closed mouth smile, the patient would be taught to practice a small, balanced smile, stopping before any involuntary muscle contractions around the eye begin (Segal et al., 1995). More difficult to execute, but also effective, is attempting to perform the desired movement to the point of onset of synkinesia and then relaxing the involuntary muscle contractions. For example, for eye synkinesis with lip pucker, the patient would be asked to move the lips forward until slight involuntary movements of the eye muscle begins. He or she maintains the lips in this position while an attempt is made to decrease the eye muscle activity. This effort requires significant concentration on the part of the patient (Diels & Coombs, 1997).

EMG Biofeedback is a very useful modality to assist in the reduction of synkinesis. It can be an effective means of learning muscle relaxation and can provide feedback to the patient on how best to minimize involuntary muscle contractions during exercise (Coulson & Croxon, 1994).

Patient motivation and sense of responsibility must be very high, as the vast majority of the exercise program is done at home. The patient often has numerous exercises to perform. Patients frequently state that the effort required for facial nerve retraining is more mental than physical. Precision and slow speed are essential components of effective practice (Diels, 1995). Visualization of the facial musculature, imagining that the different parts of the face are separate, can facilitate retraining.

Meaningful repetition of the retraining movements over time is necessary to cause lasting change. Patients typically can spend 30 minutes daily on their home exercise program. Patients’ participation in facial neuromuscular retraining frequently ranges from one to 2 years, as changes occur very slowly. Patients may initially attend therapy every few weeks while learning their exercise program. For patients living at a distance to the clinician, longer, more intensive initial sessions may work best. Once the patient demonstrates proficiency with the exercise program, follow-up sessions can be scheduled less frequently. The timing of reassessments can range from monthly to every 2 to 3 months depending on where the patient lives (Diels, 1995). Patient compliance seems to be positively effected by regular follow-up with the facial nerve therapist.

Over time the exercises become easier to perform. The synkinesis is delayed and the amount diminishes. These effects are seen very gradually with spontaneous movement (Diels, 1995). As
synkinesis decreases, muscle tone becomes more normal. Improvements are noted in complaints of muscle stiffness and discomfort. The quality and quantity of facial movement, both volitional and spontaneous, improve.

Quality of life is affected by facial nerve injury. With successful treatment, patients report improvements in their comfort and in their physical function, such as the ability to blink their eyes, to eat, to drink, and to speak. They note less self-consciousness about their physical appearance. Coulson, O’Dwyer, Adams, and Croxon (2004) reported that reduced range of facial movement and high degrees of synkinesis were found to be associated with patient’s self perception of poor expression of specific emotions. Improvements in facial muscle movement and synkinesis could be expected to have a beneficial effect on the communication of facial expression. Facial nerve retraining provides these benefits.

**Conclusion**

Management of the patient with facial nerve paresis is based on a detailed assessment. During the initial stages of paresis or paralysis, patient education is critical. Patients must be cautioned against performing gross, nonspecific, and maximal effort exercises, because they have a harmful effect on the recovering facial musculature (Diels, 1995).

As reinnervation occurs, emphasis is placed on symmetrical, controlled movements performed before a mirror. The development of any synkinesis is incorporated into the retraining process. Patients are instructed in balanced, selective exercises, inhibiting or minimizing the synkinesis. The practice of exercises that ignores the presence of synkinesis often leads to a heightening of the abnormal movement patterns (Coulson & Croxon, 1994; Diels, 1995).

Successful rehabilitation of facial nerve dysfunction is tailored to the stage of nerve recovery. It is essential that the development of synkinesis be identified and managed appropriately. Facial neuromuscular retraining has been found to be effective in diminishing the effects of synkinesis and improving voluntary movement (Diels, 1995; Ross et al., 1991).

*Joanne Dorion is a physical therapist working in the Ambulatory Rehabilitation Service of Sunnybrook and Women’s College Health Science Centre, Toronto, Canada. She is a lecturer at the University of Toronto, School of Physical Therapy. She also sees clients at Glendon Sports Medicine Clinic, York University, Toronto. Ms. Dorion may be reached at Joanne.Dorion@sw.ca.*
The Role of Therapeutic Exercises in the Treatment of Dysphagia

References


The Role of Therapeutic Exercises in the Treatment of Dysphagia
In spite of the relatively long history of therapeutic exercise as a component of speech rehabilitation, the recent emphasis on evidence-based practice has made obvious the dearth of evidence documenting the benefit of therapeutic exercise in alleviating speech or swallowing disorders. Nonetheless, an apparent abundance of anecdotal support for these techniques continues to lead many clinicians to seek out information that will help them incorporate exercise into a comprehensive dysphagia rehabilitation program. Because of the paucity of empirical data obtained from controlled study of swallowing exercise, clinicians cannot rely solely on established evidence to identify exercise programs most appropriate for individual patients. Instead, practitioners also must consider established philosophies and principles of exercise that, although often empirically supported when applied in other contexts (e.g., Patten, Lexell, & Brown, 2004), have not yet been substantiated for swallowing rehabilitation.

Given Western culture’s current interest in physical fitness, it is not surprising that many rehabilitation professionals, both in speech-language pathology as well as other disciplines, develop their philosophies about the benefit of exercise for rehabilitation from their personal experiences with exercise. They are not alone; rehabilitation scientists have similarly considered exercise science and sports medicine literature a foundation from which rehabilitative exercise principles could be drawn. The challenge faced by both clinicians and researchers is discerning the similarities and differences between these two exercise applications and using this information to guide treatment decisions and investigations. In this column, I will identify a number of general philosophies that have guided the development of therapeutic exercise programs, assess subjectively current practices related to those principles, and discuss challenges faced by clinicians intending to apply the identified principles to dysphagia intervention.

A clear difference between exercise for fitness and exercise for rehabilitation is that the first case typically involves relatively healthy neuromuscular systems, while the second targets impaired systems. Clinicians are challenged, therefore, to determine how principles of exercise developed from the study of non-impaired subjects apply to individuals with neuromuscular conditions.

When healthy muscles are exercised, a common result is increased muscle tone (resistance to passive stretch). Although this outcome is often desirable in healthy individuals as well as select patient groups, it provides a challenge for clinicians seeking to improve muscle strength of patients with baseline hypertonicity (e.g., spasticity). Specifically, it has been argued that for patients with spastic paresis, any increases in strength gained through exercise would be counteracted by reductions in movement control related to increased spasticity. It is my perception that, although many clinicians are aware of this therapeutic philosophy, in practice the principle may be overlooked or misapplied for the simple reason that weakness and altered tone may be difficult to distinguish in some patient groups. For example, although strength is defined as the ability to produce force against resistance, some oral motor assessment protocols suggest range of motion tasks, which do not involve moving against resistance, as a means of assessing strength. In fact, although reduced range of motion may reflect weakness, it may also reflect increased tone, tissue stiffness, or other physiologic impairment. Further, although both subjective and objective measures of strength are available clinically and familiar to most clinicians, neither subjective nor objective measures for assessing tone of the swallowing musculature are widely available. It is not surprising then that descriptions of strength are common in speech-language pathology assessment reports, but similar descriptions...
of tone are largely lacking, particularly in the case of acquired neuromuscular conditions. It is clear that clinicians remain challenged to appropriately identify weakness and altered tone. Even when these impairments are identified, clinicians must determine whether exercise is indicated. The philosophy that therapeutic exercise is contraindicated for patients with spasticity has been challenged by recent findings that patients with baseline limb hypertonicity improved strength through exercise without experiencing increased hypertonicity (e.g., Badics, Wittmann, Rupp, Stabauer, & Zifko, 2002). Because similar studies have not been conducted in the speech and swallowing musculature, clinicians should be cautious in generalizing these findings to dysphagia management and remain alert for evidence that exercise is causing adverse effects for any given patient.

A second way impaired neuromuscular tissue differs from healthy tissue is with respect to fatigue susceptibility. Patients with multiple sclerosis (MS), amyotrophic lateral sclerosis (ALS), and similar neuro-degenerative conditions traditionally have been considered poor candidates for therapeutic exercise because of the fatiguing effects of exercise. That is, even individuals with healthy muscle tissue experience exercise-induced fatigue that temporarily reduces muscle strength. Because patients with neurodegenerative conditions are often prone to fatigue and slow to recover from fatigue, it was thought that exercise would induce fatigue and thus further impair function without a reasonable expectation that strength would ultimately increase. It has been my observation that this philosophy is not universally embraced by speech-language pathologists, particularly with respect to the management of dysphagia in the early stages of disease or in the case of stimulated exercise (i.e., neuromuscular electrical stimulation). We can be encouraged, however, by recent studies that have challenged this long-held clinical philosophy regarding exercise in degenerative conditions, demonstrating that exercise may indeed provide at least short term benefits for individuals with ALS and MS, without exacerbating spasticity or fatigue (Ashworth, Satkumam, & Deforge, 2004; Drory, Goltzman, Reznik, Mosek, & Korczyn, 2001; White & Dressendorfer, 2004). It is unknown, however, whether exercise similarly benefits the swallowing performance of individuals with neurodegenerative disease. Treatment research exploring these issues is needed to determine not only whether swallowing exercise does more good than harm for these patients, but also at what point in disease progression exercise is of greatest value as well as the type, intensity, and duration of exercise that will result in greatest benefit.

In addition to the question of whether therapeutic exercise, in any form, is appropriate is the question of how exercise programs should be designed to best facilitate improved swallowing function. Again, we can look to the training principles adopted by fitness disciplines for philosophies regarding the rehabilitation of impaired neuromuscular systems.

The first principle to be considered is specificity of training, which refers to the observation that gains in strength (as well as other movement characteristics) resulting from training generalize only to movements very similar to the exercise itself. The implication of this principle in overall fitness training is that exercises targeting a wide variety of movements and contraction characteristics are completed so that gains in strength are not isolated. In rehabilitation, where often the goal is to improve the effectiveness of a specific movement pattern (e.g., walking, grooming, swallowing), general training of all contraction types for all involved muscles is not feasible, much less efficient. Instead, to ensure that the appropriate muscles and contraction types are trained, therapeutic exercise for swallowing rehabilitation ideally should emphasize swallowing movements. In fact, many swallowing exercises do incorporate swallowing movements (e.g., Mendelsohn, Masako anterior tongue-anchoring exercises), whereas others do not (e.g., Shaker head lifts, IOPI tongue exercises).

Clinicians are challenged to design and select exercises that not only exploit training specificity, but also ideally isolate and overload individual components of the integrated swallowing movement pattern that have been identified as weak. Overload, or taxing the muscles beyond their typical use, is necessary for a movement sequence to
be considered exercise. In fitness, overload usually takes the form of free weights, resistance bands, and mechanized resistance (e.g., weight machines). Parallel applications of overload during swallowing exercise are limited. The application of continuous positive airway pressure (CPAP) to provide resistance against velar elevation is one way that resistance can be applied directly during swallowing exercise (see Kuehn et al., 2002; Liss, Kuehn, & Hinkle, 1994 for similar exercises designed for speech).

Other swallowing exercises have incorporated overload in ways other than application of direct resistance. For example, the Masako maneuver isolates and overloads the pharyngeal constrictors by anchoring the tongue in an anterior position. The Mendelsohn maneuver overloads the swallowing mechanism by sustaining contractions for a longer duration than is typical of spontaneous swallows. In this sense, the Mendelsohn may be considered an endurance task, even though in practice it is often prescribed to increase the strength of isotonic contractions characteristic of spontaneous swallows. Another way overload is achieved during swallowing exercise is through increased “drive” or effort. For example, in the hard or effortful swallow, individuals swallow with greater effort (and thus muscle activity) than is used during spontaneous swallows. Finally, the Shaker head lift exercises achieve overload by using the weight of the head as resistance, which is greater than the resistance provided by the weight of the larynx and surrounding pharyngeal tissues.

Because muscle strength increases as a result of exercise, the intensity of exercise must be likewise increased over time to ensure that overload is maintained. The principle of exercise progression has been well-studied with respect to limb exercise, with a number of progression protocols described in the exercise physiology literature. Unfortunately, even though many swallowing exercise programs incorporate a progression strategy, no studies have specifically examined the impact of various progression strategies on swallowing exercise benefit.

Additional training principles related to overload and progression are dosage and frequency. Dosage, when applied to treatments in general, refers to the amount of intervention provided over a specific period of time. With respect to exercise, however, dosage describes the amount and intensity of exercise completed within a single session, whereas frequency describes how many sessions are completed during a designated period of time. Applied to fitness, individuals usually perform exercises in “sets” of a number of repetitions (e.g., many repetitions for low resistance and fewer repetitions for high resistance contractions). The exercise science literature generally suggests that the optimal dose is two to three sets of exercises completed to the point of fatigue. In this case, fatigue is defined as the point of muscle failure—the individual cannot perform another repetition. This dosage strategy also is advocated in many physical rehabilitation texts, suggesting that optimal dosage may be similar for healthy and impaired muscle tissue.

My perception is that dosage strategies are ill-defined for the swallowing musculature. That is, although it is not uncommon for clinicians to recommend that patients perform exercises in sets of 5–10 repetitions, it is unclear that this number of repetitions at the intensity level characteristic of swallowing exercise is optimal. For example, the Shaker head lift exercises, which arguably involve the greatest intensity (i.e., level of resistance) of all the described swallowing exercises, also involve the greatest number of repetitions per set (30), and are thus very high dose exercises. In contrast, the Mendelsohn maneuver, which involves very low resistance and would thus be expected to require many more repetitions to induce fatigue, is applied in seemingly much smaller doses. One possible explanation for this discrepancy is that exercises that incorporate high levels of training specificity require lower doses than those that do not, but I know of no studies that have explored this hypothesis.

The benefit of exercise for fitness is influenced not only by dosage, but also by exercise frequency. That is, for exercise to have the greatest effect, adequate time between training sessions must be provided so that the tissue breakdown resulting from exercise can be repaired, metabolic waste products can be removed, and energy stores
can be rebuilt. For large muscle groups such as the limbs, optimal exercise frequency is roughly every other day for healthy individuals. Interestingly, physical rehabilitation texts (e.g., Pedretti & Early, 2001) recommend daily exercise for these same muscle groups following neuromuscular injury, although no rationale for or evidence supporting this recommendation is provided. Given the dearth of research examining the effectiveness of swallowing exercise in general, it is not surprising that data regarding either the optimal dose or frequency for exercise to improve swallowing function is not yet available. Moreover, it is possible and even likely that patients with different etiologies (e.g., head and neck cancer versus neuromuscular disease) or at different points in recovery (e.g., acute versus subacute) will benefit from different dose and frequency strategies. Unfortunately, it has been my observation that therapeutic exercise for swallowing and speech disorders is applied seemingly without regard for recovery mechanisms. That is, patients tend to complete exercise as frequently as their treatments sessions are scheduled or more frequently, if “home programming” is provided. In fact, I have seen printed lists of oral motor exercises with instructions to complete the exercises 10 times per day! Until treatment research reveals evidence regarding appropriate dosage and frequency for therapeutic exercise of the swallowing musculature, however, clinicians remain challenged to rely on principles arising from studies of healthy limb musculature.

A final principle well-known to fitness advocates is reversibility— the “use it or lose it” principle. For many individuals, the physical intensity level of their daily lives is significantly less than what is encountered during exercise. Therefore, when exercise is discontinued, strength gains resulting from exercise are not maintained. Within the context of rehabilitation, the goal of exercise is to regain strength adequate to support function. Therefore, it would be expected that, to the extent that the individual maintains function (i.e., swallowing), strength gained during therapeutic exercise will be maintained. Although this is an empirical question, it is one that may be difficult to test, given that strength gains resulting from many swallowing exercises are not measured objectively, but rather inferred from function. Another issue complicating the application of this principle is the concept of functional reserve as advocated by Robbins and colleagues (Robbins, 2003; Robbins, Levine, Wood, Roecker, & Luschei, 1995). These researchers as well as other gerontologists (e.g., Pendergast, Fisher, & Calkins, 1993) have suggested that strength levels exceeding those necessary for basic function (i.e., functional reserve) may reduce the risk of developing dysphagia in the presence of other risk factors (e.g., acute illness). Within this philosophy, it is beneficial to continue therapeutic exercise even after functional swallowing has been established to develop and maintain an adequate functional reserve. Preliminary data are available supporting strength training beyond the levels needed for minimal swallowing competence (Kays & Robbins, 2004), but additional study is needed to explore the implications of the reversibility principle for swallowing rehabilitation.

In summary, although a rich literature informs the basic philosophy of therapeutic exercise as a component of a swallowing rehabilitation program, clinicians nonetheless face numerous challenges in developing strength training programs that meet the unique needs of patients with varying diagnoses and/or swallowing impairments. Given the willingness of the dysphagia research community to explore the benefits of therapeutic exercise, it is likely that the questions raised in this review will soon be addressed. Ideally, the principles established by dysphagia research will then inform research efforts examining the potential benefits of exercise for improving the speech production deficits that often accompany the swallowing impairments experienced by our patients.
The Role of Therapeutic Exercises in the Treatment of Dysphagia

References


