Peter R. Johnson, Column Editor

Professional Practice

Research: the Pursuit of Truth

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Webster's collegiate dictionary defines the word *research* as a diligent search for truth. In fact, the entire field of research is nothing more than the search for truth. The word research comes from the French *recerchier*, which means to investigate thoroughly or to search for something. Webster states that research is a "strenuous inquiry or examination, especially: investigation or experimentation aimed at the discovery and interpretation of facts, revision of excepted theories or laws in the light of new facts, or physical application of such new are revised theories or laws." Research is also viewed as the process of collecting data about a specific subject. A synonym for research is the word investigation. This word is derived from the Latin *investigatus*, which means to track, to study or observe, by systematic inquiry or examination (Webster's, 2000).

From 70 to 80% of speech-language pathologists currently practicing in the field are performing clinical activities in environments such as hospitals, nursing homes, public schools, and in private practice. Approximately 6% devote a majority of their time to doing research. In both instances, speech-language pathologists are confronted with finding the causes of communication/swallowing disorders and improving therapeutic approaches to enhance positive outcomes to treatment (Matthews, 1982). While the prior may be more concerned with individual etiologies and treatment to improve the communication of an individual patient, both clinical and research speech-language pathologists utilize the same mental methodology. Speech-language pathologists have a responsibility to understand, diagnose, and rehabilitate disorders. To do this requires that the speech-language pathologist understand the etiology of communication/swallowing disorders. This understanding is the result of a "diligent search for truth." The researcher and clinical speech-language pathologist must approach the assessment in a systematic and organized fashion.

> As we assume greater responsibility for accountability as speech-language pathologists, we also have a responsibility to try to prevent communication disorders, which requires us to learn more about their causes. This knowledge will come from the research efforts of speech language pathologists and other professionals as well. In speech-language pathology research, we try to better understand normal communication in order to better understand disordered communication. In turn, our increasing knowledge of the disordered will contribute to our understanding of the normal (Matthews, 1982, p. 17).

Research in the field of speech-language pathology has been viewed primarily as an applied behavioral science. There is however, room for more "pure" science as well. Even applied behavioral science is grounded in scientific methodology. On the other hand, even *objective* methodology frequently has *subjective* elements to the research.

> Instances in which method intractably determines the nature of the data debase genuine scientific inquiry. The significance of patterns of behavior may be ascertained by mechanical or statistical procedures or frequency counts, but most of us do better to arrive at meaningful connections through judicious reflection. Methods have value, but methods are mere dry bones until workers breathed a spark into them (Murphy, 1982, 469).

The speech-language pathologist is principally concerned with the analysis of behavior that can be observed (swallowing patterns) though covert behavior such as cognition may also be investigated. Because much of what is investigated is overt in nature the research is subject to observer error (Perkins, 1977). Due to the above, measures of reliability become paramount in research methodology.

Research in dysphagia can focus on the physiology of swallowing, including an analysis of the preparatory, oral, pharyngeal, or esophageal stages of swallowing. Research has also investigated swallowing patterns identified with various medical conditions (Logemann, 1983). In every instance, the goal of the research has been to arrive at the truth behind normal swallowing patterns, swallowing difficulties in particular etiology or specific therapeutic approaches for the remediation of dysphagic patterns. The achievement of this truth must then be applied to real people with real problems in order for the truth to become meaningful. This is the real goal of research.

Many of our practices are created from clinical need and an honest motivation to help by whatever means possible. This is noble and practical; however, if the work of research is not carried through, it results in a profession that is based on "clinical lore," rather than solid practice patterns. The clinician, with the support of the academic community, must strive to justify his/her practices through rigorous investigation or "seeking of the truth" rather than accepting the "appearance" of effectiveness. Unfortunately, this is infrequently done and results in a weak fabric to our clinical practices.

The use of SEMG biofeedback as an adjunct to the rehabilitation of dysphagia may provide an area in which we can illustrate the evolution of a rehabilitation technique and identify both the strengths and weakness of the relationship between research and practice. SEMG biofeedback is a technique long used by our colleagues in physical medicine in rehabilitation in which surface electrodes measure the electrical current generated by selected muscle groups and display that information visually, and sometimes auditorally, using a computerized system. The patient learns to control and manipulate muscle contraction by way of controlling and manipulating the EMG signal. For swallowing rehabilitation, electrodes placed submentally will allow the patient and clinician to monitor both the degree and timing of muscle contraction for some muscles involved in the deglutitive process. Execution of various swallowing rehabilitation maneuvers, such as the Mendelsohn maneuver, the effortful swallow, and the tongue holding maneuver, may be clearly visualized on the EMG signal. In addition, extraneous muscle contraction or "tongue pumping" as seen in Parkinson's disease, can be monitored and perhaps inhibited.

As an outcome of clinical need, a string of case studies began to emerge regarding the use of SEMG biofeedback in swallowing treatment. Haynes presented the first such paper as early as 1976. A 25-year-old female was referred with a diagnosis of "psychogenic dysphagia" to the author of this paper, a practitioner in psychology. It is unclear from the publication if a formal swallowing evaluation was completed; however, the therapeutic approach included reducing overall tension as a mechanism to inhibit dysphagic symptoms. Using frontal EMG biofeedback, the patient reported significant improvement in swallowing function that was maintained at least up to 6 months after the completion of direct therapy. Drazier (1986) presented another patient report in which a patient with neurogenic dysphagia utilized EMG biofeedback using a neuromuscular reeducation approach. In this paper, she outlines the use of biofeedback in the treatment of dysarthria and dysphagia; however, little detail is provided regarding specific treatment methods or evaluation of progress. A more detailed account was provided by Bryant (1991), who presented a description of the use of SEMG biofeedback in the treatment of a patient with oral pharyngeal carcinoma. This patient, a 40-year-old female with severe dysphagia secondary to resection and radiation, was able to discontinue tube feedings and return to a near-normal diet after 10 weeks of treatment. If we evaluate the evolution of the use of SEMG biofeedback in swallowing rehabilitation at this point, we can see that this "novel" treatment approach has been described by several clinicians in individual patients with differing diagnoses. However, the question remains: Will the technique apply to the broader population of dysphagic patients, and is this approach to rehabilitation is more efficacious than traditional treatment.

Crary (1995) elaborated on this single case report to describe the treatment course of six patients with chronic dysphagia secondary to brain stem infarct treated with SEMG biofeedback. Five out of six patients (mean time post onset of 18.8 months and range of 5-54 months) were able to return to oral feedings with discontinuation of tube feedings. Improvements in swallowing function were maintained on follow-up assessments. Crary and Baldwin (1997) further investigated patterns of swallowing dysfunction as measured by SEMG and speculated that analysis of the EMG waveform could provide valid clinical information for swallowing assessment. Crary's work was followed by a similar report by Huckabee & Cannito (1999) of 10 patients with chronic brain stem dysphagia who participated in a treatment regime including SEMG biofeedback and intensive swallowing rehabilitation. Eight of the ten patients returned to a full oral diet with few restrictions. All maintained their ability to feed orally with the exception of two who suffered further neurologic injury unrelated to their initial diagnosis or dysphagia. When pairing the data of Huckabee and Cannito with an earlier data set of Crary (1995) using similar methods and treatment, we found that 13 out of 16 patients with chronic dysphagia secondary to brain stem injury returned to oral intake following intensive treatment with SEMG biofeedback monitoring. Thus, it would appear that this "novel" approach generalizes somewhat to a larger number of patients with brain stem injury.

The stated projects addressed clinical questions at a basic level. However, there are additional questions related to this area—specifically, why is the technique of such benefit? Is there a sound theoretical foundation for this approach to treatment? What exactly are we measuring and how is that controlled? What are the technical and theoretical supports for this type of rehabilitative approach?

If we look both inside and outside of our profession, we can find theoretical support for the use of biofeedback monitoring in muscle reeducation. Rubow (1984) identifies two models of learning that conceptually represent different approaches to the rehabilitative process: operant conditioning and cybernetic model of learning. A critical issue in discriminating between these two models and their appropriate applications to treatment is the relative importance assigned to reinforcement and dynamic feedback. The operant conditioning model implies that learning and behavioral adaptation occur as a consequence of reinforcement or punishment that is provided in temporal association with a given task. This model of learning suggests that reinforcement is effective if it is provided within a few seconds of a desired response. Thus, the operant conditioning model of learning would typically represent a clinician-guided treatment in which the patient's rehabilitative behavior is followed by consistent, albeit delayed, feedback provided by the clinician. The consistency of the feedback is progressively withdrawn as the patient assumes greater independence in the learning process. In contrast, the cybernetic model of learning relies on a continuous, closed-loop learning process. This model requires that continuous and immediate reinforcement regarding performance is the key to perceptual-motor learning. The cybernetic model reflects the immediacy of instrumental feedback that is continuously integrated into the patients' ongoing motor control processes. Rubow summarizes that feedback in accordance with the cybernetic model is important in the early stages of rehabilitation, while the role of reinforcement, via operant conditioning, increases in later stages.

Wolf (1994) outlines two stages of motor learning, the acquisition and transfer phases, which correlate well with the cybernetic models and operant conditioning models, respectively. In his review of motor learning theory, he acknowledges that data suggests that normal learning and retention are enhanced with periodic rather than continuous reinforcement. However, he questions the validity of these data when applied to the initial motor relearning process in patients with neurologically based disorders. He suggests that the feedback signal in the initial phases of treatment may serve as a substitute for the patient's inadequate proprioceptive signals, which are instantaneous and consistent in normal settings, and that these exteroceptive signals ultimately engage the internal sensorimotor networks. Thus, the acquisition phase of relearning a motor skill requires continuous reinforcement, whereas the transfer phase begins upon engagement of the internal sensorimotor networks requiring less immediate or continuous external feedback. The success of rehabilitative programs following this model is considered to be secondary to a relearned appreciation of internal cues as well as potential "recalibration" of the proprioceptive system (Wolf, 1979). The use of biofeedback modalities is considered a temporary adjunct to treatment with the inherent goal of internalization of the feedback signal and extinction of the need for external feedback.

Given this theoretical support, what is the technical basis for SEMG? Several early studies from basic science provide the foundation for the clinical applications of electromyography (EMG) biofeedback used today. Adrian and Bonk (1929), in a study of normal subjects, determined that the electrical responses in individual muscles provided an accurate reflection of the actual functional activity of the muscle. Therefore, there is a direct linear correlation between the EMG tracing and muscle force. Reliable measurements of functional activity are a prerequisite for clinical usefulness. Two additional studies provided early documentation of the subject's ability to consciously control the biofeedback tracing. Smith (1934) and Lindsley (1935) in a series of similar studies documented that subjects could exert conscious control on even the smallest motor unit potential and demonstrated no inherent muscular tension at rest. In addition, they documented that normal subjects could achieve complete relaxation as measured by no motor response without difficulty.

Several unpublished projects have addressed the technical aspects and have SEMG in swallowing treatment. At the ASHA annual Convention in 1994, Bednarek, Tucker, and Conlin offered data that suggested that normal subjects were able to utilize the SEMG tracing to increase muscular contraction during some swallowing maneuvers. In 1995, at the Dysphagia Research Association Meeting, Huckabee, Garcia, and Barofsky, presented SEMG norms at rest and at maximal amplitude during the swallow as measured from six different sites around the head and neck. Although similar to a technical paper by Gupta, Reddy, and Canilang (1996), this study used commercially available devices typical in clinical practice. Not surprisingly, the standard deviation from the mean peak amplitude during swallowing of both liquid and secretions was significant, for some sites even greater than the mean itself. However, the standard deviation from the mean was relatively smaller for electrode placement sites most commonly used to measure amplitude of the muscles directly involved in the pharyngeal swallow (Huckabee, Garcia, and Barofsky). This study strongly cautions that SEMG amplitudes, although useful as a clinical biofeedback tool, are not appropriate for providing diagnostic information or comparing data across subjects. As no meaningful mean amplitude values have been determined, it would not be feasible to determine what is considered "normal" SEMG amplitude. Although there is some promise that evaluation of the waveform shape will provide clinically useful information (Crary, 1995; Crary and Baldwin, 1997), this type of assessment will require further investigation. Evidence of the physiologic correlation of the SEMG signal was provided by Sonies, Gottlieb, Solomon, Mathews, and Huckabee (1996) at the Annual Meeting of the Dysphagia Research Society. Using simultaneous ultrasound imaging and SEMG measurements, a very high correlation (R = .99) was noted between peak EMG amplitude and maximal hyoid elevation during all bolus consistencies. This suggests that the peak EMG waveform indicates maximum submental muscle contraction and maximal hyolaryngeal elevation. Thus, in this example, what appears to be true to the clinician has been proven through more basic research.

So where do we go from here? We have begun to establish the use of SEMG biofeedback as a clinical adjunct to the rehabilitative process. However, considerable work is yet to be done. As one example, we know that the SEMG signal accurately reflects submental muscle activity, but do we know that an increase of muscle activity directly relates to increased efficiency in swallowing and increased pharyngeal stripping. Presumably this would seem to be the case. However, this has not yet been proven. Research that correlates SEMG amplitude with pharyngeal pressures has yet to be done and would provide valuable substantive evidence. Additionally, the supposition could be made that increased muscle function as measured submentally would correlate with increased muscle function in the pharyngeal musculature (e.g., the pharyngeal constrictors). As swallowing is a synergistic motor process of multiple muscles, it would appear reasonable that increased work in one muscle group might carry over to another associated muscle group. Is this an illusion or false supposition? Research, which correlates SEMG amplitudes with contraction of the pharyngeal constrictors, as measured by needle EMG, would be of great value in validating this approach to rehabilitation.

Furthermore, although clinical reports suggest that SEMG biofeedback enhances the therapeutic process, clinical reports do not answer the question of efficacy. Controlled trial treatment efficacy studies are critical to document the effectiveness of a therapeutic technique. Research is currently underway to systematically compare outcomes of swallowing rehabilitation using SEMG as a rehabilitative adjunct when compared to more traditional swallowing rehabilitation without instrumental biofeedback. This multi-national, multi-site treatment efficacy project is evaluating the relative effects of SEMG biofeedback and intensity of swallowing treatment in a large population (N=240) of patients with neurogenic dysphagia. Until data are collected, analyzed, and critiqued, the use of SEMG biofeedback remains within the realm of clinical lore.

The speech-language pathologist engaged in research in today's environment has many new tools unheard of in the past. For example, the Internet allows the researcher to easily obtain information from sources only a click away. A simple search can open up resources such as the Dysphagia Research Society (http://www.als.uniuc.edu/drs), the Center for Swallowing Research (http://www.swallow.mitedu/swallow/phys.htm) and the Dysphagia Resource Center (http://www.dysphagia.com/research.htm). In addition, information regarding funding for research is easily obtained via the Internet through searches of sites such as the National Institutes of Health (NIH) (http://www.nih.gov/icd/). Information, which previous took weeks to obtain, is available immediately. NIH not only clearly lists all of their program activities and potential funding activities on the Internet, they also have a weekly email list service. This service transmits a weekly email of information regarding NIH grants and contracts. This free service is available through NIH subscription via email (subscribeNIHTOC-L your name). The email address for the NIH list is listserv@list.nih.gov. New researchers to NIH are encouraged to ask for a copy of the handbook "A Guide to the NIH Contracting Process." This helpful handbook gives the reader step-by-step instructions into the submission of research proposals. The serious researcher would be prudent to carefully browse much of the NIH Web pages to obtain a clear understanding of NIH policy grant procedures and peer review process.

Summary

More work needs to be done in the area of speech-language pathology. A Medline search using the keywords "deglutition" and "electromyography" yields well over 300 references. The majority of these publications address the use of electromyography in defining parameters of normal and abnormal swallowing. Research is an integral part of the field of speech-language pathology. Past research has helped us define the disorders of communication and begin to understand rehabilitation. Research should not be the province of the "research" speech-language pathologist alone. It is only with the combined effort of all speech-language pathologists that we are going to understand and rehabilitate communicative and swallowing disorders.

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Therese O'Neil-Pirozzi, Column Editor

Student Abstracts

In this issue, students from Southern Illinois University, Southeastern Louisiana University, Arizona State University, and Illinois State University summarize three research articles. Their selections cover a wide range of topics, which are of importance to our profession and have clinical implications for patient management.

First, Danielle Campbell and Lisa Covington review an article on Obstructive Sleep Apnea Syndrome. Danielle is a graduate student majoring in Speech-Language Pathology at Southern Illinois University, Carbondale. There, she studied Dysphagia with Professor Tracy Landes. Danielle's undergraduate degree is in Speech-Language Pathology from Eastern Kentucky University in Richmond. Lisa Covington is in the Speech-Language Pathology Masters Degree Program at Southeastern Louisiana University (SLU). Lisa studied Dsyphagia with SLU's Professor Sandra Johnson. Prior to beginning graduate school, she was a public elementary school teacher for 10 years.

Impaired Swallowing Reflex in Patients with Obstructive Sleep Apnea Syndrome

Authors: S. Teramoto, E. Sudo, T. Matsuse, E. Ohga, T. Ishii, Y. Ouchi, & Y. Fukuchi

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Purpose

The purpose of this study was to examine the relationship between swallowing and sleep disordered breathing in patients with obstructive sleep apnea syndrome (OSAS).

Method

Research Design: This prospective