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# Dysphagia: A Comparison of Treatment Effectiveness

Larenda J. Henshaw

*Rehabilitation Institute*, [larenda@siu.edu](mailto:larenda@siu.edu)

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DYSPHAGIA: A COMPARISON OF TREATMENT EFFECTIVENESS

by

Larenda Henshaw

A.A., Southeastern Illinois College, 2008  
B.S., Southern Illinois University Carbondale, 2010

A Research Paper  
Submitted in Partial Fulfillment of the Requirements for the  
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Larenda Henshaw

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## **Introduction**

A common neurological disorder in the world today is a stroke. Strokes can have many side effects and in the most severe cases, cause death. Dysphagia is a frequent outcome of stroke. A swallowing disorder or dysphagia is difficulty swallowing saliva, water, or food. Multiple treatments have been developed for patients with post-stroke dysphagia. These treatments have been designed to improve swallowing and may even allow for the return of normal eating and drinking. This study focuses on adults with post-stroke dysphagia to observe the effectiveness of thermal tactile stimulation compared to neuromuscular electrical stimulation in order to understand how to decrease dysphagia.

## **Mechanisms of Dysphagia**

Dysphagia can occur in children, adolescents, and adults. It is most common, however, in adults or the elderly. There are many health conditions that can cause dysphagia, such as cancer, diseases, surgical procedures, brain injuries, and strokes. Although not all brain injuries cause dysphagia, many of them resulting from a stroke do affect the swallowing process. In fact, dysphagia occurs in 45-65% of patients after a stroke (Kii-Byung Lim, Lee, Sung-Shick Lim, & Choi, 2009, p. 174).

In order to understand how to decrease dysphagia, one must first understand the mechanisms of the disorder. According to Clarkson (2011), swallowing is a complex act involving five nerves and 25 muscles. It serves two main purposes. The first and most obvious is to maintain nutrition and hydration. The second is an airway protection reflex. It empties the pharyngeal airway and prevents inappropriate material entering the larynx, trachea, and lungs. A swallow consists of forming a bolus, closing off the airway, and

moving the bolus into the throat and then into the esophagus (qtd. in Clarkson, 2011, p. 436).

A normal swallow is a swallow that is not followed by a cough or aspiration. An abnormal swallow followed by aspiration can lead to pneumonia, in which aspiration pneumonia can potentially lead to death. Daniels, McAdam, Brailey, and Foundas (1997) stated that 50% of stroke patients develop aspiration pneumonia (p. 17). In addition, the mortality rate is 43% in hospitalized elderly patients who develop aspiration pneumonia (Daniels et al., 1997, p. 17).

### **Phases of Dysphagia**

There are four phases in which the swallowing process can be disrupted. Dysphagia can occur in one, two, three, or four phases (Miller & Willging, 2003, p. 443). In order to understand the phases of dysphagia, it is necessary to understand the purpose of each phase, each of which serves a special purpose and requires the use of different muscles. The first phase is the oral preparatory phase in which food or liquid enters the mouth and mastication begins (qtd. in Clarkson, 2011, p. 436). The second phase is the oral phase in which food is chewed to form a bolus and the tongue moves food to the back of the mouth. The third phase is the pharyngeal phase. Out of the four phases, this is the most complex. During the pharyngeal phase, the vocal folds close, the larynx rises, and the epiglottis covers the larynx, providing protection for the airway to keep food and liquid from entering the lungs (Clarkson, 2011, p. 437). The fourth phase is the esophageal phase. This stage is characterized by cricopharyngeal relaxation and the onset of peristaltic action, allowing the bolus to pass through the esophagus and into the stomach (Miller & Willging, 2003, p. 443). There are several problems that can occur in each of these phases and a key component in treating a swallowing disorder is being aware of the problems that can arise in each of the four phases. Problems in the oral phase may be characterized by oral

motor difficulties (Miller & Willging, 2003, p. 443) such as: inability to sustain lip closure, lingual weakness, and mandible weakness. Individuals may have spillage or drooling if they are unable to seal their lips properly. Weak muscles in the tongue or mandible may result in trouble chewing or moving the bolus to the back of the throat. Problems in the pharyngeal phase can include difficulty initiating a swallow and getting food or liquid in the airway or lungs. Miller and Willging (2003) stated that “the pharyngeal phase of swallowing is of critical importance in that intact sensory and motor laryngeal protective mechanisms are necessary to prevent aspiration” (p. 443). Food coming back, or reflux, is a problem in the esophageal phase that may occur in post stroke patients. Strengthening these muscles can allow for the return of a safe swallow.

### **Treating Dysphagia with Thermal Tactile Stimulation**

Thermal tactile stimulation also, known as thermal application (Rosenbek, Robbins, Fishback, & Levine, 1991, p. 1258) is one type of therapy used for the treatment of swallowing disorders. This method involves stroking or rubbing the anterior faucial pillars with a cold probe prior to having the patient swallow (Lim et al., 2009, p. 174). It is hypothesized that the touch and cold stimulation increases oral awareness and provides "an alerting sensory stimulus to the cortex and brainstem such that, when the patient initiates the oral stage of swallow, the pharyngeal swallow will trigger more rapidly" (Rosenbek et al., 1998, p. 1). In individuals with reduced oral sensation or poor initiation of oral bolus transport, a cold stimulus seems to facilitate more rapid posterior tongue movement and pharyngeal swallow elicitation (Martin-Harris & Cherney, 1996, p. 31). This type of treatment has been used in the clinical setting since 1956 (Sciortino, Liss, Case, Gerritsen, & Katz, 2003, p. 16). There are two primary stimulus components of thermal tactile stimulation. They are, according to Sciortino et al. (2003), cold

temperature, or thermal, and dynamic mechanical deformation or tactile (p. 17). However, over the years the research on the effectiveness of thermal tactile stimulation has been under debate. My first claim is that when a patient with post-stroke dysphagia is treated with thermal tactile stimulation, dysphagia will not decrease.

### **Supporting Evidence**

Multiple studies support Claim One. Rosenbek et al. (1998) investigated the relationship of four intensities of tactile thermal application to changes in duration of stage transition (DST) and performance on a newly designed scale of penetration and aspiration by groups of patients made dysphagic by stroke (p. 1). This investigation consisted of 45 males from 12 Veteran Affairs Medical Centers all of whom had experienced a stroke and became dysphagic. All the participants were randomly assigned to one of four groups. Group One received 150 trials per week, Group Two received 300 trials per week, Group Three received 450 trials per week, and Group Four received 600 trials per week. Using videofluoroscopic swallowing examination, the participants were given five 3-ml and five 10-ml liquid boluses at one week and two week intervals. Rosenbek et al. (1998) defined DST as the duration from the time the head of the bolus reaches the posterior border of the mandibular rams until the beginning of maximum elevation of the hyoid bone (p. 3). Instead of using chilled laryngeal mirrors, an ice stick was used for treatment because it was guaranteed to be cold and it would melt adding liquid to the swallow. The trial consisted of rubbing the anterior faucial pillars with the ice stick and then having the patient swallow. Researchers agreed that a decrease of 0.35 seconds in DST and a decrease of 1.5 units in penetration and aspiration, at two weeks from randomization, would be sufficient to establish clinical significance between progress and baseline (Rosenbek et al., 1998, p. 5). After comparing all four treatments, not one of them appeared to be better than another. Intensities of



treatment of 150 at week one and two and 600 at week two did not improve. The rest of the intensities, however, improved on 3-ml boluses. The penetration and aspiration measures did not improve for either the 3-ml or 10-ml boluses.

Another study that supports Claim One investigated whether the elicitation of the swallowing reflex is affected by the application of cold to the pharyngeal mucosa in healthy participants (Bove, Mansson, & Eliasson, 1998, p. 728). The investigation consisted of 14 healthy volunteers. The repeated dry swallowing test was used to elicit the swallowing reflex. During this test each participant was instructed to swallow 11 times. After applying the 37 degrees Celsius laryngeal mirror to the anterior faucial pillars the test was performed. The test was repeated again after stimulation with 0 degrees Celsius. Then the test was performed again after the participant swallowed 30 ml of water at 37 degrees Celsius and again at 0 degrees Celsius. The Bove et al. (1998) results revealed that there was not a significant difference between the mirror experiments (p. 729). In 11 out of the 14 participants the water test showed a shorter swallowing test time after swallowing the cold water compared to the water at body temperature (p. 729).

Rosenbek et al. (1991) designed a study to evaluate the effect of cold application to the anterior faucial pillars on the swallow response in participants whose dysphagia resulted from multiple strokes (p. 1257). The investigation was a month long trial and consisted of seven male participants all of whom were neurologically impaired and dysphagic (p. 1258). Treatment involved rubbing the anterior faucial pillars three times on each side of the mouth. Then, the participant swallowed either three cc of water, ice chips, or dry swallowed. Six rubbings, three on each side, and a swallow constituted one trial (p. 1259). After Rosenbek et al. (1991) established a baseline the participants were randomly assigned to a single case ABAB or BABA

design. Thermal application was provided during B phases and withdrawn during A phases. Each phase was one week long. A follow up testing occurred one month after the completion of the last phase (p. 1258). This study was designed to answer three questions (Rosenbek et al., 1991). First, whether daily thermal application influences the swallowing of liquid boluses (p. 1258). To answer the question data was collected for eight duration and four descriptive measures. The results of the data showed that Participant One decreased in one duration, increased in three, and decreased in one descriptive measure. Participant Two decreased in three durations and one descriptive measure. Participant Three decreased in one duration only and Participant Four only increased in one duration. Participant Five decreased in five durations. Participant Six decreased in two descriptive measures and Participant Seven decreased in three duration and two descriptive measures. The second question this study was designed to answer was whether influences were maintained one month after treatment was terminated (p. 1258). The results revealed that none of the effects were maintained. Finally, the third question was whether baseline testing could predict responses to thermal application (p. 1258). The results showed that no relationship to performance during treatment is obvious. This study completed by Rosenbek et al. (1991) failed to reveal strong evidence that two weeks of thermal application alternating with two weeks of no thermal application improves dysphagia following multiple strokes (p.1262).

### **Refuting Evidence**

One study that does not support Claim One is the data supplied by Lazzara, Lazarus and Logemann (1986). This is the earliest data based on their single session treatment of 25 participants all of whom are neurologically impaired and dysphagic (qtd. in Rosenbek et al., 1998, p. 1). This experiment consisted of three liquids and three semisolid swallows. Thermal

tactile stimulation was applied before the third swallow of each liquid and semisolid. They summarize the comparison of selected duration measures during the two untreated and one treated swallow by observing that stimulation "improved triggering of the swallowing reflex in 23 of the 25 patients on swallows of at least one consistency" (Rosenbek, et al., 1998, p. 1).

### **Personal Comments**

The results of the study completed by Rosenbek et al. (1998) are not consistent with each other, therefore it is assumed that the treatment does not work. The intensities of the treatment of 600 improved slightly at week one, but did not improve for week two. If the treatment worked then the patient would not only show improvement during the first week, but show more improvement during the second week. The study did not state the severity of the dysphagia. Therefore, the results of the study could have been influenced by having participants of all severity levels. For example, the participants who did improve could have had mild dysphagia, while the others could have had severe dysphagia. Based on the results of this study, thermal tactile stimulation is not an effective treatment.

The study completed by Mansson and Eliasson (1998) was conducted with healthy volunteers. The fact that this study was done with healthy volunteers does not provide evidence that thermal tactile stimulation decreases dysphagia in post-stroke participants.

The study completed by Rosenbek et al., (1991) included only seven participants. If the study would have consisted of more than seven participants the results may have varied. However, the results of all three articles using thermal tactile stimulation for treatment in dysphagic patients all indicated that the therapy technique was not effective.

Lazzara, Lazarus and Logemann (1986) stated that thermal tactile stimulation speeds up the swallowing process. Although this study showed more rapid swallowing, it did not give a

clear outcome of whether or not dysphagia decreased in the patients. Therefore, it appears that even though the swallow was triggered more rapidly the treatment was not effective for decreasing dysphagia. The swallowing reflex, however, was improved because of the thermal tactile stimulation. This study did not state the severity of the dysphagia or how long each individual was provided treatment. Studies reporting high success rates with participants who have experienced a stroke generally do not include the most severe forms of dysphagia (Mary L. Freed, Leonard Freed, Chatburn, & Christian, 2001, p. 467). Therefore, it appears that the swallowing reflex may not improve and dysphagia may not be decreased in other studies.

### **Treating Dysphagia with Neuromuscular Electrical Stimulation**

Neuromuscular electrical stimulation (NMES) is another type of therapy used for the treatment of swallowing disorders. This method involves placing electrodes on one or several external sites on the anterior neck to which an electrical current is applied to peripheral tissue targets (Clark, Lazarus, Arvedson, Schooling, & Frymark, 2009, p. 362). It is hypothesized that

such stimulation aims to improve function by strengthening the swallowing musculature or by stimulating the sensory pathways relevant to swallowing or both. To facilitate strengthening, muscle contractions elicited via NMES generally recruit larger and more motor units than voluntary contractions, causing metabolic responses within the muscle tissue that ultimately lead to increased strength (qtd. in Clark et al., 2009, p. 362).

The only brand of NMES to be cleared by the FDA is VitalStim. VitalStim cannot be used by itself. It must be used in conjunction with other skilled treatment such as oral motor exercises. According to Bulow, Speyer, Baijens, Woisard, and Ekberg (2008) NMES is used to re-educate patients to use their pharyngeal muscles in the throat for patterned activity to initiate or re-establish swallowing (p. 302). NMES is a relatively new approach and the effectiveness of the

treatment is still under debate. My second claim is that when a patient with post-stroke dysphagia is treated with NMES, dysphagia will decrease.

### **Supporting Evidence**

One study that supports Claim Two is the data supplied by Baijens, Speyer, Roodenburg, and Manni (2008). Baijens et al. (2008) investigated whether NMES decreased dysphagia in participants with opercular syndrome. The study was conducted on a 76 year old man with opercular syndrome. Typical characteristics of opercular syndrome include the loss of voluntary facial, pharyngeal, lingual, and mastication movements (Baijens et al., 2008, p. 825). The voluntary phase of swallowing is severely affected and multiple strokes form the major etiology of this syndrome (p. 825). The participant experienced two strokes within a six month period. During the first year after the second stroke the participant received logopedic dysphagia treatment. However, dysphagia did not decrease and the participant remained on PEG tube feeding. Over a five month period the participant received NMES in conjunction with logopedic dysphagia treatment five consecutive days a week. Baijen et al. (2008) stated that “the major treatment goals are to improve the hyolaryngeal elevation and to stimulate the sensory input that may facilitate volitional triggering of swallowing in dysphagia” (p. 827). The NMES treatments included two positions. Position A included two sets of electrodes with an electrical current up to 10.0 mA, located on each side of the midline, above and beneath the lesser horns of the hyoid bone, on the mylohyoid muscles, and on the thyroid muscles (p. 827). Position B included one set of electrodes with an electrical current up to 17.5 mA, located on each side of the mouth, on the orbicularis oris muscle and the masseter muscles (p. 827). During treatment the participant was offered various food consistencies using swallowing maneuvers. A speech-language pathologist performed a clinical assessment before and after treatment using the functional oral

intake scale for dysphagia. After therapy the scale showed changes in feeding. The participant changed from PEG tube feeding to an oral diet with special preparation. The clinical assessment before therapy did not include a videofluoroscopic examination (VFS) or a fiberoptic endoscopic evaluation of swallowing (FEES) because of the participant's inability to swallow. After therapy, however, both assessment techniques were able to be performed. Both assessments were scored using the penetration-aspiration scale (Pen-Asp). After successful completion of the FEES, the results showed mild pooling in the pyriform sinuses without penetration or aspiration. The participant received a score of one on the Pen-Asp scale, which is considered to be within normal limits (Ludlow, Humbert, Saxon, Poletto, Sonies, & Crujido, 2007, p. 4). When performing the VFS, minor aspiration during the first swallow was observed. However, the participant was able to remove the partially aspirated bolus by coughing. Neither penetration nor aspiration was observed during the other swallows. This study reveals that NMES decreases dysphagia in participants who have experienced multiple strokes.

Another study that supports Claim Two was completed by Carnaby-Mann and Crary (2008). They investigated whether NMES was an effective treatment for swallowing disorders. The study included six participants, of which four were male and two were female. The primary diagnosis associated with dysphagia was stroke in three out of the six participants (p. 283). All of the participants were less than 90 years of age, had a chronic swallowing impairment, and were in a medically stable condition. The participants had to obtain a score of 23 or greater on the Mini Mental State Examination (MMSE) and a score of 5 or less on the Functional Oral Intake Scale (FOIS). Finally, the participants could not have received swallowing therapy within the last three months (Carnaby-Mann & Crary, 2008, p. 280). Before therapy began, baseline measures were collected for each participant. The baseline evaluation included a clinical and

instrumental swallowing evaluation, documentation of weight, and the participants' self-perception of swallowing ability. The Mann Assessment of Swallowing Ability (MASA) was used to assess swallowing ability. A videofluoroscopic swallowing evaluation was conducted to confirm the presence of pharyngeal dysphagia. According to Carnaby-Mann and Crary (2008), the standard materials attempted in the examination included thin liquid, nectar thick liquid, and pudding in both 5-mL and 10-mL amounts (p. 280). The order of the materials was modified to meet the needs of each participant. An effort was made to present all materials to each participant; however, if the participant aspirated large quantities, the examination ended. Treatment consisted of NMES in conjunction with functional swallowing activities. The treatment sessions were five days a week for one hour. The participants could receive a maximum of 15 sessions; if the participant reached a level 6 on the FOIS before all 15 sessions were completed, then treatment could be terminated (p. 280). Before treatment began, participants had to attend two sessions to familiarize themselves with the equipment and procedures (p. 281). According to Carnaby-Mann and Crary (2008), four stimulating electrodes were placed on the anterior portion of the neck. The first electrode was placed above the thyroid notch and the second electrode was placed above the first electrode. The third electrode was placed below the thyroid cartilage and the fourth electrode was placed below the third electrode. The goal of therapy was to get each participant to move up the food hierarchy. Ice chips were at the low end of the food hierarchy and foods that the participants preferred were at the high end. Carnaby-Mann and Crary (2008) stated that "the starting level of materials used in therapy was identified as the highest level on the hierarchy that did not cause aspiration or expectoration during the Videofluoroscopic examination" (p. 281). The participants advanced to the next higher level on the hierarchy when they demonstrated a successful swallow on 8 out of 10

swallow attempts. The participants would regress to the next lower level on the hierarchy if they aspirated on 3 out of 5 swallow attempts (p. 281). After therapy was completed all baseline evaluations were repeated to reassess the participants' swallowing ability. The participants were asked to return for a repeat evaluation six months after treatment (p. 282). During treatment, one participant had to be withdrawn from the study. The score on the MASA improved significantly between pre- and post- treatment assessments. In four out of five participants the primary end point of clinical improvement in swallowing ability was reached (p. 284). According to Carnaby-Mann and Crary (2008) five participants raised their score by at least 2 points on the FOIS and the majority progressed from a restricted single consistency diet to a full oral diet (p. 284). The average weight gain for the group was approximately two pounds, and five participants significantly improved their self-perception of their swallowing ability. This study supports the claim that electrical stimulation improves an individual's clinical and functional swallowing ability.

### **Refuting Evidence**

Multiple studies indicate that NMES is an effective treatment for swallowing disorders. After reviewing various studies, it appears that there have been very few studies completed that say otherwise. One study was found that does not support Claim Two. Ludlow et al. (2007) conducted a study to address the immediate and physiological effects of the use of surface electrical stimulation at rest and during swallowing (p. 8). VitalStim is the brand of electrical stimulation that was used for this study. The goal of this device is to produce an electrical current strong enough to elevate the hyoid bone. Hyoid elevation is needed in order to swallow normally. Included in this study were eight participants, all of whom had chronic long-standing pharyngeal dysphagia, were at risk for aspiration, achieved a score of 21 or greater on the



MMSE, and were medically stable (p. 3). Their swallowing disorders were a result from either a stroke, cancer, TBI, or Parkinson's disease. Two sets of electrodes were used during treatment. The participants' sensory threshold and maximum motor level was identified before treatment began. According to Ludlow et al. (2007) between one and three swallows were recorded in each of the following conditions in random order: a) with no stimulation, b) with both electrode sets on at the sensory threshold level, and c) with both sets at the maximum tolerated stimulation level (p. 3). The Rosenbak Penetration-Aspiration Scale (Pen-Asp) and the NIH Swallowing Safety Scale (SSS) was used to assess the participants' swallows. The NIH-SSS was used because the participants who were on a feeding tube could still score within normal limits on the Pen-Asp Scale even if they had severe pooling in the pyriform sinuses and none of the bolus entered the esophagus (p. 4). Lidlow et al. (2007) stated that "the first purpose of this study was to determine the physiological effects of surface electrical stimulation on the position of the hyoid and larynx in the neck" (p. 7). Lidlow et al. (2007) predicted that when both sets of electrodes were functioning at the participants' maximum tolerated levels, then the hyoid bone would be pulled down and pulled posterior. The data supported the prediction that the hyoid bone would be pulled down, but did not support the predication that it would be pulled posteriorly. According to Lidlow et al. (2007), the only appreciable motoric effects of surface electrical stimulation was to cause the hyoid bone to descend in the neck, producing movement in the opposite direction from that required for swallowing (p. 7). The results of the Pen-Asp Scale showed that swallowing did not significantly improve with sensory levels of stimulation and that there was no change observed in laryngeal position with surface stimulation at rest (p. 8). However, the results of the NIH-SSS did show improvement. Lidlow et al. (2007), stated

that the “results indicate that in some patients with dysphagia this form of stimulation could interfere with hyo-laryngeal elevation required for airway protection during swallowing” (p.9).

Another study that did not support Claim Two was completed by Bulow et al. (2008). This study compared NMES to traditional swallowing therapy in stroke patients. Three different European swallowing centers participated in this study and included 25 participants, 16 men and 9 women. There were 12 participants in the group receiving NMES treatment and 13 participants in the group receiving traditional swallowing therapy. All of the participants had a primary diagnosis of stroke, were able to elicit some pharyngeal swallow, and could communicate (p. 303). Before treatment began a clinical evaluation was conducted. According to Bulow et al. (2008) a qualitative clinical swallowing assessment was performed and included a visual analog scale (VAS) for the participants’ subjective self-evaluation of complaints, actual nutritional status, and oral motor status (p. 303). A videofluoscopic swallowing study was also performed in which each participant completed five swallows of 5-ml thin and thick liquids. The participants in the NMES group received treatment five days a week for one hour, for over three weeks. Two sets of electrodes were used during the NMES treatment. One set was placed at or above the thyroid notch and the other set was placed on each side of the midline of the throat. While receiving treatment each participant was instructed to swallow hard and fast (p. 305). The participants in the group receiving traditional swallowing therapy also received treatment five days a week for one hour, for over three weeks. However, if participants were unable to complete the 60 minute session, then they were instructed to finish the session at home. The participants received exercise sheets for the specific exercises that were targeted during treatment. No statistically significant difference was found between NMES and traditional swallowing therapy for the VAS, the actual nutrition scale (ANS), the oral motor function test

(OMFT), and for the videofluoroscopic swallowing study. According to Bulow et al. (2008) “statistically significant positive therapy effects for both groups combined were found but there was no statistically significant difference in therapy effects between the groups” (p. 308).

### **Personal Comments**

The results of the study completed by Baijens et al. (2008) shows that using NMES to treat dysphagia in post-stroke patients decreases dysphagia. Although this study only consisted of one participant it appears that NMES is an effective treatment for dysphagia. A VFS showed minor aspiration during a swallow, but the participant was able to remove the aspirated material by coughing. The fact that a VFS was able to be conducted after treatment indicates that NMES is an effective treatment because the participant’s dysphagia was so severe prior to treatment a VFS was unable to be performed.

The results of the study completed by Carnaby-Mann and Crary included participants with dysphagia resulting from health conditions besides stroke. However, the results still showed that NMES improved the participants swallowing function. It appears that NMES can decrease dysphagia in participants who have experienced a stroke, as well as other health conditions.

The results of the study completed by Lidlow et al. (2007) focuses on how NMES aids in hyoid movement. Lidlow et al. (2007) stated that “it has been hypothesized that electrical stimulation may assist swallowing by augmenting hyo-laryngeal elevation or by increasing sensory input to the central nervous system to enhance the elicitation of swallowing” (p. 2). There have been multiple studies indicate that NMES helps improves a person’s swallowing abilities. Although this study did not provide enough data to support this hypothesis, it indicated that the effectiveness of NMES depends on the severity of the swallowing disorder. The results of the NIH-SSS scale showed a significant improvement during swallowing. The results showed

that the participants with the greatest improvement were the ones that were the most severely affected (p. 8). With that being said, the effectiveness of NMES may depend on the severity level of the dysphagia.

The results of the study completed by Bulow et al. (2008), showed that both NMES and traditional swallowing therapy improved the participants swallowing ability, but there was no significant difference between the two therapy groups. However, the visual analog scale showed that the participants in the group receiving NMES had more severe dysphagia than the participants in the other group. Therefore, the results of the NMES group could have been influenced by having participants that were more severe. If both groups would have had participants with the same severity levels then the results could have varied.

### **Neuromuscular Electrical Stimulation Compared to Thermal Tactile Stimulation**

Multiple studies have compared electrical stimulation to thermal tactile stimulation in the treatment of dysphagia. My third claim is that NMES in patients with post-stroke dysphagia will yield greater improvement in swallowing function than thermal tactile stimulation.

### **Supporting Evidence**

One study that supports Claim Three is the data supplied by Freed et al. (2001). Freed compared the effectiveness of NMES to the effectiveness of thermal tactile stimulation in patients with post-stroke dysphagia. This study was conducted at Hillcrest Hospital in Cleveland, OH and it included both in-patients and out-patients. There were 110 participants, however 11 of the participants dropped out for various reasons, leaving 99 participants to complete the study. All participants had a primary diagnosis of stroke and a swallowing disorder. A videofluoroscopic swallowing study also known as a modified barium swallow (MBS) was conducted to confirm the presence of and severity of the dysphagia. Before the treatment

sessions began the participants were alternately assigned to either the thermal tactile stimulation group or the NMES group. In-patient treatment was one hour a day and continued consecutively until a swallow function score of at least five was achieved (p. 468). Out-patient treatments were one hour a day, three times a week. The out-patient participants continued to receive treatment until a swallow score of at least six was achieved or maximum progress had been made. All of the in-patient participants were placed in the group that received thermal tactile stimulation. The treatment was given in three 20 minute intervals daily. During treatment the base of the anterior faucial arch was touched with an examination mirror that had been emerged in ice. If the participant could successfully elicit a dry swallow, then the participant was challenged with thickened liquids (p. 469). The participants in the group that received NMES received treatment for one hour. All but six of the participants were in-patients. The intensity level of the current was set according to the participant's tolerance level which varied among participants. When a successful voluntary swallow response was elicited the participant was asked to attempt a swallow with a specific consistency (p. 469). The results show that both treatment groups showed some form of improvement in swallow score, but the NMES treatment group had higher final swallow scores than the thermal tactile stimulation group. According to Freed et al. (2001), "the thermal tactile stimulation treatment group had 27% remain at their initial swallow score, 11% get worse, and none achieved a final swallow function greater than four" (p. 470). The study later concluded that "only 52% of the thermal tactile stimulation participants experienced successful treatment, compared to 95% of the [NMES] participants" (p. 470).

A study completed by Lim et al. (2009), also supports Claim Three. The purpose of this study was to assess the effectiveness of NMES in patients with dysphagia caused by stroke (p. 175). This study was conducted at Ilsan Paik Hospital and included 36 participants.

However, only 28 participants completed the entire study. All of the participants had a primary diagnosis of stroke and a swallowing disorder. A videofluoroscopic swallow study was conducted to confirm the presence of dysphagia. The participants had to obtain a score of 21 or greater on the Mini-Mental State Examination (MMSE) and had to be medically stable in order to participate in the study. According to Lim et al. (2009) each participants' swallowing was assessed using three systems: the swallow function scoring system, Rosenbek Pen-Asp scale, and pharyngeal transit time, at baseline and after four weeks of treatment. Prior to treatment, the participants were assigned to one of two groups. The participants in the experimental group received NMES and thermal tactile stimulation treatment simultaneously (p. 175). The experimental group included 16 participants, 14 men and 2 women. The participants in the control group received only thermal tactile stimulation treatment. The control group included 12 participants, 10 men and 2 women. The participants in the experimental and control group received treatment for one hour, five days a week for four weeks. Two sets of electrodes were used during the NMES treatment. One set of electrodes was placed between the anterior belly of the digastrics muscle and hyoid bone, and the hyoid bone and thyroid cartilage (p. 175). The second set was placed between the thyroid cartilage and cricoids cartilage and below the cricoid cartilage (p. 175). The thermal tactile stimulation procedures included stimulation of the oral cavity with a cold mirror and stimulation of the side of the face with an ice stick. The results showed that after treatment there was a significantly higher change in the swallow function score for the experimental group than the control group. After treatment there was a significant improvement in the Pen-Asp Scale for the experimental group. However, there was a slight improvement for the control group. The change in pharyngeal transit time was significantly greater in the experimental group after treatment. Before treatment 12 of the 16 participants in

the experimental group were tube fed. Out of the 12 participants, 6 progressed to oral feedings. There were 7 out of the 12 participants who were tube fed in the control group, but only one progressed to oral feeding. According to Lim et al. (2009) “the results show that the NMES treatment with thermal tactile stimulation has a better effect on improving swallowing or aspiration severity than does thermal tactile stimulation alone” (p. 177).

### **Refuting Evidence**

Current literature containing study results that suggest that thermal tactile stimulation is more effective than NMES could not be found.

### **Personal Comments**

The results of the study completed by Freed et al. (2001) showed that both NMES and thermal tactile stimulation had some form of improvement, but overall NMES was more successful. This study showed that 11% of the group receiving thermal tactile stimulation got worse than they were before they started treatment. If thermal tactile stimulation was a more effective treatment than NMES then all of the participants should have improved their swallowing function. Based on the results of this study, NMES is a more effective treatment for dysphagia than thermal tactile stimulation.

The results of the study completed by Lim et al. (2009) showed that NMES is more successful at treating dysphagia than thermal tactile stimulation. This study included 28 participants, 19 of which were tube fed. Seven out of the 19 participants returned to oral feeding. Out of those seven participants six of them were in the group that was treated with NMES, while only one was in the group treated with thermal tactile stimulation. If thermal tactile stimulation was a more effective treatment than NMES, then the results would have indicated so. Based on

this evidence, NMES will yield greater improvement in swallowing function than thermal tactile stimulation.

## **Discussion**

The first purpose of this literature review was to compare the effectiveness of thermal tactile stimulation to NMES in patients post-stroke with dysphagia. Thermal tactile stimulation is a treatment that has been used for many years for the treatment of dysphagia. However, NMES is a relatively new approach to the treatment of dysphagia. The effectiveness of both treatments has been under debate. Multiple studies show that when comparing thermal tactile stimulation to NMES, NMES is more effective. However, there are various factors that may hinder the rehabilitation of a stroke patient. It appears that the type of treatment provided and the effectiveness of the treatment will depend on the severity of the dysphagia, the age of the patient, and the type of stroke because every post-stroke patient is different. No articles were found that showed greater improvements for participants receiving thermal tactile stimulation. In all the articles reviewed comparing the two treatments, electrical stimulation always showed greater improvement in swallowing. It appears that when treating dysphagia in post-stroke patients, NMES will yield greater improvement in swallowing functions. Nevertheless, electrical stimulation has not been proven to be effective 100% of the time, therefore more comparative research needs to be conducted before one can claim that it is a valuable treatment option for dysphagia.

The second purpose of this study was to examine if thermal tactile stimulation or NMES would aid in decreasing dysphagia in participants with post-stroke dysphagia. Claim One predicts that when treated with thermal tactile stimulation dysphagia will not decrease in post-stroke patients. Current evidence suggests that treating dysphagia with thermal tactile stimulation



will not decrease dysphagia. Claim Two predicts that when treated with NMES, dysphagia will decrease in post-stroke patients. Evidence shows that treating dysphagia with NMES can decrease dysphagia, but effectiveness may depend on the severity of the disorder. Claim Three suggests that NMES in post-stroke dysphagia patients will yield greater improvement in swallowing function than thermal tactile stimulation. It appears that since no articles showing otherwise were found, that the claim is either correct or further comparative studies are required.

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VITA  
Graduate School  
Southern Illinois University

Larenda J. Henshaw

10575 Ringgold Road  
Shawneetown, IL 62984

Southeastern Illinois College  
Associates in Arts, May 2008

Southern Illinois University Carbondale  
Bachelors of Science in Communication Disorders & Sciences, Curriculum, May 2010

Special Honors and Awards:

SIUC Graduate Tuition Scholarship: Fall 2010, Spring 2011, Fall 2011

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Major Professor: Kenneth O. Simpson