

**A case study examining the effectiveness of  
surface electromyography (sEMG) biofeedback  
in dysphagia rehabilitation and the SWAL-QOL  
quality of life outcome measure.**

Sarah Newlove

3059956

Master of Speech Language Therapy Practice  
(MSLTPrac)

Research Project

Speech Science  
Department of Psychology  
The University of Auckland

2006

Formatted for submission to NZSTA

## **Abstract**

Dysphagia is very common following a stroke and in the US alone 500,000 individuals experience a stroke each year. As a result, advances in dysphagia management are growing and include the use of surface electromyography (sEMG) as a biofeedback tool. There is also a shift taking place in terms of how patients are viewed by professionals. In rehabilitation there is less of a focus on impairment-based rehabilitation and more on how the patient functions holistically in their environment, based on the International Classification of Functioning (ICF) framework. The current study aimed to investigate the effectiveness of sEMG as a therapy tool; the effect it has on a person's quality of life (measured by the SWAL-QOL); and the impact it has on treatment outcomes when therapy is delivered intensively. The results indicated a trend to significance in the progress made by the participant (as measured by videofluoroscopy interpretation) and additionally in the dietary changes after treatment. There was also a significant change in the participant's perception of their quality of life after treatment. These findings provide a useful basis for the generation of future hypotheses in larger research yet to be conducted.

**Keywords:** Surface electromyography (sEMG) – dysphagia - SWAL-QOL - quality of life – therapy – treatment – rehabilitation.

## **Introduction**

As speech-language therapists (SLTs), we are called to carry out our services under the International Classification of Functioning (ICF) framework and because of this there has been a burgeoning interest in the patient perspective of general treatment

outcomes and the impact these outcomes have on their daily life (Langmore, 2000; McHorney et al., 2000). Of particular relevance here is the impact of dysphagia and the use of Surface Electromyography (sEMG) as a biofeedback tool in dysphagia rehabilitation. The following study investigates the current use of sEMG and the outcome measures necessary to evaluate this.

### **What is Dysphagia?**

Dysphagia is a swallowing disorder that is viewed as a dysfunction in the transfer of a bolus, either solids or liquids, along the pathway from the lips to the stomach (Groher, 1997; Leonard & Kendall, 1997). The dysfunction can impact on any of the stages of swallow. These are; oral preparatory phase, oral phase, pharyngeal phase and oesophageal phase (Love & Webb, 2001). Dysphagia is often a secondary symptom of other diseases which are commonly neurogenic or mechanical in origin (Carrau & Murry, 1999; Groher, 1997), and “the presence of dysphagia has been associated with an increased risk of chest infection, poor nutritional state, and mortality”(Elmstahl, Bulow, Ekberg, Petersson, & Tegner, 1999, p. 61). Of all the causes of dysphagia, stroke is the most common. In the United States, stroke is the third most common cause of death (Carrau & Murry, 1999), moving up to the second most common cause of death worldwide (Feigin, 2005). In the United States approximately 500, 000 people per year are reported to suffer from a stroke with 30% to 40% also developing dysphagia as a result (Carrau & Murry, 1999). It is believed that approximately 20% of patients with stroke related dysphagia will die within one year as a result of aspiration pneumonia (C. M. Steele & Fong, 2003).

In Australia Mann, Hankey and Cameron (1999) found from 128 patients with acute stroke, 51% of them were detected clinically as having dysphagia and 64% were detected using videofluoroscopy. Videofluoroscopy detected 13% more patients with dysphagia that had gone undetected at bedside (Mann, Hankey, & Cameron, 1999). In New Zealand there are approximately 32 000 people who have survived a stroke (Feigin, 2005). Although New Zealand research is currently unavailable, it could be assumed from studies and figures published in other countries that there is a high incidence of dysphagia among these people.

### **Management of Dysphagia**

Typically when it comes to the management of dysphagia there are two distinct approaches that can be used either separately or in conjunction with each other. The approaches vary in name depending on the literature, and can be referred to as, for example, compensatory strategies or rehabilitation strategies (Huckabee & Pelletier, 2003), or as direct or indirect therapy respectively (Lin et al., 2003; Logemann, 1997; Neumann, 1993; Neumann, Bartolome, Buchholz, & Prosiegel, 1995; Smith & Connolly, 2003). For the purpose of this study they will be referred to as direct and indirect therapy.

Direct therapy is used with the patient consuming small amounts of food with no aspiration (Logemann, 1997), whereas indirect therapy uses exercises without food or liquid to improve sensorimotor impairment (Logemann, 1997; Neumann, Bartolome, Buchholz, & Prosiegel, 1995). There are swallow manoeuvres that can be used either directly or indirectly (Logemann, 1997). Some of the swallow manoeuvres that have

been used in research are the Mendelsohn manoeuvre, the supraglottic swallow and the effortful swallow.

Research has looked at swallowing and nutritional outcomes when patients are given therapy either directly, indirectly or both (Elmstahl, Bulow, Ekberg, Petersson, & Tegner, 1999; Lin et al., 2003; Neumann, 1993; Neumann, Bartolome, Buchholz, & Prosiel, 1995). All these studies found that swallowing therapy is associated with successful treatment outcomes. For example, in a study by Lin et al. (2003), it was found that improvements were made in 84% of the subjects. The individualized therapy used was shown to improve swallowing speed and volume and significantly decrease coughing and choking episodes during meals (Lin et al., 2003).

### **Management of Dysphagia using Surface Electromyography as Biofeedback**

The introduction of Surface Electromyography (sEMG) as a biofeedback tool has started to evolve over the past few decades. The use of biofeedback is defined as “the use of a machine to reveal to a subject the workings of some internal physiological process” (Barofsky, 1995, p. 19). SEMG biofeedback provides a visual to both the therapist and the patient of the physiological processes occurring during swallowing (Barofsky, 1995; Huckabee, 1996). Therefore it is viewed as a tool to be used in clinical settings to enhance the therapeutic process (Barofsky, 1995; Huckabee, 1996), through teaching and carrying out direct and indirect therapy. An advantage to this technique as a biofeedback tool is that changes in the physiological processes are detected and then reinforce the behaviour that resulted in the change (Barofsky, 1995). It is also growing in popularity as it is a non invasive method for evaluating a

persons swallowing physiology (Crary & Baldwin, 1997; Gupta, Reddy, & Canilang, 1996).

Several studies over the years have investigated and discussed the use of sEMG in dysphagia therapy and the treatment outcomes (Crary, 1995; Crary & Baldwin, 1997; Crary, Carnaby, Groher, & Helseth, 2004; Crary & Groher, 2000; Huckabee, 1997; Huckabee & Cannito, 1999). Three of these studies will be discussed here to highlight how the use of sEMG is evolving as a biofeedback tool in the management of dysphagia.

Crary (1995) conducted a study that uses sEMG as both a treatment tool and a measure of treatment outcomes. There were six participants in the study all of whom had dysphagia as a result of a brainstem stroke. They had all previously been given therapy involving thermal stimulation and swallowing exercises with no success. The time post onset for these participants ranged from 5 to 54 months (Crary, 1995). A videofluoroscopy showed that the participants had swallowing dysfunction such as a delayed swallow, reduced hyolaryngeal excursion, pharyngeal constriction and limited upper esophageal sphincter opening (Crary, 1995). Participants were to use the Mendelsohn maneuver therapy technique, which required them to maintain contraction for two or more seconds (Crary, 1995). The use of sEMG during treatment was to provide the participants information on the muscle movement patterns during the swallow and to increase the strength of the pharyngeal swallow (Crary, 1995). Participants were seen on a daily basis as much as possible over a three week period and a biofeedback device was provided at home for use in the three home therapy sessions each day over the three week period (Crary, 1995). Outcome measures were determined by i) the patients' ability to increase oral intake and

reduce/eliminate tube feedings; ii) sEMG assessment pre and post therapy measuring physiological changes in the swallow; and iii) a questionnaire completed by patients 18-24 months post treatment to establish long term outcomes (Crary, 1995).

The results showed that three out of six participants returned to consistent oral intake after the therapy. Another participant had to continue therapy for a further five months, once a month, before they could have a full oral diet (Crary, 1995), and another reached this level after seven months of therapy. At the end of all the therapy blocks, five out of six participants returned to total oral feeding. Crary concluded that direct therapy with the use of sEMG does produce successful and efficient outcomes for participants with chronic neurogenic dysphagia as a result of a brainstem stroke (Crary, 1995). Also that sEMG had “clinical value in both the evaluation and treatment of certain swallowing disorders” (Crary, 1995, p. 14). Crary’s use of the sEMG measurements as an outcome tool has been questioned due to the lack of knowledge and evidence available on the direct correlation of sEMG recording and the physiologic features (Huckabee & Cannito, 1999).

Consequently Huckabee and Cannito (1999) developed the work of Crary, by investigating the functional and physiologic outcomes of treatment in 10 participants with chronic dysphagia as a result of a single brainstem stroke. The treatment involved traditional dysphagia management with the use of sEMG as a biofeedback tool. The treatment was individualized and involved 10 sessions within a one-week period, so each participant had two sessions a day for one hour each. They also had a home programme that was conducted daily during that week (Huckabee & Cannito, 1999). In this study treatment outcomes were measured using videofluoroscopy, with 17 physiologic severity descriptors that were evaluated on a nine point rating scale,

and the evaluation of functional ability to safely consume oral intake, on a five point rating scale where one, is 'feeding tube only; no oral intake' and five is 'oral intake only, feeding tube removed; minimal texture restriction' (Huckabee & Cannito, 1999). The functional outcomes were then measured pre treatment, post treatment, six months and at final outcome (which was between one – four years post treatment). Physiological measures were taken pre and post treatment (Huckabee & Cannito, 1999). The results indicate that a statistically significant improvement was seen in the functional outcomes at the three post treatment measures (Huckabee & Cannito, 1999). With the median assigned diet level being two at post treatment, four after six months and five after the final outcome. The physiological changes were also found to be statistically significant with the median severity rating decreasing by one post treatment (Huckabee & Cannito, 1999). However, only eight of the ten participants returned to full oral intake. One participant did have a history of depression and failed to complete the home programme appropriately, which may have impacted on treatment outcomes (Huckabee & Cannito, 1999). These findings suggest that sEMG therapy does not require long lengths of therapy to achieve results, which is contrary to what has been found in other studies that do not use sEMG (Lin et al., 2003; Neumann, 1993; Neumann, Bartolome, Buchholz, & Prosiegel, 1995).

A further study (Crary, Carnaby, Groher, & Helseth, 2004) conducted a retrospective observational study of 25 participants with dysphagia following stroke and 20 participants with dysphagia following treatment for head/neck cancer and put them through a swallowing treatment programme involving sEMG biofeedback (Crary, Carnaby, Groher, & Helseth, 2004). The purpose of the study was to investigate functional outcomes of swallowing therapy, the time required in therapy and the cost of the treatment measure. Participants were seen on a daily basis for a 50-minute

session and also completed two home therapy sessions per day using a portable biofeedback unit. The technique used was the Mendelsohn manoeuvre (Crary, Carnaby, Groher, & Helseth, 2004). There were three outcome measures assessed. One was change in functional oral intake, which was measured using the functional oral intake scale (a seven point ordinal scale) based on the participants' report of the ability to safely intake orally (Crary, Carnaby, Groher, & Helseth, 2004). Another was the number of therapy sessions, with the final outcome measure being the cost per unit of functional change (Crary, Carnaby, Groher, & Helseth, 2004). The third measure was determined by calculating the cost per therapy session multiplied by the number of therapy sessions completed and then divided by the change in the functional oral intake scale (Crary, Carnaby, Groher, & Helseth, 2004).

From the results the average amount of therapy sessions completed by the stroke group was 12.32 with a range of 4 – 28 sessions. For the head/neck cancer group the average amount of therapy sessions was 9.3 with a range of 5 – 16 sessions (Crary, Carnaby, Groher, & Helseth, 2004). In terms of change in functional oral intake, there was an overall increase by at least one scale in 87% of all participants (Crary, Carnaby, Groher, & Helseth, 2004). In the stroke group the increase was seen in 92% of participants and in the head/neck cancer group the increase was 80% (Crary, Carnaby, Groher, & Helseth, 2004). In terms of average change in score, the stroke group improved by 2.96 on the functional oral intake scale with a range from 0 – 6 and the head/neck cancer group improved by 1.58 with a range of 0-5 (Crary, Carnaby, Groher, & Helseth, 2004). The difference between the groups showed no real statistical significance ( $p = 0.079$ ) even though the study reported a trend to statistical significance (Crary, Carnaby, Groher, & Helseth, 2004). In terms of cost effectiveness, when the average cost per unit of functional change was calculated, the

stroke group paid \$321.00 (US dollars) and the head/neck cancer group paid \$453.00 (Crary, Carnaby, Groher, & Helseth, 2004), indicating that the therapy was more cost effective for the stroke group. It was concluded that when sEMG biofeedback is used in conjunction with therapy then improvement of functional oral intake can be achieved within a limited timeframe for people with dysphagia from treatment of head/neck cancer and stroke (Crary, Carnaby, Groher, & Helseth, 2004).

In summary, the management of dysphagia when using sEMG as a biofeedback tool is similar across the different studies. Each study, to some degree, starts treatment with an intensive block of therapy using sEMG, a home programme and additional therapy sessions. This is because “clinical experience suggest that an optimal program to enhance swallowing function consists of an initial intensive treatment regime followed by home programming and a more traditional therapy schedule” (Huckabee, 1996, p. 6). The home programme (which consist of short, multiple, daily exercises) allows for generalization and consolidation while the additional therapy is used until the therapy goals are met. However it has been queried whether the significant results reported in the studies were due to the combination involved in the treatment process or because of the intensive block of therapy (C. Steele, 2004).

### **Measuring dysphagia and treatment outcomes.**

There are several procedures that can be used to assess dysphagia in patients starting with a clinical bedside assessment and moving on to utilising a videofluoroscopy if further investigation is required (Hoppers & Holm, 1999; Ramsey, Smithard, & Kalra, 2003). Since the late 1980s a procedure called fiberoptic endoscopic evaluation of

swallowing (FEES) has also been used to assess dysphagia (Langmore, 2003), but videofluoroscopy is the most widely used assessment tool in hospitals throughout America (McCullough, Wertz, Rosenbek, & Dinneen, 1999).

The videofluoroscopy (VF) assessment involves a patient consuming liquids or solids of different consistencies mixed with barium whilst their swallow is imaged, typically in a lateral view (Ramsey, Smithard, & Kalra, 2003). It is seen to be the measure most commonly used to objectively diagnose dysphagia in patients (Broniatowski, 1998; Hoppers & Holm, 1999). The VF provides a visual of the movement, structure and function of the swallow throughout most of its stages. It also allows the speech language therapist to see any dysfunction or aspiration that may be occurring. As a result postural modifications and bolus change can be more effectively used (Leslie, Carding, & Wilson, 2003), and effective rehabilitation techniques can be better utilised. Videofluoroscopy is considered to be the gold standard for assessing the physiology and symptomology of swallowing (McCullough, Wertz, Rosenbek, & Dinneen, 1999) and a number of studies using sEMG had used videofluoroscopy to assess the level of dysphagia (Crary, 1995; Crary & Baldwin, 1997; Crary, Carnaby, Groher, & Helseth, 2004; Huckabee & Cannito, 1999).

Using the International Classification of Functioning (ICF) framework there is a growing interest in patients perspectives of how dysphagia impacts on their daily living and how they perceive treatment impacting on their recovery (Langmore, 2000; McHorney et al., 2000). The SWAL-QOL was established for that purpose and measures patients' perspective of their quality of life as a result of dysphagia. The SWAL-QOL was designed to be a dysphagia-specific, patient-based treatment outcome tool (McHorney et al., 2000) and is the only standardized tool that measures

dysphagia separate to other co-morbidities (Langmore, 2000). Apart from the work of McHorney and colleagues in the development of the SWAL-QOL there are no other studies have been found that have used the SWAL-QOL to measure patients' perspectives and treatment outcomes.

As previously noted, evaluating patterns of sEMG activities is not a well established outcome measure (Huckabee & Cannito, 1999). At the same time electrode placement may differ between sessions, which may compromise accurate comparisons to be made across sessions (C. Steele, 2004). For these reasons sEMG measurements were not used as an outcome measure. The two outcome measures used were videofluoroscopy and the SWAL-QOL.

### **Proposed aims**

There are three aims to be examined within this study, those being i) to explore the effectiveness of sEMG as a therapy tool for someone with an oral phase dysphagia characterized by an uncoordinated swallow response. In this respect, it differs from the approach taken in previous research; ii) to investigate whether sEMG therapy has an impact on a person's perspective of their quality of life; and iii) to investigate whether sEMG used intensively without a home programme or additional therapy programme had any impact on swallowing treatment outcomes. This is again a different approach to that taken by previous research, which has included all three.

## **Method**

### **Participant**

There was one participant included in the case study. They had been referred to the University of Auckland, Speech and Language Therapy clinic at the Tamaki campus. The participant suffered a left sided basal ganglia and caudate nucleus infarct after she had surgery for an elective clipping of a MCA aneurysm. As a result the participant now has dysphagia, dyspraxia, dysphasia, and a dense right hemiplegia. The participant was (and still continues to be) seen by another SLT for rehabilitation of their language difficulties. They are able to communicate through some spoken output supported by the use of a light writer and their auditory and reading comprehension is still fairly intact.

With videofluoroscopy examination the participant presented with dysphagia that was characterized by poor oral control as a result of oral weakness and poor coordination. There was also frequent premature spillage to the level of the valleculae with puree, soft fruit and bread and to the level of the pyriform sinus with thin fluids and juice from mixed consistencies.

### **Procedure**

#### ***Therapy programme***

The participant was seen daily for 11 sessions, including weekends. The first session was an initial assessment with the SWAL-QOL being filled out by both the participant and their spouse. The following 10 sessions were approximately 50 minute sessions involving therapy with sEMG. No home programme or additional therapy

sessions were given, as one of the aims was to see the impact the intensive therapy block with sEMG had on treatment outcomes. There was no set number of swallow trials during each session as these were instead determined more by participant fatigue.

The goal for the therapy sessions was to augment coordination of the swallow. Increasing volitional control of the initiation of swallow achieved this. Combinations of conditions were trialed throughout the therapy block to help increase awareness of the participants swallow and in turn improve coordination. These combinations are in the table below.

**Table 1. Combination of conditions**

Condition	Abbreviation
3 Second Preparation, Nectar Thick Fluids	3SPTF
3 Second Preparation, Dry Swallow	3SPDS
3 Second Preparation, Cold Bolus	3SPCB
3 Second Preparation, Cold Bolus, Icing	3SPCBI
3 Second Preparation, Sour Bolus	3SPSB
3 Second Preparation, Nectar Thick Fluids, Icing	3SPTFI
Cold Bolus	CB
Cold Bolus, Icing	CBI
Nectar Thick Fluids, Icing	TFI

One of the common conditions used was the 3 second preparation technique. This involves having the participant hold the bolus in their mouth for 3 seconds and then swallow. The purpose of this technique is to alter “the swallows from a reflexive

response to a more volitionally controlled action” (Huckabee & Pelletier, 2003, p. 113). Icing was also used on the facial pillars with the notion that it would heighten the sensory information.

### ***sEMG Biofeedback***

SEMG involves the placement of electrodes on the skin over the target muscle or muscle group, which then feeds back an electromyographic signal relating to the muscles (Huckabee, 1996). The sEMG biofeedback component provides visual feedback to the participant on their swallow response. Only one electrode was used throughout the sessions and was placed over the suprahyoid musculature. It was mostly used in conjunction with 3-second preparation. The visual information being displayed from the sEMG was then explained to the participant so that they could monitor what they were seeing.

### **Outcome Measures**

Two outcome measures were used. These were the SWAL-QOL and videofluoroscopy.

### ***SWAL-QOL***

The SWAL-QOL is a quality of life questionnaire that investigates the impact that dysphagia has on people’s lives, see appendix A. The questionnaire is a 5-point rating scale. There are 44 items that assess 11 concepts relating to quality of life, these being; food selection, burden, mental health, symptom frequency, social functioning, fear, eating duration, eating desire, communication, sleep and fatigue (McHorney et

al., 2002). There are eligibility criteria that people must meet in order to complete the SWAL-QOL. These involve the person being an outpatient, with a recent videofluoroscopy, they are clinically stable, are able to provide informed consent and they comprehend English (McHorney & Robbins, 2003) The participant completed a SWAL-QOL both pre and post treatment in order to determine whether the patients perception of their swallowing difficulty had changed as a result of the therapy programme. The spouse of the participant also completed the SWAL-QOL pre and post treatment to see whether their perception changed and whether any changes were similar to the participant's.

### ***Videofluoroscopy***

A videofluoroscopy was conducted both pre and post therapy as it is considered to be the 'gold standard' in terms of assessing dysphagia. Both videofluoroscopies were conducted by independent SLTs who wrote a report, which was then analysed by the researcher.

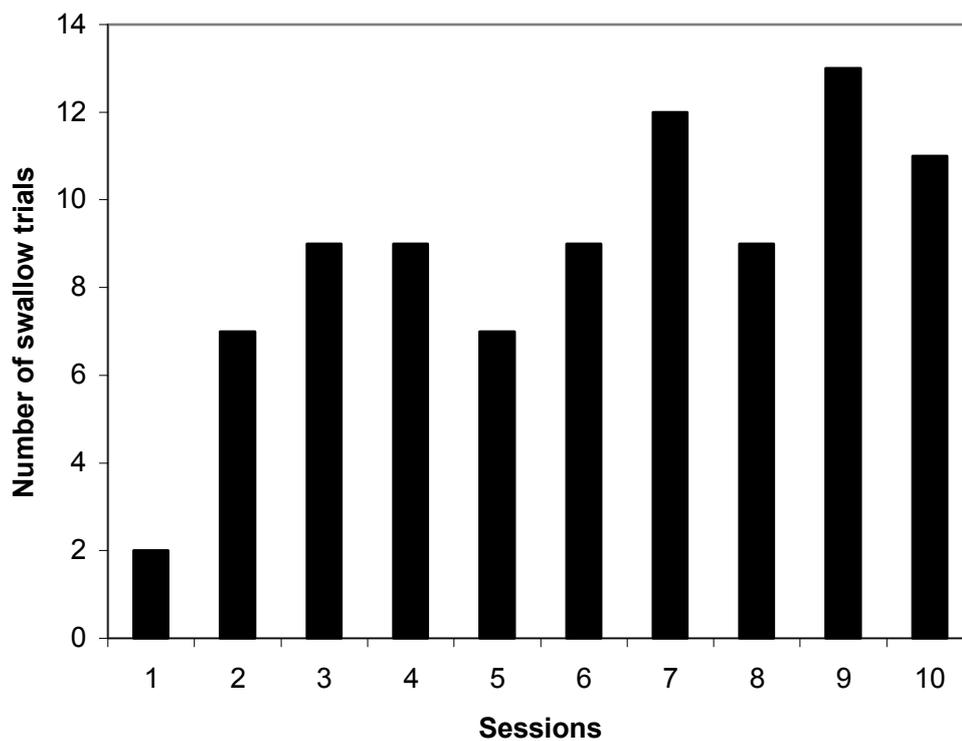
## **Results**

### **Therapy Schedule**

The participant completed all ten-therapy sessions. The condition that was used most often, in combination with the sEMG, was the 3-second preparation, cold bolus and icing (45% of the time). Table 2 outlines how often each condition was used and the percentage throughout the treatment process. There was no set number of swallow trials that were used in a session. Figure 1 summaries the number of swallow trials completed in each session. On average, 8.8 trials were attempted (range of 2-13).

**Table 2: Number of times the conditions were used and the percentage of the conditions use (Percentage values rounded).**

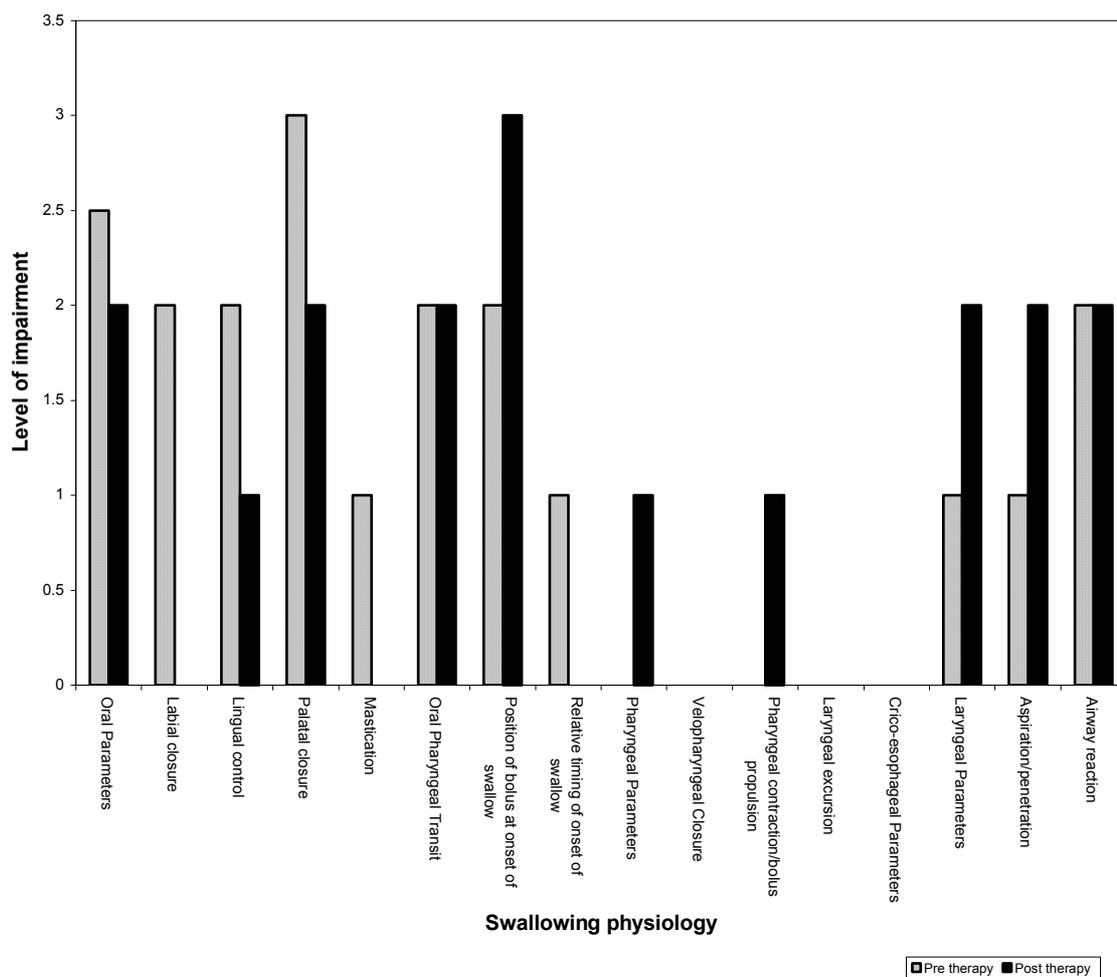
Condition	Number of trials	Percentage of total trials
TF	4	5%
3SPTF	11	13%
3SPDS	4	5%
3SPCB	4	5%
CB	6	7%
3SPCBI	40	45%
CBI	2	2%
3SPSB	1	1%
3SPTFI	13	15%
TFI	2	2%



**Figure 1: Summary of the number of swallowing trials during each session.**

**Videofluoroscopy Interpretation**

The two videofluoroscopies were completed by two separate SLTs that had not been involved in the treatment programme. Figure 2 shows the videofluoroscopy scores based on the NZIMES and the level of impairment for each physiology pre and post therapy. This is based on the New Zealand Index for Multidisciplinary Evaluation of Swallowing (NZIMES) (Huckabee, 2001) – see appendix B.



**Figure 2: The videofluoroscopy scores based on the NZIMES and the level of impairment for each physiology pre and post therapy.**

As the data collected were non-parametric, statistical analysis was conducted using the Wilcoxon matched pairs test. When applied to all the subscales of the NZIMES

the result was  $z = 0.267$ ,  $p = 0.79$ . This indicates that there was no significant effect overall between the two videofluoroscopies. However the therapy treatment itself only focused on the oral phases involved in swallowing. This being the case, further analysis was applied only to those subscales which related to the oral phases; which ranged from oral parameters to relative timing of onset of swallow. The result was  $z = 1.69$ ,  $p = 0.09$ . These statistics suggest a statistical trend towards significance.

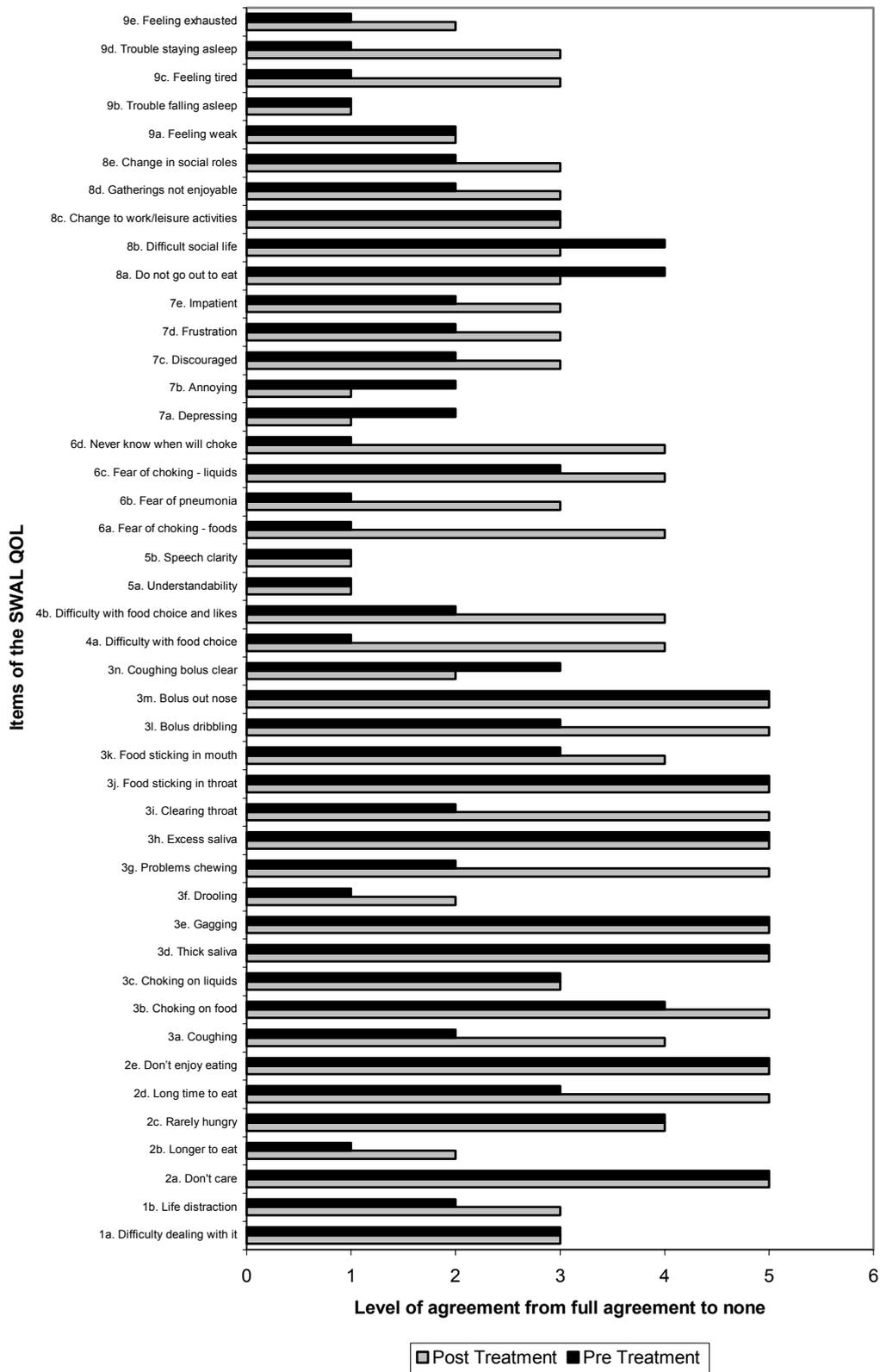
In terms of functional changes, the initial videofluoroscopy report suggested a diet modification of a 'soft 1' diet with no bread and nectar thick fluids. The videofluoroscopy report written post therapy suggested a diet modification of soft to normal consistencies and thin fluids. This change in diet suggests improvements were made in both the nutritional and hydrational status of the participant.

### **SWAL-QOL Measures**

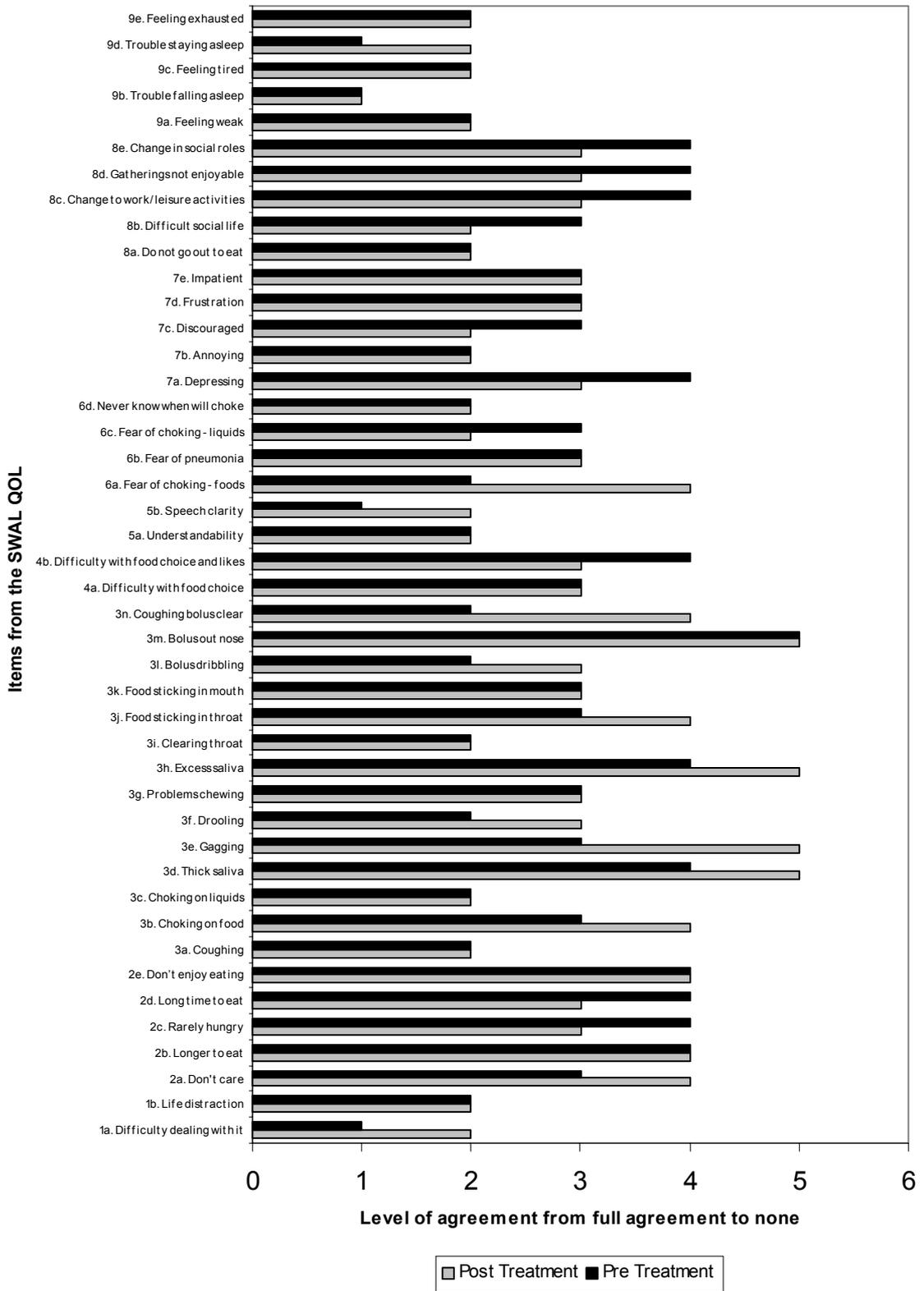
The SWAL-QOL was conducted pre and post treatment by both the participant and their spouse. Although the SWAL-QOL was designed for use with the person with dysphagia, it was used with the spouse in this instance to investigate the significance of the spouse's perspective. The spouse reported a positive change of perspective in 29% (13/44) of the items, a negative change in 23% (10/44) of the items and no change in 48% (21/44) of the items. These scores can be seen in figure 4. Again the Wilcoxon matched pairs test was used for statistical analysis, which gave a result of  $z = 1.6$ ,  $p = 0.11$ , and indicated that the change in scores for the spouse is not significant.

The aim of the study, however, was to investigate the impact the treatment had on the participant's perspective. In contrast to what the spouse reported, the participant reported a positive change of perspective in 57% (25/44) of the items, a negative change in 11% (5/44) of the items and no change in 32% (14/44) of the items. These can be seen in figure 3. When statistical analysis was conducted, the results showed  $z = 2.52$ ,  $p = 0.01$ , indicating that the change in scores for the participant were statistically significant.

Further analysis, using the Spearman rank order correlations was conducted to investigate whether the results of the SWAL-QOL were correlated. The participant's pre and post SWAL-QOL scores correlated ( $r_s = 0.66$ ,  $p < 0.05$ ), as did the spouse's ( $r_s = 0.73$ ,  $p < 0.05$ ). The participant and spouse's pre scores did not significantly correlate ( $r_s = 0.46$ ,  $p < 0.05$ ) nor did their post scores ( $r_s = 0.49$ ,  $p < 0.05$ ). However there was significant correlation between the participant's pre scores and the spouse's post scores ( $r_s = 0.64$ ,  $p < 0.05$ ).



**Figure 3: Summary of the pre and post therapy results of the SWAL-QOL completed by the participant**



**Figure 4: Summary of the pre and post therapy results of the SWAL-QOL completed by the participant's spouse.**

## Discussion

As outlined in the aforementioned studies, sEMG has typically been used on brainstem stroke patients with an incomplete swallow. However, this study aimed to explore the effectiveness of sEMG as a therapy tool for someone with an oral phase dysphagia characterized by an uncoordinated swallow response. The second aim was to investigate whether sEMG therapy had an impact on a person's perspective of their quality of life. The final aim of the study was to investigate whether sEMG used intensively without a home programme or additional therapy programme had any impact on swallowing treatment outcomes.

In addressing the first aim, it was found that no real significant change occurred in the NZIMES scores when the results from the videofluoroscopy were analysed statistically. When examined further there is a statistical trend to significance that was found when only the oral phases were analysed. This trend therefore shows support for the therapy used, as treatment focused on improving the oral phases of the swallow but not the pharyngeal phase, as it was initially identified that the participant had a deficit in the oral parameters of their swallow. A variable that affected the results was having two different SLTs interpreting each videofluoroscopy, which thereby increases the level of subjectivity. This also impacted on the type of intervention that was applied in the treatment process, explaining why only the oral parameters were the focus of treatment. The report from the initial videofluoroscopy reported that there was no significant impairment in any of the subscales of the pharyngeal parameters, and therefore, there was no need to have therapy targeting this area. However, in the final videofluoroscopy it was reported that there was a mild impairment in this area. Although the NZIMES was used in both cases, and the tool

itself was created to increase objectivity when interpreting videofluoroscopies, there is still an element of subjectivity when it comes to classifying what is seen on the video into a specific category. Ideally, the same individual should have evaluated both the pre and post treatment videofluoroscopies to achieve consistency in the scores. Further, inter-rater reliability could have been achieved had both therapists interpreted each videofluoroscopy. In functional terms however, the participant did make a positive change in their diet modification, as recommendations were changed from nectar thick fluids and 'soft 1' diet to normal fluids and soft-normal diet. This indicates that improvements were made between the pre-treatment videofluoroscopy and the post-treatment videofluoroscopy.

The second aim of the study was to determine whether sEMG therapy has an impact on a person's perspective of their quality of life. As a stronger emphasis is placed on multidimensional approaches to treatment outcomes there is a need to establish outcome measures that consider the patient holistically in their environment and the importance of their quality of life. In their 2000 study McHorney et al comment that although a vast amount of research exists based around the biomechanics of dysphagia, this research lacked measuring outcomes from the patients' perspective, stating that "physiologic function is not synonymous with patient functioning and well-being" (McHorney et al., 2000, p. 115). As a result McHorney and her colleagues devised the SWAL-QOL, a standardised quality of life assessment. This proved to be a useful tool in this study to assess treatment outcomes, as the results mentioned previously have shown.

There was a significant change in the participant's pre and post treatment perception, indicating that they felt that the treatment was having a positive impact on their

swallow recovery. The 44 items of the SWAL-QOL are divided into 11 categories. On further investigation it was discovered that improvements were made within the majority of the categories. In terms of viewing the dysphagia as a burden, a shift along the scale was made showing that it had become less of a distraction in the participant's life. With eating duration the participant reported taking less time to eat a meal post treatment compared to pre treatment. The third category was symptom frequency, which measures some of the physical problems that people with dysphagia experience. Here the participant reported improvement in how often they cough and choke when eating, with a decrease in the following areas; drooling, food and liquids dribbling out of the mouth, chewing difficulties, throat clearing and food sticking in the mouth. In terms of food selection, the participant initially found it difficult to figure out and locate the types of food they were able to eat. However, after treatment this was no longer reported to be a problem.

Regarding the participant's perspective on their ability to communicate, it was found that no change occurred in their opinion after the treatment. This category was not expected to vary pre and post treatment as the treatment itself focused solely on dysphagia and not on communication. The participant's perceived fears relating to the dysphagia also improved after the treatment. They reported 'almost always' having a fear of choking when eating, not knowing when they were going to choke and developing pneumonia, and post treatment they reported 'hardly ever' having concerns in this area. After the treatment the participant reported that feeling depressed and annoyed by the dysphagia was 'always true', where previously it was 'often true'. One possibility for the negative change could be that the treatment increased their level of awareness towards the dysphagia. However under the same category of mental health the participant reported feeling less frustration, less

impatient and less discouraged post treatment. Improvements were also reported by the participant post treatment in terms of the impact the dysphagia had on their social life as well as reporting that they feel less tired and fatigued. However, there was no change in still feeling weak 'most of the time'.

As the SWAL-QOL is designed for people with dysphagia, it was not unexpected that the changes in the spouse's scores would not be significant – what was interesting however, were the correlations discovered. Although it was expected that the individual pre and post SWAL-QOL scores would correlate, it was found that the couples' scores (both pre and post treatment) did not correlate. Essentially, this shows that they were of different opinions as to how the dysphagia affected the participant's quality of life. However there was a significant correlation between the participant's pre scores and the spouse's post scores. That correlation suggests that during the treatment process the spouse's awareness and understanding of the participant's perspective of their quality of life adjusted to that same level as the participant's own view before they started the treatment. In other words the spouse was beginning to catch up with the participant in terms of how they both viewed the dysphagia. The treatment appeared to have provided the spouse with further insight into the difficulties experienced by the participant; however the treatment also seemed to further improve the participant's understanding of their quality of life, which explains why both their scores post-treatment did not correlate. It is difficult, however, to determine the level of impact that the treatment programme had for a number of reasons. First, different analyses provided different outcomes. As discussed, one of the treatment outcomes (the videofluoroscopy) did not find a statistically significant change in the results even though there was change in the diet modification. Conversely, the participant's perspective of their quality of life did have a statistically

significant change in the results. It is difficult to establish from this study how much credence to place on each of the outcome measures.

The third and final aim investigated whether sEMG used intensively without a home programme or additional therapy programme had any impact on swallowing treatment outcomes. This aim was partly proved, as there were some changes that occurred as a result of the intensive therapy block, in particular, the change in diet as well as the significant change in the participant's perspective of her quality of life. However, it is difficult to determine the level of impact, as there was no comparison group that received either a home programme, additional therapy, or both. By having a combination of groups, superior measurements can be conducted to ascertain how much improvement is made when sEMG is used intensively; intensively with a home programme; or intensively with a home programme and additional therapy.

Furthermore, a single case study does not have a strong enough evidence base to allow for the results to be generalised to the greater population (Petrisor, Keating, & Schemitsch, 2006). However what a case study allows for is hypothesis generation for further research to be conducted (Petrisor, Keating, & Schemitsch, 2006).

### **Conclusion**

SEMG is finding growing support in the current literature as a valuable tool for providing biofeedback in dysphagia rehabilitation. This study has shown to some extent that sEMG is a useful therapy tool in the rehabilitation of a patient with oral phase dysphagia characterised by poor oral control and decreased coordination. Using this study as a foundation, future research could continue to investigate the effectiveness of sEMG for rehabilitation purposes when there is a deficit in the oral

parameters of the swallow. It would also be recommended that future research increase the number of participants in order to strengthen the validity of the findings. Given that this study involved a participant with multiple acquired communication disorders, there were some significant findings, which may provide a future opportunity to use sEMG with patients who have multiple difficulties. However, once again the research would require larger population sizes to see if this was possible as variables such as the severity and aphasia type would most likely impact on outcomes.

This study also suggests that the SWAL-QOL was a noteworthy tool in terms of measuring treatment outcomes due to the significant changes and correlations found. The SWAL-QOL, as the first dysphagia specific quality of life, may become an essential everyday tool used clinically in the not too distant future. However, further research is still required on a larger participant size to determine whether significant changes are still found.

This study highlighted that the impact of intensive sEMG therapy on treatment outcomes was difficult to determine, without a comparison group. Despite the findings of some gains in treatment outcomes, future research will need to investigate the impact of intensive sEMG therapy in comparison to sEMG therapy that involves a home programme, additional therapy or both, as has been demonstrated in previous research (Crary, 1995; Crary, Carnaby, Groher, & Helseth, 2004; Huckabee & Cannito, 1999).

*Acknowledgements.* The author acknowledges the following people for the contributions that they made. The participant and their family, Simone Newsham,

Clare McCann, Suzanne Purdy, Rochelle Parsons, Rachael McEvoy, Nancy Felix, and  
Felicity Bright.

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