Swallowing Rehabilitation after Stroke

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Abstract

Swallowing problems after stroke are common affecting up to 65% of people. In a small proportion of people will have persistent problems. Previously it has only been possible to compensate for these swallowing problems by modifying the swallow or altering the diet. There are now increasing numbers of therapies that show promise in enabling the swallow to be rehabilitated much in the same was as stroke as a whole.

“To be able to eat and swallow is important not only for physical, but social and spiritual well wellbeing”

Being able to swallow safely will result in the ability to enjoy food such that it is not a chore to keep body and soul together but also a convivial social past time. This joy may be removed following brain injury, in the case of this paper, following stroke. It is accepted that for meaningful recovery of limb function and speech a period of rehabilitation should be undertaken. Swallowing has often been neglected, with an air of nihilism that used to pervade stroke as a whole. This paper is a brief review of accepted and emerging interventions that assist in the rehabilitation of swallowing and the return to oral feeding.

The appear is not about the management of dysphagia and as a consequence there is purposely little emphasis on the role of enteral nutrition as the provision of nutrition supports rehabilitation rather than having a direct effect of its own.

Keywords: Rehabilitation; Stroke rehabilitation

Introduction

The process of swallowing has been described as the most complex of “all or non- reflex” [1,2], however, although the pharyngeal swallow is a reflex it can be modified by the cortex depending on feedback regarding bolus size and viscosity emanating from afferents in the mouth and pharynx [3]. Because individual swallows can be influenced by bolus characteristics, a normal swallow is difficult to define, but essentially it is a series of sequential coordinated events that ensures a safe passage of food or liquid from the mouth to the stomach [4].

Preparation of the swallow begins as food is brought from the plate or cup towards the mouth, preparation to; there are essentially three functions to the oro-pharyngeal swallow. These are bolus preparation, airway protection and bolus passage through the pharynx; and three phases, oral, pharyngeal and oesophageal (relaxation of the upper oesophageal sphincter). The relationship between these phases of timing and duration are dependent to some degree on bolus characteristics.

Bolus Preparation / Oral Phase

The oral phase of swallowing is under volitional control, in that it is personal choice how long food is chewed for before the bolus is gathered together and this will be influenced by bolus viscosity, texture, volume and personal preference [5,6].

As the bolus approaches the lips, the hyoid bone moves forward and up pulling the larynx up against the base of the tongue [7,8]. Once the bolus has been placed in the oral cavity, lips are closed; the bolus is prepared for swallowing, by chewing and mixing with saliva in the case of a solid bolus (e.g. meat). When ready, the bolus is collected on the tongue and trapped between the tongue and the hard palate, such that in the antero-posterior view it is said to resemble a Viking long boat. The bolus is then propelled backwards to the pharynx by a rippling movement of the tongue from anterior to posterior.

Passage through the Pharynx

Passage of the bolus through the pharynx is not straightforward. Once the bolus has left the back of the tongue, it moves into the valleculae, momentarily, before passing over or around the epiglottis [9,10]. The food then passes through the lateral food channels (pyriform sinus), before coming together to pass through the upper oesophageal sphincter (cricopharyngeus), which has relaxed and opened at this time.

The movement of the bolus is not a passive phenomenon but an active process with a rippling of the lateral [11] posterior pharyngeal wall (the pharyngeal stripping wave) [12].

Airway Protection

The pharynx is an anatomical structure/ “tube” that is shared by both respiration and swallowing, to swallow safely, there needs to be an interruption to the respiratory cycle [9,10,13-15]. As a consequence during swallowing there is a period of apnoea, followed by expiration...
but this is not invariable and certainly after sequential swallowing, inhalation may occur [9,10]. Where apnoea is not possible, e.g. lung fibrosis, COPD, heart failure, swallowing may be a problem and dysphagia results.

Protection of the airway commences at the beginning of the swallow, with upward and forward laryngeal movement. Concurrently the false vocal cords begin to come together followed, closely, by the true vocal cords and then the epiglottis. The real protection of the airway is not the epiglottis but the vocal cords. It is possible to swallow without the presence of an epiglottis [16] and in sequential swallows the epiglottis is upright [9].

As the bolus moves to the back of the oral cavity, the soft palate elevates to close off the nasal passages, aided by the forward movement of the posterior pharyngeal wall (Passavant’s cushion) [3,17].

Commencement of the Pharyngeal Swallow

Original research had suggested that the pharyngeal swallow would commence once a bolus passed the base of the anterior faucial arches. Subsequent research has found that, this is true in some cases but for others the swallow does not trigger until the bolus is in the pharynx itself [18-22].

Neural control of swallowing

As Doty [2] commented this is a very complex reflex. The pharyngeal swallow is triggered by the presence of the bolus in the pharynx. The exact point at which the swallow triggers is different in each person. Information regarding the bolus presence is referred to the brainstem and cortex [23-25], and a swallow is triggered, cf little a tendon reflex. However there is not one interneuron but a system of connections with in the reticular formation of the medulla, near the inferior Olive, which has an important role to play. At the same time information regarding the bolus characteristics are conveyed via afferents (with in cranial nerves V, VII, IX, X-XII) to the cortex, which then modulates the swallow to regulate how long the upper oesophageal sphincter remains open, the dimensions of the pharynx and the control of respiration and airway closure [26-28].

Cortical control is complex and is detailed elsewhere [29-31], suffice to say that there is no one region that has ultimate control, and that the swallow is bilaterally, but asymmetrically represented [30,32] within the cortex. Two areas that appear to be critical for the coordination of swallowing are the nigrostriatal pathway and the anterior insula cortex [2]. Within these areas are numerous transmitters including substance P, Dopamine and nor adrenalin [33,34]. The Motor cortex, supplementary motor cortex, amygdala, frontal cortex and cerebellum are also involved [2,30].

Swallowing following stroke

Fifteen million people suffer a stroke annually and stroke is the third largest cause of death in the world behind ischaemic heart disease and cancer (WHO Atlas). Of these up to 65% will have dysphagia acutely, with approximately 10% having on going problems [35,36].

The presence of dysphagia following an acute stroke may not be directly related to the cerebral insult. The ability to swallow safely may have many different aetiologies/comorbidities that interplay; compounded by the fact that some older people will have presbyphagia, and a new physiological insult has led to a decompensation of their swallow. Frequently medications will also have a negative impact on swallowing (Table 1).

<table>
<thead>
<tr>
<th>eMedication Class</th>
<th>Effect</th>
</tr>
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<tbody>
<tr>
<td>Benzodiazepines</td>
<td>Drowsiness, Over activity of the GABA pathways</td>
</tr>
<tr>
<td>Anti-depressants</td>
<td>Anti-cholinergic effects eg: dry mouth</td>
</tr>
<tr>
<td>Anti-psychotics</td>
<td>Inhibit dopamine pathway, Sedation, dry mouth</td>
</tr>
<tr>
<td>Opiates</td>
<td>Dry mouth, sedation</td>
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Table 1: Examples of Medications that may adversely affect the swallow

What type of stroke results in dysphagia and where in the brain does the stroke occur. Stroke has two essential aetiological pathologies, ischaemic and haemorrhagic. Ischaemic strokes can be sub-divided further by aetiology [37], or stroke syndromes depending on stroke severity and location [38].

Dysphagia may following a stroke in any area/lobe of the brain, as the pathways are complex and interdependent. The occurrence and recovery of dysphagia frequently depends on the relative dominance between the affected and unaffected hemisphere for swallowing, there has been much research investigating the lesion location, but there has been no conclusive single cortical location identified as the most relevant. Stroke within the subcortical structures, cerebellum and brainstem may be more likely to result in dysphagia, particularly because of the close proximity of many important pathways [2,34].

Abnormalities within the swallowing system are common following stroke, and some authors have suggested that the occurrence may be as high as 100%, however clinically relevant problems with swallowing or dysphagia, is present in 28-65% of people during the acute phase of stroke, reducing significantly during the early times of stroke, such that by 14 days after the stroke 90% of people will be swallowing safely [35,39,40]. However a small proportion of people will have on going problems for some time [36]. Some of those that appear to have returned to a safe swallow after 3 months are found to have difficulties at 6 months [35,41]. If the swallow does not show any signs of recovery in the first ten days, it is probable that the return of a safe swallow may take between 2 and 3 months.

Swallowing recovery is dependent on neural plasticity [42-44], with either the non-affected hemisphere enlarging [42] or other cortical areas taking over or both. Failure of the non-affected hemisphere to enlarge will result in dysphagia persisting [42,44]. Hamdy and colleagues have undertaken many eloquent studies to show this using both fMRI and Trans Cranial Magnetic Stimulation [45,46].

The presence of dysphagia following a stroke is an independent marker of outcome, and evidence is that there is short term and long-term associated with dysphagia.

What Next?

The swallow may improve under its own volition, but may take many months or years in some cases. If the ability to swallow has not improved, then the vexed question of “What next or now”? is raised.

The key to recovery after stroke is rehabilitation, and there are many different techniques employed to maximize physical recovery from stroke [47-49], what is available to rehabilitate the swallow.
In a recent review of the literature for 2012-13, Drulia and Christy [50] noted that most rehabilitation approaches, on their own, offer marginal or no effect. However when direct and indirect treatments (Table 2) were used together a clinical effect was seen.

<table>
<thead>
<tr>
<th>Direct</th>
<th>Indirect</th>
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<tbody>
<tr>
<td>Compensatory Manoeuvres, Chin tuck, Head Turn</td>
<td>Mendelsohn</td>
</tr>
<tr>
<td>Airway Protection</td>
<td>Surgery</td>
</tr>
<tr>
<td>Supra-glottic swallow, Breath holding</td>
<td>NMES</td>
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<tr>
<td>Dietary modification</td>
<td>Pharyngeal Stimulation, Shaker exercises</td>
</tr>
<tr>
<td>Transcranial Magnetic Stimulation</td>
<td>Tongue exercises</td>
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Table 2: Direct and Indirect interventions for swallowing after stroke

Faucial Stimulation

Swallowing is a sensori-motor process. A successful swallow relies on feedback form the mouth as well as the pharynx, relaying information regarding the bolus back to the cortex. Lazzara et al. [51] studied a mixed group of neurologically impaired individuals. Results suggested that there was a decrease in the oral and pharyngeal transit times. Power et al. studying stroke patients only were unable to replicate these findings, instead noted that stimulation of the faucial arches at a frequency of 5Hz increased the swallowing response time by 114%, whereas 10Hz inhibited the swallow [52]. This suggests that the relationship is far more complex than initially realized, which is borne out by the variability of the triggering of the swallow between individuals.

Bolus Consistency

Following stroke, the effects on the swallow can be legion. Bolus temperature, viscosity, volume and taste can modulate the swallow [53]. The change to bolus viscosity will vary between individuals, depending on where the major problem is. Oral/tongue deficits require, in many cases, a thicker bolus to promote bolus cohesiveness, whereas pharyngeal paresis/slow transit and pooling may require, in many cases, a thinner consistency. Bolus size and consistency, with a normal diet (p=0.04). The incidence of chest infection was reduced on feedback form the mouth as well as the pharynx, relaying information regarding the bolus back to the cortex. Lazzara et al. [51] studied a mixed group of neurologically impaired individuals. Results suggested that there was a decrease in the oral and pharyngeal transit times. Power et al. studying stroke patients only were unable to replicate these findings, instead noted that stimulation of the faucial arches at a frequency of 5Hz increased the swallowing response time by 114%, whereas 10Hz inhibited the swallow [52]. This suggests that the relationship is far more complex than initially realized, which is borne out by the variability of the triggering of the swallow between individuals.

Clavé et al. [55] found that increasing bolus consistency in those oral preparatory problems reduced the risk of laryngeal penetration and aspiration (39.5% vs 26.3%). Hamdy et al. [56] examined the effect of bolus pH and temperature on the swallow. Cold water with citric acid added slowed the swallow significantly. Although the texture and size of a bolus are frequently changed to support oral feeding in the clinical setting, little work has been done in anything other than water [57,58]. The taste of the bolus alters oral transit and submental muscle contraction. Sweet and Sour elicits the shortest oral preparatory phase, but strong submental muscle contraction particularly with Sour taste may be beneficial with rehabilitation. Similarly bitter tastes produce a longer oral preparatory phase, which may provide longer for pharyngeal protection and should be explored in the realms of rehabilitation [53].

Behavioural Techniques

Behavioural techniques often utilize biofeedback as part of the treatment package.

Traditional swallowing exercises

Swallowing exercises are the physiotherapy approach to dysphagia rehabilitation. They require no equipment and can be done at the bedside by the patient after instruction.

The role of the speech and language therapists (Pathologist) is to reduce the risk of aspiration and improve swallowing function to allow a safe ingestion of food and liquid [59]. This is achieved by using posture changes (Chin tuck, head turning), or swallow manoeuvres (breath holding, effortful swallow) to alter the physiology of swallowing. The literature supports the use of swallowing manoeuvres and postural movements for some patients [60,61]. Rasley et al. found that head turning or chin tuck was beneficial in 67% and 77% respectively at reducing aspiration with some bolus consistencies [60]. Ertekin, using electrophysiology, noted that head turning to the parietal side and chin tuck increased the size of the bolus that could be swallowed [61]. Bülow et al. [62] using manometry studied the intrabolus pressures and did not find any significant changes, despite the apparent clinical benefit. McCullough and Kim [63] studying the Mendelsohn manoeuvre noted some clinical benefit, but found that in stroke patients fatigue was a problem, particularly with older patients.

Carnaby et al. [64] compared usual care with three times weekly and daily swallowing therapy for one month. Those with daily therapy were more likely to regain their swallow (p=0.02) and be eating a normal diet (p=0.04). The incidence of chest infection was reduced.

However, the evidence is limited due to the size of the studies and that often studies are of mixed aetiologies [65].

Similarly requesting change in eating or drinking speed may prove a problem, particularly in older patients, due to changes in oral sensorimotor function and the in ability to fully monitor the bolus characteristics [66].

Tongue exercises

To move the swallow from the front of the mouth to the back relies on the movement of the tongue in relation to the palate and the pressures exerted during this procedure. Steele et al. [67] have noticed that this different between different viscosities and textures.

Stroke, although a disease of all age groups, affects predominantly older people. Butler et al. [68] had noticed that 30% of older adults were at risk of aspirating and that this was more common if there was reduced isometric and swallowing tongue strength.

Robins et al. [69] studies tongue strength in older people and found that an eight week progressive resistance regimen improved swallowing pressures and increased muscle volume by 5%. Similarly Lazarus et al. [70] found that using the IOWA Oral Performance Instrument there was a significant increase in tongue strength. Clark et al. [71] in a slightly larger cohort (39 adults) found similar results after 9 weeks directional training.

Robins et al. [72] found improvement in tongue strength and improved swallowing (timings and residue remaining) and less aspiration in a small cohort (10) stroke patients with dysphagia. Tongue volume was increased in those that were able to undergo MRI.
by 4.35% but this was not consistent across the group. Yeates [73] in a series of 3 case studies found similar results but suggest that older people may require longer rehabilitating their swallow using tongue exercises.

**Shaker exercises**

The Shaker exercise programme, consists of a series of head raising exercises whilst lying flat on the bed or floor. Three head raises are sustained and followed by a series of 30 repetitive head raises; strengthens the suprahoid muscles resulting in improved upper oesophageal opening, laryngeal anterior excursion and a reduction in post swallow aspiration. In a small study of 27 people in 2002, Shaker and colleagues [74] demonstrated that those in the treatment arm were able to resume swallowing, videofluoroscopy was the gold standard assessment. Logemann et al. [75] in a small multicenter study (19 Patients) that was beset with problems noted that the Shaker and traditional therapy produced similar results but by different mechanisms. They concluded that the traditional exercises (Mendelssohn Maneuvre) should be used where there are neck problems. A further small study [76] of 11 patients showed that the Shaker exercise resulted in an increase thyrohyoid shortening after 6 weeks compared to traditional exercises involving tongue exercises and swallow manoeuvres.

**McNeill dysphagia training program**

The MDTP uses the act of swallowing as an exercise incorporating a hard swallow [77]. The main thrust of the program is to rebuild functional patterns of swallowing. During the program a patient is moved up or down the ladder of treatment of increasing resistive forces and alterations in movement velocities, timings and movement specificity of the swallowing activity. Small case series have suggested that the MDTP is superior to standard therapy with sEMG. However the studies are all a mixed case series and are not stroke specific [77,78].

**Pharmacological Interventions**

Swallowing is complex with several sites of intervention, including the cerebral hemispheres/lobes, brainstem and topically.

A topical theory is that depletion of substance P in the pharyngeal plexus as well as centrally results in a disordered pharyngeal swallow. Several papers [79,80] have suggested that ACE-Inhibitors can reduce aspiration and the incidence of aspiration pneumonia. Capsaicin, will act topically on the pharynx recent work by Rofes et al. [81] has shown an increase in the vertical movement of the larynx with capsaicinoids by way of the TRPV1 receptor reducing, laryngeal penetration by 50% (p<0.05) and pharyngeal residue by 50% (p<0.05), and shortened the time of laryngeal vestibule closure (p<0.001), upper esophageal sphincter opening (p<0.05) and maximal hyoid and laryngeal displacement Rofes et al. [82] using Piperine, acting via the TRPV1/A1 receptor in the pharynx noted a 35% reduction in unsafe swallows (P=0.004) at 150 μM and by 57% (P<0.001) at 1 mM. The severity score of the penetration-aspiration scale from 3.25 ± 0.51 to 1.85 ± 0.27 (P = 0.003, 1 mM); and (b) shortening the time to laryngeal vestibule closure from 0.366 ± 0.024 to 0.270 ± 0.022 s with 150 μM piperine (P<0.001) and from 0.380 ± 0.032 to 0.306 ± 0.028 s with 1 mM piperine (P<0.05) were all improved.

Perez et al. [83] found improvements in pharyngeal transit times (a mean reduction of 1.34 seconds, (95% CI -2.56, -0.11) and a reduction in swallow delay of 1.91 seconds (95% CI -3.58, -0.24) using Nifedipine controlled release in a cross over design study.

These studies would suggest that the pharynx host an array of receptors, which can be utilized to assist in the recovery of the swallow. It is possible that all medications are acting via a final common pathway, which may be Substance P or calcium channels or both.

**Biofeedback**

Biofeedback is used in conjunction with other methods of swallowing therapy. Logemann [84] reported a case study in 1990 using indirect biofeedback with pharyngeal swallowing manoeuvres.

Over the years different researchers have experimented with the use of biofeedback in conjunction with surface EMG [85-87] and video endoscopy [88], accelerometry [89] and neck transducers [90].

**Surface Electromyography**

sEMG is the recording of electrical activity within muscles. It has been advocated as an adjunct to swallowing therapy [91]. Crary et al. reviewed the charts of 25 stroke patients who had had dysphagia for a mean of 24.8 months, and found that after a period of therapy that there was a 92% increase in oral intake with a mean improvement of 2.96 on the Functional Oral Intake scale.

Bogaardt et al. [92] found improvement in all 11 subjects to varying degrees. Apart from a standard use of sEMG for varying periods of time (mean 7 sessions), different swallowing therapy was used (Mendelssohn, Shaker exercises).

**Neuromuscular Electrical Stimulation**

Neuromuscular electrical stimulation (NMES), usually transcutaneously is of interest as it is potentially a non-invasive way of retraining the swallow. The whole basis of the treatment is to stimulate innervated healthy muscle recruiting fibres to cause a contraction. If the stimulation is used to augment a functional activity then it is referred to as Functional Electrical stimulation. NMES in the case of swallowing involves the placing of electrodes on the skin over the larynx and during the swallow and using the muscle stimulation of the hyoid muscles to cause the larynx to elevate. There are many muscles in this area, intramuscular stimulation has noted that the thyro-hyoid is more closely related time wise to the laryngeal elevation than the myelohyoid [93].

Transcutaneous stimulation is unable to attain this degree of accuracy. In a meta-analysis of 7 studies Carnaby-Mann et al. [94] found a small but positive effect for this intervention. In 2009 Clark et al. [95] recommended that further studies were required as no high quality randomized trials existed. Studies by Shaw [96] and Bulow [97] have noted positive effects with NMES. Permsirivanich et al. [98] in a single blind randomized study compared rehabilitation swallowing therapy (Diet modification, oral motor exercises, thermal stimulation and swallowing manoeuvres) to NMES therapy (Diet modification, oral motor exercises and NMES). Both groups showed an improvement in swallowing using the Function Oral Intake score, by 3-4 levels, however there was an absolute benefit in the NMES arm by 10% (81% vs. 91%). The difference in mean change was significant at the p<0.001.

There is increasing evidence that NMES does have a place in swallowing treatment, but that as Ludlow et al, noted in their review, it
is beneficial for a small group of mild to moderate dysphagia rather than severe dysphagia.

**Pharyngeal Stimulation**

Swallowing although reflexic is highly dependent on sensory feedback [23]. This feedback provides information regarding bolus characteristics. Fraser et al. [45] and Hamdy et al. [54] have shown that stimulation of the pharynx will produce changes in the cortex lasting up to 30 mins. However the peak excitation of pharyngeal swallow is later than that usually produced by a volitional swallow [57] suggesting that the maximal benefit of pharyngeal stimulation would be achieved in conjunction with volitional swallowing exercises. Jayasekaran and colleagues further investigated this effect in people with acute stroke [99]. One treatment each day (U=8.0; P=.043) for 3 days (U=10.0) produced improved airway protection compared with controls (P=.038). Active PES also reduced aspiration (U=54.0; P=0.049), improved feeding status (U=58.0; P=.040), and resulted in a shorter time to hospital discharge (Mantel–Cox log-rank test, P=0.038) [99].

**EEG**

EEG bio-feedback has been used in stroke for example for the treatment of neglect [100]. Yang et al. [101,102] have proposed a scheme to combine the EMG with EEG wave forms to assist in the rehabilitation of the swallow.

**Music Therapy**

Music therapy is being explored in many areas of medicine, particularly in the areas of brain injury, including dementia [103,104] and strokes [105]. Music therapy is particularly beneficial in communication [106] and fine motor movement [107]. Kim [108] examined the role of music therapy with an enhanced swallowing rehabilitation. The question that needs to be asked is whether with swallowing exercises in conjunction with music therapy, the swallow improves as part of the rehabilitation of swallowing.

**Acupuncture**

Li [109] and Zou [110] suggest that acupuncture following stroke may be beneficial in swallowing recovery. In the 2008 Cochrane review, Xie and colleagues [111] concluded that there was not enough evidence to support the use of acupuncture for the treatment of dysphagia in acute stroke. Long and Wu [112], undertaking a meta-analysis of 72 RCTs enrolling a total of 6134 patients, report that the treatment with acupuncture with usual treatment was more effective than usual treatment (OR 5.17, 95% CI 4.18-6.38). They do acknowledge that majority of the trials there were question marks regarding methodology and randomization, but conclude further studies are needed.

**Orthoses**

Selley and colleagues [113] reported the use of a palatal training device, essentially a wire loop attached to the plate of a full denture that supports the soft palate. In 37 stroke patients, of the 23 that survived 22 were taking adequate oral diets.

**Surgery**

Surgical techniques for the management of aspiration are not new, with publications being prevalent in the 1970s. Brooks and McKelvie [114] published a case review of a patient that underwent an epiglottopexy for intractable aspiration. This involves subtotal closure of the larynx by fixation of the epiglottis. The report suggest that the airway is maintained, speech preserved and aspiration abolished. Cricopharyngeal myotomy has been suggested by some authors, where there is a lack of relaxation of the cricopharyngeus or upper oesophageal sphincter resulting in pooling. The results are mixed though some have found god results [115].

Other surgical techniques such as laryngeal suspension, laryngeal closure or diversions have been employed in the field of head and neck cancer.

Vocal cord injection/medialisation has been suggested and may be useful in a unilateral cord paralysis following stroke. Evidence suggests it is of limited value.

**Nasogastric Tube**

It is generally considered that the presence of nasogastric tubes inhibit swallow [116]. Wang et al. [117] found no difference. It has been suggested that the presence of a nasogastric tubes, by their direct stimulant effect on the pharynx helps swallow rehabilitation. The benefit from nasogastric tube feeding is probably due to the effect of providing nutrition rather than any direct effect on the swallowing mechanism.

**Percutaneous Endoscopic Gastrostomy (PEG)**

PEG feeding has becoming the enteral feeding route of choice over the last few years, due to the consistency of compliance with feeding regimens [118]. What is not certain is to whether the use of PEGS improves the swallow, or that the swallow improves as part of the general improvement seen after their placement [119,120]. A review by Gomes et al. [121] for the Cochrane Library has suggested that PEG feeding is probably safer and more effective than nasogastric tube feeding.

**Outcome Measures**

The question that needs to be asked is whether with swallowing studies, are the right questions being asked and are the right things being measured. It is always useful to know what he physiology is, and whether an intervention improves this. But the end result is an improvement in swallowing and hence quality of life. Changes to physiology do not matter if there is no change clinically.

The DOSS [122], SWALQOL [123] and FOIS [124] are useful measures in the clinical situation as it permits the clinicians to speak a common language. All studies using patients should use these scales or a common scale so that results can be pooled. Researchers in the dysphagia field need to think about a common minimum data set and there needs to be a push towards randomized trials.

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