

The Effects of Lingual Exercise in Stroke Patients with Dysphagia. (Robbins et al. 2007)

Background Dysphagia is very common after stroke and is documented in up to 76% of acute stroke patients. Dysphagia following stroke has a dramatic impact on quality of life, as well as overall health. Dysphagia can lead to such medical complications as pneumonia, dehydration, and malnutrition.

There is little evidence to support the efficacy of treatments for swallowing difficulty. “Few of the available treatment programs are designed to directly rehabilitate the neurophysiologic underpinnings of dysphagia resulting from stroke. Instead, the current practice of dysphagia rehabilitation frequently relies on teaching the patient or a caregiver to enforce compensatory measures or behavioral strategies, such as dietary modifications or reduced bolus size. Such practices can negatively impact quality of life and fail to promote an active patient role or capitalize on the neural basis of recovery post-stroke.” (Page 1)

In contrast, the literature supports that an active exercise program can promote motor re-education and resulting gains in function. This has been documented in the physiology literature, as well as in previous research by this author on the swallow system in normal, aging adults.

The purpose of this study was to assess whether patients with chronic or acute stroke who perform an 8-week progressive lingual resistance exercise program will demonstrate:

1. Increased lingual muscle strength, defined as isometric pressure generation
2. Increased lingual strength and pressures *when swallowing* as a result of the increased isometric pressure generation
3. Increased function in the swallow per measures of bolus duration, direction and clearance; as well as improved quality of life

Study Design Prospective cohort intervention study.

Methods 10 Ischemic stroke patients, ages 51-90. All subjects were screened and had a history of CVA, showed reduced lingual pressures with the anterior or posterior tongue as per pre trial assessment, and were referred by a physician for an MBS which showed asp/pen or oropharyngeal residue.

8 week lingual exercise program using the IOPI¹, targeting the anterior and posterior portions of the tongue²; 10 repetitions, 3x per day for 3 days/week.

Each participant kept a daily log to chronicle their participation in the exercise program.

A baseline maximal pressure was identified before the start of the exercise protocol. This baseline measure was the highest amount of pressure generated in 1 repetition from 2 sets of 3 trials. Subjects exercised at 60% of the baseline for the 1st week and 80% of the baseline for the remaining 7 weeks. Each subject's maximal pressure was measured again at the end of weeks 2, 4, 6 and 8 and the 80% exercise target was recalculated per this reevaluation.

Measurements The following measurements were obtained:

1. Maximal Isometric Pressure obtained using the IOPI during isometric resistive tasks. Both anterior and posterior tongue pressures were measured in 2 sets of 3 trials.
2. Swallow Pressures measured in natural swallows during an MBS using 3 air filled bulbs adhered to the roof of the mouth and attached to a monitoring device connected to the Kay Swallow Station. (Note: Only 7 of 10 subjects completed this part of the trial due in part to equipment issues.)
3. Swallow Function was assessed using measurements for 3 bolus flow parameters during the MBS: duration, direction, and clearance. These assessments were completed at baseline, week 4 and week 8. There were 11 total swallows of 4 randomly assigned bolus types; 3 swallows of 3 mL of thin, 10 mL of thin, 3 mL of a semisolid, and 2 effortful swallows of 3 mL of thin. If a subject demonstrated aspiration on any 2 consecutive swallows, this bolus was discontinued and the next bolus was trialed. The bolus flow duration was measured using standard criteria. The bolus flow direction was measured using

¹ IOPI = Iowa Oral Performance Instrument. Measures tongue pressure using an air filled bulb that is placed on the tongue blade, between the tongue and hard palate. This bulb is connected by way of plastic tubing to a pressure biofeedback device that measures the pressure change in the tubing. The user is alerted to successful achievement by a series of lights changing from red to green, as well as with numbers.

² The tongue locations were based on evidence of regional differences in the tongue tissues, as well as documented differences in use of the anterior vs. posterior portions of the tongue for pressure generation during swallowing. The oldest stroke subject was only able to perform the exercise on the anterior tongue.

the Penetration-Aspiration Scale, and the bolus flow clearance was measured using a 3-point scale with reported inter- and intrajudge reliability.

4. Quality of Life (QOL) indicators were measured using the SWAL-QOL and a dietary intake questionnaire.
5. An MRI was performed on 3 of the 10 subjects to measure lingual mass. The subjects were instructed to press their tongue tip to the back of their top teeth and hold.

Results

1. There was a significant increase in maximal isometric pressures for both the anterior and posterior tongue sites, with the greatest percentage of gains being obtained during the first 4 weeks.
2. Maximum swallowing pressures significantly increased on at least 1 of 3 trials for 10 mL of thin liquid, 3 mL thin liquid, and semisolids after 4 and 8 weeks of exercise for those who completed these trials at baseline (7/10 subjects).
3. Swallow function per the 3 bolus flow measures yielded the following results:
 - a. Clearance of residue: there was a significant decrease in overall residue for the 3mL effortful swallow, 10 mL thin liquid, and 3 mL thin liquid with the most change occurring in pharyngeal residue and a trend toward decreased average residue in the oral cavity and cricopharyngeus at week 8. The authors report that there was no significant change in average residue in the pyriform sinus region or vallecular space after 8 weeks.
 - b. Direction of bolus per the Penetration-Aspiration Scale: scores were significantly reduced indicating increased swallow function and safety for the 3 mL of thin after 4 weeks; and the 10 mL of thin after 8 weeks. The effortful swallow showed a significant decrease in airway penetration at 4 weeks; and a trend toward decreased airway penetration at 8 weeks. At the end of the 8 week trial, more of the participants were able to complete all of the MBS trials indicating decrease in episodes of aspiration.
 - c. Duration measures: there was a noted increase in oral transit duration for the 3 mL liquid and an increase in pharyngeal response duration for both 3 and 10 mL liquid in 1 / 3 trials for

those who could do these trials at baseline.

4. QOL indicators used yielded the following results: The SWAL-QOL scores showed statistically significant increases in the areas of fatigue, communication and mental health. There were benefits and increases in scores for all subscales and substantial gains noted in the burden and social subscales. 6/10 subjects reported on the questionnaire that they were now including 'difficult-to-swallow' food items to their diet after completing the swallow exercise program.
5. MRI results showed that 2/3 subjects who underwent the MRI of the tongue demonstrated an increased lingual volume after the 8 week program with an average increase of 4.35%; the third subject who completed the MRI showed a decline in lingual volume of 6.5%.

Discussion

Patients with dysphagia in this study showed:

- Increased lingual strength as evidenced by increased isometric lingual pressure generation measures after an 8-week resistive exercise program.
- Greater lingual strength during the actual swallow as evidenced by increased pressures in 3 of 4 bolus conditions. This is worth noting given that the exercise regime only consisted of isometric exercises, not swallowing trials, thereby indicating some carryover to the swallow function.
- Bolus flow measures showed a decrease in residuals and a decrease in the frequency of aspiration. At the baseline MBS, only 40% of the subjects were able to complete the entire MBS, as compared to 90% of the subjects at the post trial MBS showing again a decrease in aspiration frequency.

There is evidence to show that elderly patients are most likely to aspirate on liquid boluses. The results of this study show gains in increased swallowing pressures and function for liquids.

This study shows gain in pressure and function of the swallow but does not address changes at the muscle level alone, nor does it address neuroplastic changes. Other types of studies and measures would need to be completed to address those changes.

The authors speculate that the increased muscle mass in 2 of the 3 subjects who underwent the MRI suggests that hypertrophy may play a part in the swallow function gains. The authors further suggest that the third subject that demonstrated a decline in muscle mass may have demonstrated gains still

given his report of depression and decreased PO before the study.

Some strengths of this study include the defined exercise and study protocol based on EBP (previous studies). The authors also describe the limitations of the study and needs for further research in areas such as larger samples of specific CVA patients.

Weaknesses of this study include the fact that the bolus flow measures for duration and residue were assessed using non-validated tools, making replication of those measures challenging. Further, the lack of use of validated tools can also discredit the data that was collected relative to those specific measures.

Take home message: CVA patients with dysphagia can participate and may benefit from progressive resistive swallowing exercises to regain function in the swallow and improve QOL.

Reference

Robbins J, Kays SA, Gangnon RE, Hind JA, Hewitt AL, Gentry LR, and Taylor AJ. The effects of lingual exercise in stroke patients with dysphagia. *Arch Phys Med Rehabil* 88: 150-158, 2007.