

Review Article

Tongue Strength Training for Older Adult Dysphagic Patients

Faerella Boczko*

The New Jewish Home, Department of Speech-Language and Swallowing Disorders, New York, New York 10025, USA

*Corresponding author

Faerella Boczko, The New Jewish Home, Department of Speech-Language and Swallowing Disorders, New York, New York 10025, USA

Tel: +1-212-870-5077

Email: fboczko@jewishhome.org

Submitted: 10 January 2017

Accepted: 27 March 2017

Published: 04 April 2017

Copyright: © 2017 Boczko

OPEN ACCESS

Keywords

- Dysphagia
- Lingual exercises
- Tongue strength
- Penetration
- Aspiration
- Swallow
- IOPI

Abstract

A pilot study was conducted to determine the effect of isometric lingual exercises on swallowing function in a sample of 44 patients with dysphagia. They participated in a four-week long intervention designed to improve and strengthen swallowing function using the Iowa Oral Performance Instrument (IOPI). Patients were pre-tested and post-tested on the IOPI, ASHA NOMS swallowing level scale, and the penetration aspiration scale. Significant pre-test/post-test differences were found on all assessments for all participants, showing increased tongue strength and swallowing safety. In addition, of 25 participants for whom there were complete data, 13 were upgraded in the consistency of food they could ingest. Results suggest that lingual exercises can ameliorate some consequences of dysphagia.

Abbreviations: IOPI: Iowa Oral Performance Instrument; ASHA: American Speech Language Hearing Association; NOMS: National Outcome Measurement Scale

INTRODUCTION

Oropharyngeal dysphagia (difficulties in the oral and/or pharyngeal phases of swallowing) in the older adult is a growing health care concern. As many as 80% of individuals living in skilled nursing facilities have been reported to exhibit clinical signs of swallowing difficulty [1,2], among them: reduced effectiveness of tongue movements for propulsion of food and liquid, difficulty initiating the pharyngeal swallowing response, and poor airway protection. Consequences of dysphagia include dehydration, malnutrition, and aspiration pneumonia (the development of infection from invading material). Treatment today often involves food texture changes or a feeding tube, but these can have negative effects on the patient's quality of life.

An alternative approach to treating dysphagia has emerged over the past few years, targeting lingual muscles through strengthening exercises that are based on maximal isometric pressure tasks [3]. During swallowing, tongue motion changes the pressure applied to food and liquid by rising towards the palate and generating an anterior-to-posterior pressure wave that squeezes food and liquids backwards towards the pharynx. Alterations in tongue strength and pressure may result in disruption of bolus (food or liquid) movement from the oral cavity to the pharynx resulting in inadequate airway protection and risk of aspiration before or after the swallow. Research has shown that aspirators have significantly lower isometric tongue

pressures than nonaspirators [4].

A study was conducted to determine the effectiveness of isometric lingual exercises using the Iowa Oral Performance Instrument (IOPI Medical LLC, Carnation, WA) for measurements of tongue pressure and strength. This study occurred over a 12-month period and involved 44 patients. Patients with a diagnosis of oral-pharyngeal dysphagia were placed on the "IOPI protocol" (IP), which emphasizes resistive and progressive loading for muscle strengthening. The purpose of this study was to assess the value of isometric tongue strengthening exercises as a dysphagia treatment protocol in a geriatric long term and post acute care population.

MATERIALS AND METHODS

Participants

Sixty patients were initially enrolled in the IP, but 16 were lost due to refusal/inability to complete FEES or to discharge prior to completing 2 weeks of lingual exercises. Thus, 44 patients participated in the protocol for more than 2 weeks, with 25 completing the protocol (Table 1). Demographic information was obtained from the patient's medical record at the onset of therapy. Twenty-eight males and 16 females participated in the IP. Of the 44 patients who participated in the protocol, the mean age was 79.56 years with a SD on 9.57. Assessment of education revealed:

8 completed elementary school, 7 completed high school, 6 had some college, 12 completed college, and 11 completed graduate/post graduate school.

Table 1: Pre-treatment/Post-treatment Results for the IOPI, P/A Scale, and ASHA NOMS Swallowing Scale

Variable	N	Pre-treatment		Post-treatment		F	η^2	Observed Power
		M	SD	M	SD			
IOPI (kPa)	44	26.99	11.66	36.82	14.73	52.91	0.55	1
P/A Scale	25	5.64	2.5	3.04	2.39	20.69	0.46	0.99
NOMS Swallowing Scale	25	2.68	1.31	3.4	1.35	146.07	0.86	1

Notes: All F-ratios significant beyond the $p < .001$ level. Df: IOPI, 1, 43; P/A Scale, Dysphagia Scale, 1, 24

Participants' medical diagnoses were: 9 with aspiration pneumonia, 8 recurrent pneumonia, 9 with post cerebral vascular disease, 4 with Parkinson's disease, 3 with pulmonary disorders, 3 with head and neck cancer, 3 with intracerebral bleeding, 2 with chronic heart failure, 2 were idiopathic, and 1 with transient ischemic accident. The rehabilitation needs for each patient were determined using a coordinated multidisciplinary team approach with input from medical doctors, nurses, social workers, and physical and occupational therapists. Participants had been referred by their physician for a clinical bedside swallowing evaluation. Criteria for inclusion in the study were lingual weakness as observed on the oral motor portion of the evaluation that resulted in oral/pharyngeal dysphagia, and the ability to follow one step oral motor commands. Patients were excluded if tongue exercise would increase weakness, for example, in patients with multiple sclerosis, or myasthenia gravis.

Instrumentation

The IOPI measures the pressure generated when an air filled bulb is compressed between the tongue and hard palate [5]. The IOPI device assesses tongue strength by measuring the pressure that patients can exert upon a disposable tongue bulb by pressing the bulb against the palate with their tongues. The tongue bulb is attached to the device with a connecting tube, and the base of the bulb is lined up posterior to the front teeth. The peak pressure is displayed on an LCD screen. The tongue bulbs are single patient use.

Solomon et al. reported moderate to strong correlations (r_s between .54 and .67) between IOPI measures and clinical assessments by SLPs [6]. No learning or fatigue effects were observed. Repeated measures reveal little error, suggesting reliability over time. Yoshikawa and associates use the IOPI as the criterion for assessing the validity of a new device that they were testing: scores on the two devices correlated at .69 [7]. The authors noted that the IOPI was easy to use and that they made it the benchmark for the new device they had developed.

Besides measuring tongue strength, the IOPI can be used for tongue exercises [7]. Lingual pressure is translated to a vertical array of light emitting diodes. When more pressure is exerted on the bulb, progressively higher lights turn on, providing

biofeedback and positive reinforcement. The clinician sets the target pressure on this biofeedback light array and instructs the patient to squeeze and hold the tongue bulb so that the topmost light stays on for about 30 seconds.

Initial and discharge scores for swallowing abilities were assigned by using the American Speech-Language Hearing Association (ASHA) National Outcome Measurement System (NOMS) swallowing level scale developed by the National Center for Treatment of Effectiveness in Communication Disorders [8]. This is designed to measure both the patient supervision level required and his/her diet level by assigning a single number between 1-7, with 1 indicating that the patient cannot swallow anything safely by mouth and 7 indicating that swallowing would be safe for all liquid and food consistencies. Intermediate levels reflect swallowing capabilities, compensatory strategies, and intensities of SLP intervention [9]. Diet recommendations pre and post intervention were collected in order to identify changes.

The eight point Penetration Aspiration Scale (P/A) was used for the measurement of penetration aspiration in conjunction with Fiberoptic Endoscopic Evaluation of Swallowing (FEES[®]). The penetration aspiration scale assesses the depth that ingested material enters the airway and whether or not it is expelled [5,10]. Penetration is assessed in increasing depth from 1-5, with 1 indicating no penetration. Increasing levels of aspiration are scored from 6-8. It has been tested for interrater reliability with high levels of agreement [11,12]. Assessments of convergent, divergent, and construct validity have been positive [5,12].

Procedures

When potential participants were identified, they were invited by the researchers to participate in the intervention program. The researchers advised participants of the nature of their participation, risks and benefits, and rights to confidentiality, refusal without retribution, and access to the findings of the study. They were provided with access to the researchers by phone or email. Once assent was granted, participants were pre-tested on the IOPI, severity of dysphagia using FEES[®] and the P/A scale, and the ASHA NOMS Swallowing Scale.

The protocol established at the start of the evaluation consisted of a 4-week program. Therapy sessions were held five days a week for the next four weeks with each session taking approximately 30-45 minutes to complete. During each session, the patient performed 30 repetitions on the IOPI. During the first week, the 30 repetitions per day were to be performed at 60% of the average maximum value recorded on the first day; during the second week, at 80% of that value. At the beginning of Week 3, a new average maximum value was established using the same procedures as on Day 1, but during Weeks 3 and 4, participants were asked to perform the daily repetitions at least at 80% of the new average maximum value. Maximum peak value on the IOPI was measured on the final day of therapy. Maximum anterior lingual pressure, measured in kilopascals (kPa), was determined from maximum peak pressures sampled at various intervals during therapy. FEES[®] was conducted twice on the participants in order to assess severity of dysphagia and measure Penetration/

Aspiration (P/A).

RESULTS

Patients' tongue strength and swallowing performances were assessed using the IOPI, the P/A Scale, and the ASHA NOMS Scale pre-treatment and post-treatment. Data were available for 44 patients on the IOPI and for 25 patients each on the P/A Scale and the ASHA NOMS Swallowing Scale. Pre-treatment/post-treatment results were assessed using repeated measures analysis of variance. Table 1 contains the results of those analyses.

Pre-treatment tongue pressures of the 44 subjects on the IOPI revealed a mean score of 26.99 kPa ($SD = 11.66$); posttest pressures revealed a mean score of 36.82 kPa ($SD = 14.73$). This difference was indicative of a significant increase in tongue pressure from pre-treatment to post-treatment ($F_{[1,43]} = 14.73, p < .001$). Pre-treatment/post-treatment differences accounted for 55% ($\eta^2 = .55$) of the total within-subjects variance.

Scores on the P/A scale decreased from a mean of 5.64 ($SD = 2.50$) to 3.04 ($SD = 2.39$), indicating a significant decline in penetration and aspiration from pretreatment to post treatment ($F_{[1,24]} = 20.69, p < .001$). Pre-treatment/post-treatment differences accounted for 46% of the within-subjects variance. Scores on the NOMS Swallowing Scale increased from 2.68 ($SD = 1.31$) to 3.40 ($SD = 1.35$), indicating a significant improvement in swallowing function from pre-treatment to post-treatment ($F_{[1,24]} = 146.07, p < .001$). Pre-treatment/post-treatment differences accounted for 86% of the within-subjects variance.

Changes in oral feeding were made in both liquid and food categories. Diet consistency recommendations following FEES were analyzed. 52% of the patients ($N=25$) had upgraded diet consistency recommendations from initial to final FEES®, conducted prior to discharge from the study. Assuming random diet changes without intervention, observed changes were statistically significant ($\chi^2 = 12.13, 2 \text{ df}, p < .01$). Diet changes in both food and liquid consistency were also analyzed. Food only changes were noted in a total of 16% ($N=4$) of the patients. Changes in liquid only were observed in 12% ($N=3$) of the patients. Changes in both food and liquid were noted in 24% ($N=6$) of the patients. Descriptive data are contained in Table 2.

Table 2: Dietary Changes among Study Participants ($N = 13$)

Number of patients	Diet following initial FEES®	Diet following final FEES®
2	NPO	Snacks(puree)
4	NPO	Puree
1	NPO	Soft
2	Honey-thick liquids	Nectar-thick liquids
1	Puree	Ground
1	Puree	Soft
2	Soft	Regular

Abbreviations: IOPI: Iowa Oral Performance Instrument; P/A: Penetration/Aspiration; ASHA: American Speech Language Hearing Association; NOMS: National Outcome Measurement Scale; FEES: Fiberoptic Endoscopic Evaluation of Swallowing; NPO: Nothing by mouth

Six participants improved from nothing by mouth to eating puree consistency food, 1 changed from nothing by mouth to eating soft consistency diet, 2 improved from drinking a honey thick liquid to drinking a less thick liquid of nectar, 1 changed from a puree diet to eating an upgraded ground diet, 1 went from eating a puree diet to an upgraded soft consistency diet, and 2 were upgraded from eating a soft diet to a regular diet.

DISCUSSION

The findings of the study indicate that the intervention using the IOPI protocol was able to help patients increase their tongue pressure when swallowing which served to improve their swallowing safety and oral intake. It was found that patients evidenced significantly lower levels of penetration and aspiration. Signs of dysphagia decreased significantly. All statistical differences were strong and the power of inference was high, providing confidence in the findings.

Although the findings of the study were extremely encouraging, the research design was only quasi-experimental and, therefore, subject to limitations because of possible challenges to internal validity [13]. The desire to see improvement could perhaps influence SLPs' assessment techniques in a positive direction from pretest to posttest. The present study also lacked a control group, but it was conceived as a pilot study because putting some patients at the same host institution on a waiting list might have seemed unethical. This is, therefore, only a preliminary study, but the results suggest that exercise-based approaches to swallowing rehabilitation improves tongue muscle strength and function, and thus swallowing safety, in the older patient.

CONCLUSION

Dysphagia is increasingly recognized as disorder secondary to a variety of etiologies that increase in prevalence with age; therefore, as the population ages, so too will the number of people living with dysphagia. The evidence presented here suggests that an exercise-based approach to swallowing disorder treatment improves lingual muscle strength and swallowing function.

ACKNOWLEDGEMENT

We are grateful for the support of the Peter A. & Elizabeth S. Cohn Foundation. We are also very grateful to three anonymous reviewers for their comments and peer-review.

DISCLOSURE

The author declares no conflicts of interest.

REFERENCES

1. Steele CM, Greenwood C, Ens I, Robertson C, Seidman-Carlson R. Mealtime difficulties in a home for the aged: not just dysphagia. *Dysphagia*. 1997; 12(1): 43-50.
2. Chen P, Golub JS, Hapner ER, Johns MM, III. Prevalence of perceived dysphagia and quality-of-life impairment in a geriatric population. *Dysphagia* (0179051X). 2009; 24(1): 1-6.

3. Robbins J, Gangnon RE, Theis SM, Kays SA, Hewitt AL, Hind JA. The effects of lingual exercise on swallowing in older adults. *Journal of the American Geriatrics Society*. 2005; 53(9): 1483-1489.
4. Steele CM, Cichero JAY. Physiological factors related to aspiration risk: a systematic review. *Dysphagia*. 2014; 29(3): 295-304.
5. Rosenbek JC, Robbins JA, Roecker EB, Coyle JL, Wood JL. A penetration-aspiration scale. *Dysphagia*. 1996; 11(2): 93-98.
6. Solomon NP, Clark HM, Makashay MJ, Newman LA. Assessment of orofacial strength in patients with dysarthria. *Journal of Medical Speech-Language Pathology*. 2008; 16(4): 251-258.
7. Yoshikawa M, Yoshida M, Tsuga K, Akagawa Y, Groher ME. Comparison of three types of tongue pressure measurement devices. *Dysphagia*. 2011; 26(3): 232-237.
8. American Speech-Language-Hearing Association. National Outcomes Measurements System (NOMS): Adult Speech-Language Pathology Training Manual. Rockville, MD: ASHA; 1998.
9. American Speech-Language-Hearing Association. NOMS: Adults in health care, functional communication measures speech-language pathology Rockville, MD: ASHA; 2013.
10. Robbins J, Coyle J, Rosenbek J, Roecker E, Wood J. Differentiation of normal and abnormal airway protection during swallowing using the penetration-aspiration scale. *Dysphagia*. 1999; 14(4): 228-232.
11. Hind JA, Gensler G, Brandt DK, Gardner PJM, Blumenthal L, Gramigna GD, et al. Comparison of trained clinician ratings with expert ratings of aspiration on videofluoroscopic images from a randomized clinical trial. *Dysphagia*. 2009; 24(2): 211-217.
12. Martin-Harris B, Brodsky MB, Michel Y, Castell DO, Schleicher M, Sandidge J, et al. MBS measurement tool for swallow impairment-MBSImp: establishing a standard. *Dysphagia*. 2008; 23(4): 392-405.
13. Campbell DT, Fiske DW. Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*. 1959; 56(2): 81-105.

About the Corresponding Author

Faerella Boczko

Summary of background:

Faerella Boczko, MS, CCC-SLP, BCS-S, is a Board Certified Specialist in Swallowing and Swallowing Disorders. She is Director of the Department of Speech-Language and Swallowing Disorders, The New Jewish Home, New York. Faerella Boczko has served as principal investigator to two research grants, authored book chapters, published research articles, and presented at numerous international and state professional society meetings. She has over 35 years experience working with the geriatric population. Most recently, she is the recipient of the "Professional of The Year" award, LeadingAge, New York.

Websites:

www.jewishhome.org
www.swallowingdisorders.org
LinkedIn - <https://www.linkedin.com/in/faerella-boczko-88557b4a/>

Permanent e-mail address:

fboczko@jewishhome.org
fboczko@gmail.com

Journal of Preventive Medicine & Healthcare

Journal of Preventive Medicine & Healthcare is an international, peer-reviewed journal that aims to publish scholarly papers of highest quality and significance in the field of preventive medicine & healthcare. The journal publishes original research articles, review articles, clinical reports, case studies, commentaries, editorials, and letters to the Editor.

For more information please visit us at following:

Aims and Scopes: <https://www.jscimedcentral.com/PreventiveMedicine/aims-scope.php>

Editorial Board: <https://www.jscimedcentral.com/PreventiveMedicine/editors.php>

Author Guidelines: <https://www.jscimedcentral.com/PreventiveMedicine/submitpaper.php>

Submit your manuscript or e-mail your questions at preventivemedicine@jscimedcentral.com

Cite this article

Boczko F (2017) Tongue Strength Training for Older Adult Dysphagic Patients. *J Prev Med Healthc* 1(1): 1004