Tongue Strength Training for Older Adult Dysphagic Patients

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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.

Keywords

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

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:

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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 (rs 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/
Patients’ tongue pressure 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 = 12.13, 2 df, p < .001). Pre-treatment/post-treatment differences accounted for 55% (η² = .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 = 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 = 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 (χ² = 12.13, 2 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 19% (N=6) 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)

<table>
<thead>
<tr>
<th>Number of patients</th>
<th>Diet following initial FEES</th>
<th>Diet following final FEES</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>NPO</td>
<td>Snacks (puree)</td>
</tr>
<tr>
<td>4</td>
<td>NPO</td>
<td>Puree</td>
</tr>
<tr>
<td>1</td>
<td>NPO</td>
<td>Soft</td>
</tr>
<tr>
<td>2</td>
<td>Honey-thick liquids</td>
<td>Nectar-thick liquids</td>
</tr>
<tr>
<td>1</td>
<td>Puree</td>
<td>Ground</td>
</tr>
<tr>
<td>1</td>
<td>Puree</td>
<td>Soft</td>
</tr>
<tr>
<td>2</td>
<td>Soft</td>
<td>Regular</td>
</tr>
</tbody>
</table>

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

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 rehabilitation improves tongue muscle strength and function, and thus swallowing safety, in the older patient.

DISCLOSURE

The author declares no conflicts of interest.

REFERENCES


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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.

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