

Examining the Efficacy of Long-Term versus Short-term intervention and that randomized the participants Individual Swallowing Therapy to Improve Optimal Swallowing Physiology in Geriatric Individuals with Dysphagia

Cağla ELİKÜCÜ¹, Fatma ESEN AYDINLI², Didem ŞENER DEDE³, Karabekir ERCAN⁴

1. Ankara Bilkent City Hospital Language and Speech Therapy Unit Dysphagia Clinic

Speech Language Pathologist, Expert & Hacettepe University Faculty of Health Sciences
Department of Speech and Language Therapy, Phd(c), Corresponding Author

2. Hacettepe University Faculty of Health Sciences Department of Speech and Language
Therapy, Speech Language Pathologist, Associate Professor

3. Ankara Bilkent City Hospital Medical Oncology Department, Medical Doctor, Professor
doctor

4. Ankara Bilkent City Hospital Radiology Department, Medical Doctor, Specialist

Abstract

Aim: The aim of this study is to compare the effectiveness of short-term (6 weeks) and long-term (12 weeks) individual swallowing therapy program in geriatric individuals diagnosed with dysphagia through instrumental evaluation.

Method: 127 participants with a mean age of 66.82 ± 16.39 (min=66, max=83) were included in the study. At the beginning of the study, the recordings of the Videofluoroscopy Swallow Study / Modified barium swallow study were scanned and examined, and those with the same dysphagia severity finding who had problems in swallowing safety and efficiency were determined. Patients were randomly assigned to either a short-term intervention group (six weeks; n=62, 48.8%,) or a long-term intervention group (12 weeks; n=65, 51.2%). During Videofluoroscopy, patients were scored with the Penetration-Aspiration Scale by giving food in different consistencies (thin liquid, honey, nectar, pudding, solid consistency) according to the International Dysphagia Dietary Standardization Initiative protocol. Functional Oral Intake Scale and Turkish Eating Assessment Tool results were compared between the groups receiving long-term and short-term swallowing therapy. An exercise-based individual swallowing therapy program was applied to both groups.

Results: Penetration aspiration score was higher in the short-term therapy group than in the long-term group. There was a significant difference between the post-therapy penetration aspiration scores of individuals who received long-term and short-term therapy ($p < 0.001$). Pharyngeal phase abnormalities were detected in 81 patients (88.4%), and laryngeal penetration/aspiration status was found in 78 patients (85.3%). Both variables were found to be significantly higher in the short-term group ($p: 0.015$; $p: 0.014$). Turkish eating assessment tool scores were found to be 21.51 ± 3.84 in the long-term group after therapy ($p < 0.05$). Silent aspiration of thin liquid and nectar consistency was experienced in 69% of the patients before the therapy.

Conclusion: Long-term swallowing therapy program was proved to be more effective than short-term in geriatric individuals with dysphagia.

Key Words: Dysphagia, aged, swallowing problems, Videofluoroscopy, Modify Barium Swallowing Study, swallowing therapy

INTRODUCTION

Safe and effective swallowing is a highly complex neuromuscular process. The pharynx must quickly reorganize from a breathing configuration to a swallowing configuration (1). As a result of instrumental evaluations in geriatric individuals, unsafe (the bolus enters the laryngeal vestibule, carries the risk of aspiration into the lungs) and inefficient swallowing (presence of residue) are observed (2). In this group; Disturbances in the pharyngeal phase, decreased posterior movement of the tongue root, impaired velopharyngeal closure, delayed swallowing reflex, decreased pharyngeal contraction, decreased hyolaryngeal elevation, impaired laryngeal vestibule closure, decreased Upper Esophageal Sphincter (UES) opening, increased pharyngeal residue and aspiration can be observed (2). Due to deterioration in the timing, strength and coordination of velopharyngeal structures of swallowing, Pharyngeal clearance cannot be fully achieved; residual and aspiration may be observed. Silent aspiration may be observed due to sensory impairment (2).

Dysphagia management includes the implementation of compensatory strategies and/or rehabilitation exercises to optimize a person's swallowing safety and efficiency (1,2). The prevalence of dysphagia in the geriatric population ranges from 7% to 22%, and this rate rises to 40% to 50% in patients requiring long-term care (3). Age-related atrophy of the swallowing muscles (sarcopenia) is accepted as a common explanation for age-related decline in swallowing function. Weakness is observed in the tongue, geniohyoid muscle, and pharyngeal constrictor muscles (3). In the geriatric population, age-related changes affecting swallowing physiology and accompanying comorbid conditions make these individuals more at risk for aspiration (3).

Videofluoroscopic swallowing assessment (Videofluoroscopic Swallowing Study (VFSS), also known as Modified Barium Swallowing Study (MBSS)) is a radiographic procedure that provides direct and dynamic visualization of oral, pharyngeal and esophageal function during swallowing (4). Patterns that disrupt swallowing physiology and their consequences are identified. The effect of compensatory strategies is examined and the swallowing safety of the

patient is determined. Evaluation is done by speech and language therapists accompanied by a radiologist using a fluoroscopy device. The passage of the bolus and physiology is observed during the oral, pharyngeal and esophageal phases of swallowing, by providing the patient with food and beverages containing radiopaque substances in different consistencies and amounts. Performing VFSS as an instrumental evaluation in addition to clinical evaluation in swallowing disorders; considered as the gold standard in the dysphagia plan literature. Both during the test and at the end of the test, the speech and language therapist monitors the images, interprets them and determines the appropriate dysphagia plan (3, 4).

With the early detection of dysphagia, necessary precautions can be taken, it can be tried to be prevented before the negative consequences of dysphagia, the quality of life of the patients can be increased and the morbidity and mortality rate can decrease (5). An important point is to support the caregivers to be cautious in the face of any situation by following the home program and counseling on diet modification, consistency and amount of the diet (6). Therefore, in our study, the protocol of teaching the family and caregivers what to do by developing personalized treatment strategies in geriatric patients with dysphagia has an important place.

There are limited studies investigating the effects of swallowing therapy in older adult populations with dysphagia (4,5,6). Koyoma et al.(2015) found that the long-term swallowing rehabilitation program shortened the transition time to oral intake in patients with sarcopenia-induced dysphagia (7). Momosaki et al. (2015), on the other hand, found low mortality rates in the dysphagia group due to aspiration pneumonia as a result of the swallowing rehabilitation program that lasted for 12 weeks (8). In another study, Park et al.(2016) found that Penetration Aspiration Scale (PAS) scores in thin liquid consistency decreased, Functional Oral Intake Scale (FOIS) scores increased, cough reflex increased, and expiratory cough flow peak increased after swallowing therapy in the dysphagia group due to respiratory disorders(9). In this study it is hypothesized that a long-term swallowing therapy program is more effective than a short-term program in geriatric individuals with dysphagia (9). The aim of the study is to compare the effectiveness of short-term (6 weeks) and long-term (12 weeks) individual swallowing therapy program in geriatric individuals diagnosed with dysphagia through instrumental evaluation.

METHOD

This study consists of patients who were consulted to the speech and language therapy department from the medical oncology and radiology department. The study was conducted in accordance with international ethical standards and the Declaration of the World Medical Association of Helsinki. The study was approved by No. 1 Clinical Research Ethics Committee of Ankara City Hospital Ethics Committee (Approval No: E1-22-3049). In our ethical statement, written informed consent to participate in this study was obtained. There is no funding for the study. All data generated or analysed during this study are included in this article. Further enquires can be directed to the corresponding author. The names and protocol numbers of the patients who were consulted by the Medical Oncology Unit for Velopharyngeal Cinefluoroscopy with 802.330 ICD code between 01.04.2019-30.09.2022 were retrospectively analyzed. Inclusion criteria for the research is the presence of difficulty swallowing complaints. According to the information obtained from the medical records, 22.4% of the patients suffered from advanced laryngeal cancer (T3a, T3b, T4a), 18.7% had respiratory disorders, 15.8% had gastrointestinal disorders, 21.1% had sarcopenia-related dysphagia, 14.7% had pre-diagnosis of aspiration pneumonia, 7.3% had metabolic disorders. Patients who could not adapt to the test (those with severe psychiatric condition such as schizophrenia, those who need the use of a neurological test battery, mental retardation), Acquired Language Disorder (Aphasia, Dysarthria, post-cerebrovascular disease, etc.), the patient group whose alertness and cognitive status is not suitable and the patients with positive PCR test result cannot participate in the study. At the beginning of our study, the VFSS recordings were scanned and the patients who had problems in swallowing safety and effectiveness and who had the same dysphagia severity finding were divided into two therapy groups. Randomly, patients who received 12-week therapy were put into long-term therapy group (LT- 51.2%, n=65) and patients who received 6-week therapy were put into short-term (ST- 48.8%, n=62) therapy group. Patients who were to receive 6- or 12-week therapy were randomly assigned to the short or the long-term groups based on the VFSS results. It also was clear as to how soon after admission the patients underwent VFSS assessment (in fifty days -all patients) 127 participants with a mean age of 66.82 ± 16.39 (min=65, max=83) were included in the study. Signs of silent aspiration (the appearance of a bolus of fluid or mash under the true vocal folds without coughing during the VFSS examination) were examined. 6 week-swallowing therapy was applied to the short-term

group and 12 week- swallowing therapy was applied to the long-term group. Severe impairment of oral intake has been defined as a FOIS score of <5 (10). We were the FOIS and EAT-10 administered prior to the VFSS.

Clinical swallowing evaluation results, dysphagia severity results, presence of swallowing evaluation scale used, feeding patterns of patients (NG, PEG, etc.), transition time to oral feeding in geriatric patients were examined through scanning the records. Patients with all these findings who voluntarily accepted to receive therapy were included in the study. A second evaluation was made between 1 week and 10 days after the last therapy session.

The main complaints of the patients, when their complaints started and how they progressed, what food types their complaints were related to and how they appeared, possible pneumonia history, dietary habits and reflux symptoms were recorded by scanning clinical swallowing evaluation records. Nutritional style, diet level, presence of tracheotomy tube, presence or history of endotracheal tube, need for aspiration (suction), complaints such as coughing during eating and drinking, voice change, feeling of suffocation and choking, weight loss, nutritional deficiency, not consuming enough fluid, physical condition and additional barriers were examined. The patient's respiratory status, blood oxygen saturation level, respiratory rate and need for respiratory support were recorded during a hospitalization. And also chest infection was defined by presentation of a least three symptoms: fever>38 degrees Celsius, productive cough, abnormal respiratory exam [tachypnea (>22/min)], tachycardia, inspiratory crackles, bronchial breathing], arterial hypoxemia (PO₂<70 mmHg), culture of a relevant pathogen, and /or positive chest radiograph in a patient with suspected chest infection.

Assessment / Evaluation Tools

FOIS (Functional Oral Intake Scale) Form

The Functional Oral Intake Scale (FOIS), which shows the functional levels of the patients in their diet, is a scale developed by Crary et al. in 2005 (19). It grades the functional level of oral intake in 7 steps according to the solid and liquid food that individuals take orally. The level of functional oral intake scale is determined by questioning the oral intake status of the patient (1-2-3: non-oral nutrition, 4-7: oral nutrition. 7: normal).

Eating Assessment Tool (Eat-10) Form

The EAT-10 is a self-scoring scale that scores the perceived extent of dysphagia by the patient. A total of 10 questions are asked while applying EAT 10, which is simple, easily applicable, and enables us to obtain information about dysphagia symptoms in individuals and to estimate the risk of aspiration. The measuring items are in clear language. The total score obtained from the questionnaire is an important guide for the patient's swallowing disorder. Scoring is done by taking the answers scored from 0-4 for each question, from no problem to severe. The highest score achieved is 40. High scores indicate severe swallowing difficulties. The Turkish validity and reliability of this scale was determined by Demir et al. (2016) (11).

PAS (Penetration and Aspiration Scale) Form

It is important to determine the penetration and aspiration severity in the evaluation of the treatment indication in swallowing disorders. In order to increase the power of instrumental techniques, various rating scales have been developed to express clinical status and aspiration severity. PAS provides information about the presence and severity of aspiration and penetration. It is preferred in our study because it is widely used in the clinic. PAS, which was developed by Rosenbek et al. (1996) to determine the severity in patients with aspiration and penetration, rates the penetration aspiration score between 1-8 (12). According to this scale, 1 point means no penetration and aspiration, 2-5 points means penetration, and 6-8 points means aspiration. The Turkish interpersonal reliability study of this scale was conducted by Karaduman et al. (2012) (13).

Videofluoroscopic Ingestion Evaluation

Videofluoroscopic swallowing evaluation was carried out in Ankara City Hospital, Department of Radiology, General Hospital, General Radiology, Fluoroscopy room. CONNEXITY GE, 01144/TAEK77555 Fluoroscopy System (GE Healthcare Medical Systems, France 2012) was used, images was taken at 25 frames per second (fps). Velopharyngeal Cinefluoroscopy procedure with 802.330 ICD code must be made by the Medical Oncology Unit before the protocol. In the protocol, lateral and antero-posterior imaging were performed on the individuals. Before starting the videofluoroscopic swallowing evaluation, the materials to be used during the test were prepared according to the criteria determined by IDDSI. Then, the

procedure to be applied to the individuals was explained in detail and information was given about what is expected from them. Management of the Dysphagia Plan was performed (Figure 1). Before the contrast agent was given to the patient, Glomerular Filtration Rate (GFR) value was checked, which is a procedure of our hospital.

Preparation of Test Materials:

Thin liquid, nectar, honey, pudding and solid consistencies were used in the test materials as specified in the IDDSI protocol. Water as thin liquid and water mixed with Nestle Resource Thicken Up thickener was used to adjust the consistency of nectar, honey and pudding. First of all, the contrast agent named Omnipaque (350 mgI/ml) containing 100 ml of iohexol active ingredient was added to 100 ml of water in 1/1 measure. Then, for consistency adjustments, as specified in the thickener product prospectus, 1 measure of thickener was added to 100 ml of water for nectar consistency, 2 scales for honey consistency, and 3 scales for pudding consistency. IDDSI flow test was applied to ensure that the consistency of the prepared materials was suitable for the desired level.

Presentation of Test Materials:

All food presentations during testing including the guidelines were performed as outlined in the IDDSI protocol. During lateral imaging, 5 ml of thin liquid was given 2 times with a teaspoon, and the command "Hold this liquid in your mouth, swallow when I say" was given each time. Then, the glass containing thin liquid was given to the individual, and the command was given to "take a normal sip from the glass, hold it in your mouth until I say swallow". Subsequently, the command "drink the water in the glass at your normal speed until I say stop" was given and subsequent swallowing was ensured. Nectar consistency was presented as 5 ml (1 teaspoon), a normal sip from the glass and consecutive drinking from the glass, using the same commands. Honey consistency and pudding consistency, was presented by giving 5 ml (1 teaspoon) and saying "Keep it in your mouth until I say swallow". For solid consistency, petit pastry biscuit measuring 2.54 cm x 2.54 cm x 0.63 cm, 3 ml pudding consistency coated with material containing contrast agent was used. At the same time, "Chew and swallow this as you have always done." command was given.

Interpreting the Shots:

The recordings were recorded in the fluoroscopy system, taken from the system with an external hard disk, and viewed later by using the Radiart software. A PAS score of 1 indicates that there is no penetration or aspiration during swallowing and that the normal airway is preserved. Scores of two to 5 are considered penetration, indicating that the bolus has entered the larynx but not below the vocal folds. Scores between six and 8 are considered aspiration, meaning food has passed under the vocal folds. Penetration-aspiration scale level was determined for each consistency at the same time as the PAS scoring was done, as recommended by the protocol. Total scores were calculated and recorded. To assess the reliability of test interpretation, 20% of all tests were interpreted by a second language and speech therapist who is blind to all other variables. In terms of the reliability of the analyses, a correlation was determined between the findings of both evaluators.

Dysphagia Plan Management: Swallowing Therapy Protocol

An individual swallowing therapy program consisting of oral hygiene, thermal tactile stimulus, diet modification, postural changes, swallowing strategies, compensatory maneuvers (effortful swallowing, super supraglottic maneuver, Masako maneuver, supraglottic maneuver, Mendelsohn maneuver), swallowing exercises (shaker, lingual resistance/ tongue base exercise, effortful pitch glide, vocal fold (VF) adduction exercises) was applied to both groups (13,14). Exercises protocol is given in Table 1(16,17). Therapy sessions were determined to be once a week (45 minutes) for each participant. Each participant in the study performed the swallowing exercises shown in the therapy sessions; applied in their daily home programs and completed the therapy follow-up checklist. Two times in a week were the subjects instructed to perform the swallow exercises at home. The frequency and dosage of the exercises was 24 repetitions/session or 12 repetitions/session, two times or one times number of sessions per day. Some of the exercise instructions are given in Figure 1.

Statistical Analysis

For statistical analysis and calculations, IBM SPSS Statistics 26.0 (IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp.) program was used. The Shapiro-Wilk test was used to assess whether the variables in the study were in normal

distribution or not. The median (Minimum-Maximum) values are given when displaying the descriptive statistics of the variables. Number (n) and percentage values are given in the representation of the variables obtained within the scope of the study. The impact of group factor (long-term therapy and short-term therapy), time factor (6 weeks and 12 weeks of therapy), and the interaction of both factors on PAS scores were examined within the scope of Mixed Pattern ANOVA. The impact of time factor on FOIS scores was examined through the chi-square test. For the EAT-10 score, paired sample t-test was performed between the long-term and short-term pre-therapy and post-therapy factors. The statistical significance level was accepted as $p < 0.05$. In order to avoid the bias of the study, both the patients and the experts who performed the measurement were not informed about which group the patients were in (double blinding). A double-blind evaluation of the VFSS findings was conducted by a PhD candidate studying speech rehabilitation and a professional physician with many years of experience in diagnosing dysphagia. The two doctors independently completed the evaluation. Any discrepancies between the two researchers were reconciled by discussion between these two individuals before determining the final results.

Results

Demographic information

127 patients who signed the informed consent form participated in the study. Patients who received 12 weeks of therapy were divided into long-term (LT) (51.2%, $n=65$) therapy groups, and patients who received 6 weeks of therapy were divided into short-term (ST) (48.8%, $n=62$) therapy groups. 127 participants ($M=81$, $F=46$) with a mean age of 66.82 ± 16.39 ($\text{min}=66$, $\text{max}=83$) participated in the study.

According to the information obtained from their medical records, 22.4% ($n=29$) of the patients had advanced laryngeal cancer -these patients who were treated with surgery/chemoradiotherapy/combined surgery chemoradiotherapy (T3a, T3b, T4a), 18.7% ($n=24$) had respiratory disorders, 15.8% ($n=20$) had gastrointestinal disorders, 21.1% ($n=26$) had dysphagia due to sarcopenia, 14.7% ($n=19$) had prediagnosis of iatrogenic aspiration pneumonia and 7.3% ($n=9$) had metabolic disorder problem.

Findings of the videofluoroscopic swallowing study in patients with dysphagia

Of the patients, 109 experienced penetration or aspiration (84.6%). The median penetration score of 28 patients in the oral and pharyngeal phases was found to be 5. Aspiration scores in pharyngeal phase problems were 6 of 36 patients (residue at subglottic level). Pharyngeal phase abnormalities were detected in 81 patients (88.4%) in the VFSS study (Table 2). The mean hospital stay was between 27.1 ± 1.5 days for the long term and 36.2 ± 2.4 for the short term. There is as to when during the hospital stay the VFSS was performed, one week from admission to initiation of the swallow therapy program. A second evaluation was made between 1 week and 10 days after the last therapy session. 4 participants were excluded from the study due to the cause of death, 8 participants were excluded from the study due to their inability to continue the therapy, and 2 participants were excluded from the study due to the inability to tolerate the videofluoroscopic swallowing study. Each participant included in our study completed a 12-week (8 sessions) and 24-week (12 sessions) swallowing therapy program.

Dysphagia management

An individual swallowing therapy program consisting of oral hygiene, thermal tactile stimuli, diet modification, postural changes, swallowing strategies, compensatory maneuvers (effortful swallowing, super supraglottic maneuver, supraglottic maneuver, mendelsohn maneuver) and swallowing exercises (shaker, tongue strengthening exercises, effortful pitch glide, vocal fold adduction exercises) was applied to both groups.

Findings of FOIS and EAT-10 scores

The FOIS score of 42.9% (n=45) of individuals who received long-term therapy was 5, 36.1% (n=38) had 4, and 21.0% (n=22) had 3. No significant relationship was detected between the FOIS score and the duration of therapy ($p > 0.05$). That is, the distribution of FOIS scores of individuals receiving long-term and short-term therapy is similar. As a result of paired sample t-test analysis of Teat-10 scores of long-term and short-term geriatric patients after the therapy, it was detected that swallowing parameters in the short-term group were 68.22 ± 1.42 before the therapy and 32.94 ± 2.58 after the therapy while it was 67.61 ± 2.33 before the therapy and 21.51 ± 3.84 after the therapy in the long-term group ($p < 0.05$) (Table 3).

Findings of PAS scores

While the median of thin-liquid PAS scores of individuals receiving long-term therapy is 7.00 (min=5.00, max=8.00), the median of PAS scores after the therapy is 4.00 (min=3.00, max=6.00). The median PAS scores of individuals receiving short-term therapy before the therapy is 7.00 (min=1.00, max=8.00), and the median PAS scores after the therapy is 6.00 (min=4.00, max=8.00). Significant difference was found between PAS scores of individuals who received long-term and short-term therapy after the end of the therapy ($p<0.001$). Similarly, there is a significant difference between PAS scores of the individuals after long-term and short-term therapy ($p<0.001$). A significant correlation was found between the aspiration status of different consistencies and the duration of therapy as a result of the chi-square test ($p=0.049$). The aspiration status of individuals receiving long-term and short-term therapy is significantly different (Table 4).

Pharyngeal phase abnormalities were found to be significantly higher in the short-term group ($p:0.015$). After the instrumental evaluation before the therapy, loss of strength in pharyngeal constrictors due to aging, the need for multiple swallowing to clear the pharynx, low thrust force (tilti) as a result of tongue movement, prolongation of oral and pharyngeal transit time, decrease in hyolaryngeal elevation, decrease in laryngeal delay in vestibule closure, decrease in the opening of the upper esophageal sphincter, decrease in the sensitivity of the pharynx and supraglottic area, slowdown in oral and pharyngeal bolus movement, need for more chewing, weakness in rotator movement, and pharyngeal residue were detected in the geriatric group who participated in the study. Laryngeal penetration/aspiration was seen in 78 patients (85.3%). Laryngeal penetration/aspiration was found to be significantly higher in the short-term group ($p:0.014$). While the rate of severe aspiration problem is 75% in the short-term group, the swallowing problem is 40% in the long-term group. In the enterally fed patient group, silent aspiration was more common in the short term group. 69% of the patients in the aspirated short-term group performed silent aspiration with thin liquid and nectar consistency. After the instrumental evaluation before the therapy, loss of strength in pharyngeal constrictors due to aging, the need for multiple swallowing to clear the pharynx, low thrust force (tilti) as a result of tongue movement, prolongation of oral and pharyngeal transit time, decrease in hyolaryngeal elevation, decrease in laryngeal delay in vestibule closure, decrease in the opening of the upper

esophageal sphincter, decrease in the sensitivity of the pharynx and supraglottic area, slowdown in oral and pharyngeal bolus movement, need for more chewing, weakness in rotator movement, and pharyngeal residue were detected in the geriatric group who participated in the study.

The PAS scores obtained after therapy were higher in the short-term therapy group than in the long-term group. It was also determined that there was a significant interaction between time and group (Figure 2).

Discussion

The swallowing process involves a series of complex, highly coordinated, and fixed muscle movement behaviors. Applying instrument to evaluate swallowing can more directly and accurately evaluate the swallowing situation in oral, pharyngeal and esophageal stages, and understand the integrity of the protection function of the swallowing airway. It is significance for the diagnosis, selection of intervention methods, and management of Dysphagia in the swallowing stage. VFSS and flexible endoscopic examination of swallowing (FEES) are the gold standard to determine Dysphagia. Compared to VFSS, the above evaluation methods have their unique advantages and unavoidable drawbacks. FEES can observe the transport of food pellets to the throat during swallowing under direct view of the monitor and observe the deformation and displacement of food pellets in the throat. FEES can better reflect the anatomical structure of the throat and the accumulation of food masses compared to VFSS, and is more suitable for swallowing dysfunction caused by cranial neuropathy, postoperative or traumatic injuries, and anatomical structural abnormalities (14). Therefore, the VFSS qualitative and quantitative results were compared and analyzed in this study. Most of the quantitative and time parameter values showed statistically significant differences according to the different qualitative grades assigned during the VFSS, including the oral transit time, swallowing reaction time in the pharyngeal phase, soft palate lift duration, hyoid movement duration, pharyngeal cavity transit time in present study.

A significant portion of geriatric individuals experience negative changes in swallowing function as a result of aging (13,14). Age-related atrophy-regression (sarcopenia) of swallowing function in the swallowing muscles, especially in the tongue, geniohyoid muscle, and pharyngeal constrictor muscles, is accepted as a common explanation (14). Heslin and Regan

(2021), in their study on adults with dysphagia, pointed out that the upper esophageal sphincter relaxation pressure did not change significantly with effortful swallowing exercise (14). They stated that it may be more difficult to change the extent of the upper esophageal sphincter opening through the intervention of dysphagia due to age-related changes in physiology. Therefore, some minor findings that would be considered pathological in young adult patients may be considered normal in elderly geriatric patients. The finding of dysphagia is a risk for geriatric patients in terms of optimal swallowing physiology. Therefore, long-term swallowing therapy is of great importance at this stage (14,15).

It has been stated in the literature that the high number of repetitions of individually created exercise-based swallowing therapies in terms of cerebral reorganization and neuroplasticity in geriatric patients provides an increase in muscle activity and accelerates slow recovery (15). Therefore, an individual swallowing therapy program was applied in our study.

Swallowing tests performed by giving 10 cc of fluid at the bedside in geriatric individuals or a decrease of more than 2% in oxygen saturation during swallowing are simple tests that are used to evaluate the risk of aspiration. Videofluoroscopic evaluation is accepted as the gold standard in evaluating swallowing functions (15). 127 participants who had problems with effective and/or safe swallowing were included in the VFSS assessment of the study. While PAS scores obtained before therapy were similar in both long-term and short-term therapy groups (PAS=7), PAS scores obtained after therapy were higher in the short-term group than in the long-term group ($p<0.001$). The median of PAS scores after short-term therapy was estimated to be 6.00 while the median of PAS scores after long-term therapy was 4.00. In the VFSS study, 81 patients were detected to have pharyngeal phase abnormalities and 78 patients had laryngeal aspiration/penetration. Pharyngeal phase abnormalities and laryngeal aspiration/penetration were significantly higher in the short term group. T-EAT-10 scores were found to be lower in the long term group after therapy.

Balou et al. (2019) (16) applied an 8-week swallowing therapy protocol in geriatric individuals, including effortful swallowing, Mendelsohn maneuver, tongue base exercises, supraglottic swallowing, Shaker exercises, and effortful pitch glide exercise. Daily home practices were

performed in addition to the treatment sessions. They achieved positive results on optimal swallowing physiology in older adults after exercise-based swallowing therapy. Zhang et al. (2023) also supports this study (17). Kim et al. (2017) showed that the Mendelsohn maneuver in a 20-session long-term swallowing therapy program contributed positively to swallowing physiology in older adults with dementia (18). In another study, Zhang et al. (2021) found the positive impact of long-term swallowing therapy program consisting of effortful swallowing and the Mendelsohn maneuver on optimal swallowing physiology in elderly adults with dementia who had a stroke (19). In the geriatric patients of our study; use of an individual swallowing therapy program which includes oral hygiene, thermal tactile stimulus, diet modification, postural changes, swallowing strategies, compensatory maneuvers (forceful swallowing, super supraglottic maneuver, supraglottic maneuver, mendelsohn) and swallowing exercises (shaker, tongue base exercise, effortful pitch glide, vocal fold (VF) adduction exercises) was found to be beneficial in long term and short term groups and much more effective in the short term group.

Carnaby et al. (2020) found that after 12 weeks of exercise-based swallowing therapy, the severity of dysphagia decreased, the EAT-10 score decreased, and the transition to early oral intake accelerated in geriatric individuals. An increase in the amount of laryngeal elevation and laryngeal vestibulum closure was observed after long-term therapy. They found a significant difference in PAS score when compared to the pre-therapy results (20). Following the intensified exercise-based 8-week swallowing therapy in geriatric patients with advanced head and neck cancer, Masonet et al. (2020) found improvement in swallowing functions, positive improvement in eating functions and an increase in quality of life (21). In another study, Eltringham et al. (2019) stated that early dysphagia intervention is vital in geriatric adults with various comorbidities and intensive care patients with aspiration pneumonia and dysphagia. Among the different comorbid groups, PAS and EAT-10 scores decreased after long-term swallowing therapy; improvement in swallowing reflex, decrease in oral transit time and multiple swallowing movements were detected, thus, improvement in swallowing function was observed (22). Sura et al. (2012) found an improvement in nutritional levels and a significant reduction in the risk of pneumonia after long-term swallowing therapy in geriatric individuals with respiratory disorders diagnosed with dysphagia. Decrease was observed in PAS score,

EAT-10 score and pharyngeal residue (23). In our study, it was found that from the two different groups who received long-term and short-term swallowing therapy, the T-EAT-10 result after therapy was lower in the long-term group.

Elderly patients admitted with aspiration pneumonia with a co-diagnosis of dysphagia were less likely to have inpatient morbidity and mortality compared to their counterparts. This may be due to improved speech evaluation and treatment in patients with dysphagia allowing for better control of macro and micro aspiration. Future research is needed to examine if universal speech therapy can reduce hospitalization and long-term mortality for such patients. This may be due to a combination of multiple factors. Aoyagi et al. (2016) examined the level between the FOIS score and the severity of dysphagia in 216 geriatric patients with stroke (24). They found that patients in the tube feeding group (FOIS level 1-2, N = 68) had a worse general condition, less functional level, and worse dysphagia severity level than patients in the oral feeding group (FOIS level 3-7, N = 68). In our study; The FOIS score was 5 points in 45 patients, 4 points in 38 patients, 3 points in 22 patients, and no swallowing problems were detected in the remaining 10 patients. At the end of the process, 30 patients had mild swallowing problems while 26 were fed completely orally. 4 patients had certain limitations of food and one patient required dietary modification. It was observed that the distribution of FOIS scores of individuals receiving long-term and short-term therapy were similar.

We theorize that a history of dysphagia suggests prior workup and evaluation by speech therapy, and therefore likely appropriate lifestyle and dietary modifications need to be made. There are similar studies in the literature. Our study is one of the rare studies in terms of sample size. On the other hand in this present study is that there are hardly any studies evaluating swallowing in five consistencies. Studies conducted in maximum three consistencies are dominant. In our study, five consistencies were tested using the full protocol. This examination is a widely used and relatively mature technique for assessing the swallowing function of patients in clinical practice, as it can directly reflect dynamic changes in the functions of the participating organs. VFSS is mainly used to assist in the diagnosis of swallowing disorders and is considered to be the “ideal method” for swallowing disorders examination, and it remains the “gold standard” for diagnosis. In addition, the use of the VFSS study, which is accepted as

the gold standard test for instrumental swallowing assessment in these patients, is very rare. So, assessing this gold standard in our study is a big plus. Although a history of coughing while eating or drinking increases the risk of aspiration, silent aspirations are common in geriatric individuals (23,24). In a study by Ding and Logemann (2005) (25), silent aspiration was observed in 46.2% of the VFSS findings of elderly adult patients with the risk of aspiration. In our study, as a result of the pre-therapy VFSS findings of the 69% patients, silent aspiration with thin liquid and nectar consistency was observed. Due to the negative effect of this important silent aspiration finding in different groups and geriatric individuals with different diagnoses on swallowing physiology, it is of great importance that geriatric individuals are in the long-term follow-up and rehabilitation process.

The quantitative of VFSS based on pathological samples collected from a wide range of individuals with multiple diseases, the extraction of the most effective and valuable information from dysphagia angiography and the objective comparison of the levels of functionality within-patients before and after treatment, as well as between patients, can fully meet the comprehensive needs of scientific research, stimulate more innovative research, and generate ideas and references for the evaluation and follow-up treatment of dysphagia.

Conclusion

This study aimed to determine whether a concurrent diagnosis of dysphagia conferred a higher risk of complications in the elderly admitted for aspiration pneumonia. And also; we propose that the VFSS, an objective assessment of dysphagia that guides interventions, should be included in the comprehensive geriatric assessment of hospitalized older patients. After the instrumental evaluation before the therapy, loss of strength in pharyngeal constrictors due to aging, the need for multiple swallowing to clear the pharynx, low thrust force (tilti) as a result of tongue movement, prolongation of oral and pharyngeal transit time, decrease in hyolaryngeal elevation, decrease in laryngeal delay in vestibule closure, decrease in the opening of the upper esophageal sphincter, decrease in the sensitivity of the pharynx and supraglottic area, slowdown in oral and pharyngeal bolus movement, need for more chewing, weakness in rotator movement, and pharyngeal residue were detected in the geriatric group who participated in the study. Silent aspiration of thin liquid and nectar consistency was experienced in 69% of the patients before

the therapy. The PAS scores obtained after therapy were higher in the short-term therapy group than in the long-term group. It was also determined that there was a significant interaction between time and group. There was a significant difference between the post-therapy penetration aspiration scores of individuals who received long-term and short-term therapy. Turkish eating assessment tool both variables were found to be significantly higher in the short-term group. Turkish eating assessment tool scores were found to be less in the long-term group after therapy.

This study has the following limitations: (1) considering the imaging factors, the radiation amplification effect could give the impression that the distance between two points on the image is larger than the actual value, and the radial distortion of the ray could stretch the length of the structure around the image. Radiation amplification and radial distortion of the rays may have affected the accuracy of the analysis; (2) during video acquisition, due to the patients' conditions, the body position, head control, and degree of cooperation could have been impacted, among other factors, which could have affected the clarity of imaging of various anatomical components, resulting in difficulties and errors in the qualitative analysis; (3) Another factor to consider is how and when the diagnosis of dysphagia was made for those patients admitted for aspiration pneumonia, as having a long-standing history of dysphagia may also subject this study to lead time bias. So that, at the beginning of the study, it is a very meticulous task to capture and determine the same dysphagia severity score in 6 different diagnosis groups. We had a hard time keeping up with the standard. This caused the study to take quite a long time; (4) Furthermore, we did not further delineate whether patients had oropharyngeal or esophageal dysphagia, both of which have different interventions and would likely carry different prognoses in terms of hospital course and adverse outcomes.

Clinical rehabilitation impact of this study reveals that long term therapy initiated within 6 months onset may be associated with improved long-term survival in selected dysphagia patients. Investigating the effects of preventive programs and individual swallowing therapy program application results on optimal swallowing physiology is of critical importance for our rapidly aging society, considering general health and quality of life. In geriatric individuals with dysphagia, the long-term swallowing therapy program is more effective than the short-term. Future research should explore if such assessment and intervention can reduce the short- and

long-term severe complications of dysphagia. Those with a pre-existing diagnosis of dysphagia may also present with symptoms of aspiration pneumonia earlier due to earlier caregiver awareness, allowing for better outcomes compared to those without a prior workup for dysphagia.

The main aspect of the paper which makes it worth worldwide is that in addition to swallowing training and nutritional interventions, newer rehabilitation approaches of long term rehabilitation techniques are showing promise and may significantly impact future treatment strategies. Besides, the research gives a summary of the experts' view and clinical experience and points out significant questions that need to be answered. In particular, the development and validation of specific interventions for older adults and establishing the effect of dysphagia on swallowing function have the potential to improve the situation in this fragile patient group. We highlight the desperate need for high-quality research to guide best practices in treating dysphagia in older adults.

Conflict of Interest, Disclosure Statement

The authors declare that they have no conflicts of interest. The authors have indicated they have no financial relationships relevant to this article to disclose.

Ethical Approval: The study was conducted in accordance with international ethical standards and the Declaration of the World Medical Association of Helsinki. The study was approved by No. 1 Clinical Research Ethics Committee of Ankara City Hospital Ethics Committee (Approval No: E1-22-3049). In our ethical statement, written informed consent to participate in this study was obtained.

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Table 1. The Exercises Protocol (16,17)

Exercise	reps per	Targeted output	Instructions
Effortful swallowing	20	Increasing muscle activation of pharyngeal constrictor and tongue root	1. Push your tongue against your upper palate 2. Swallow "hard" with effort 3. Think of it like swallowing a golf ball (8)
Masako	20	Increased contraction of the upper pharyngeal constrictor muscle	1. Gently hold your tongue between your teeth 2. Swallow your saliva in this position (12)
Supraglottic and super supraglottic	20	voluntary laryngeal vestibule closure (8)	1. Breathe in and hold 2. Bear down with your abdominals while swallowing
Shaker	20	Strengthening the hyolaryngeal elevation muscles (3)	1. lie flat on your back 2. Just lift your head and look at your toes (don't lift your shoulders) 3. Hold this position for 1 second and then lower your head (19)
Mendelsohn maneuver	20	Hyolaryngeal elevation and voluntary lengthening of the upper esophageal sphincter opening (3)	1. Squeeze your muscles as you feel your larynx move upward 2. Maintain this position for up to 5 seconds 3. Relax and finish swallowing (15)
Effortful pitch glide	20	Shortening and narrowing of the pharynx	1. Take a deep breath 2. Say "iii" from low to high pitch (16)

**Informed consent (both written and verbal) was obtained from the patient.*

***All treatments were provided by speech language pathologists working within the rehabilitation setting. The therapists were experienced clinicians with >5 years active dysphagia rehabilitative experience.*

Table 2. Distribution of individuals in terms of swallowing therapy timing, number, age range and gender

	Number (n)	Mean $\pm$ SD (min, max)
Group		
Long Term	65 (M=41, F=24)	51.2 $\pm$ 1.4 (66-81)
Short Term	62 (M=40 ,F=22)	48.8 $\pm$ 2.3 (67-83)
Type of disorder	% n) 22.4 % (n=29) advanced stage (T3a,T3b,T4a) larynx CA 18.7 % (n=24) respiratory disorders 15.8 % (n=20) gastrointestinal disorders, 21.1 % (n=26) sign of dysphagia due to sarcopenia, 14.7 % (n=19) iatrogenic aspiration pneumonia 7.3 % (n=9) metabolic disorders	
Phases of swallowing before therapy	%(n) No problem 8 (12.1) Oral phase problems 28 (23.4) Pharyngeal Phase Problems 36 (42.2) Oral and pharyngeal problems 28 (22.3)	

Table 3. FOIS and T-EAT-10 levels after long-term and short-term therapy

FOIS	Long Term n (%)	Short Term n (%)	t	P
5	45 (42.9)	23 (47.0)		
4	38 (36.1)	18 (36.7)		0.780
3	22 (21.0)	8 (16.3)		
T EAT-10	Long Term Mean±SD	Short Term Mean±SD		
Pre-therapy	67,61±2,33	68,22±1,42	9.2	p<0.05
Post-therapy	21,51±3,84	32,94±2,58	8.3	

*FOIS: Functional Oral Intake Scale, ** Test:chi-square ***Teat-10: Turkish Eat-10 scale, SD: Standard deviation,

p<0,05 Test:paired t test

Table 4. Comparison of PAS scores in thin liquid consistency on the basis of time and group

	Long term Median (Min-Max)	Short Term Median (Min-Max)	p (Group)	P (Interaction)
PAS Scores				<0.001
Before	7.00 (5.00-8.00)	7.00 (1.00-8.00)	<0.001	
After	4.00 (3.00-6.00)	6.00 (4.00-8.00)		
p (time)	<0.001			
test: Mixed Design ANOVA				
	Long term (n%)	Short term (n%)	p	
Distribution of groups with aspiration after swallowing therapy with different consistencies				
Thin liquid	28 (26.2)	54 (33.1)	0.049	
Nectar consistency	22 (20.6)	43 (26.4)		
Honey consistency	30 (28.0)	22 (13.5)		
Pudding consistency	15 (14.0)	28 (17.2)		
Solid consistency	12 (11.2)	16 (9.8)		
test:chi-square				

*PAS:Penetration-Aspiration Scale, Min: Minimum, Max: Maximum**test: Mixed Design ANOVA***test:chi-square

Figure 1. Dysphagia Plan Management: An overview of our intervention program (13,14)



E:Exercise,E1,E2,E3,E4:Instructions

Figure 2. Short-term and long-term time group interaction of PAS scores

