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ORIGINAL ARTICLE

Examining the effect of intensive individual swallowing exercise therapy protocol on swallowing physiology in geriatric patients hospitalized in the thoracic diseases service with a complaint of major swallowing dysfunction with multiple prognoses

Çoklu prognoza sahip majör yutma disfonksiyonu şikayeti ile göğüs hastalıkları servisinde yatmakta olan geriatrik bireylerde yoğunlaştırılmış bireysel yutma egzersizi terapi protokolünün yutma fizyolojisine etkisinin incelenmesi

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ABSTRACT

Objectives: The study aimed to compare the effectiveness of short-term (one month) and long-term (three months) individual swallowing therapy programs in the geriatric individuals diagnosed with dysphagia by instrumental evaluation.

Patients and methods: Hospital records of 31 patients (16 females, 15 males; mean age: 66.8±16.4 years; range, 66 to 83 years) were prospectively examined between April 1, 2019, and September 30, 2022. Fiberoptic endoscopic swallowing study recordings were made at the beginning of the study. The recordings were scanned and examined, and individuals with observed problems in swallowing safety and efficacy, having the same severity of dysphagia, were identified. Patients were randomly assigned to long-term (51.2%; n=16; 8 males, 8 females) and short-term (48.8%; n=15; 7 males, 8 females) therapy groups. During fiberoptic endoscopy, patients were given food of different consistencies (thin liquid, honey, nectar, pudding, and solid consistency) according to the International Dysphagia Diet Standardization Initiative protocol, and they were evaluated before therapy and one week, one month, and three months after therapy using the penetration-aspiration scale and the Yale Pharyngeal Residue Severity Scale-Vallecula/Pyriform Sinus. Functional Oral Intake Scale and Turkish Eating Assessment Tool-10 (T-EAT-10) results were compared between the groups. An exercise-based individual swallowing therapy program of one and three months was applied to short-term and long-term therapy groups, respectively.

Results: When the post-therapy penetration aspiration scores and pharyngeal residual severity scores of individuals receiving long-term and short-term therapy were compared, a higher score was found in the group receiving short-term therapy than the long-term group, and a significant difference was found ($p<0.001$). Pharyngeal phase abnormalities were detected in 27 (88.4%) patients, whereas laryngeal penetration/aspiration status was found in 23 (75.3%) patients, and both variables were found to be significantly higher in the short-term group ($p=0.015$ and $p=0.014$, respectively). The T-EAT-10 scores obtained before therapy in the long-term therapy group were significantly higher than T-EAT-10 scores obtained at the third month after therapy ($p=0.004$, $p<0.001$, and $p<0.05$, respectively). Silent aspiration of thin liquid, nectar, and solid consistency was experienced in 78% of patients before therapy.

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

Keywords: Aspiration pneumonia, dysphagia, fiberoptic endoscopic evaluation of swallowing, geriatric individual, individual swallowing therapy program.

ÖZ

Amaç: Bu çalışmada, enstrümental değerlendirme ile disfaji tanısı alan geriatrik bireylerde kısa dönem (bir ay) ve uzun dönem (üç ay) bireysel yutma terapisi programı etkinliği karşılaştırıldı.

Hastalar ve yöntemler: Otuz bir hastanın (16 kadın, 15 erkek; ort. yaş: 66,8±16,4 yıl; dağılım, 66-83 yıl) hastane kayıtları 01 Nisan 2019 - 30 Eylül 2022 tarihleri arasında prospektif olarak incelendi. Çalışmanın başında fiberoptik endoskopik yutma çalışması çekim kayıtları yapıldı. Kayıtlar taranıp incelendi ve yutma güvenliği ve etkinliğinde sorun gözlenen, aynı disfaji şiddetine sahip bireyler belirlendi. Hastalar uzun dönem (%51,2; n=16; 8 erkek, 8 kadın) ve kısa dönem (%48,8; n=15; 7 erkek, 8 kadın) terapi gruplarına randomize bir şekilde ayrıldı. Hastalar fiberoptik endoskopi sırasında Uluslararası Disfaji Diyet Standardizasyon Girişimi protokolüne göre farklı kıvamlarda (ince sıvı, bal, nektar, puding, katı kıvam) besin verilerek Penetrasyon-Aspirasyon Skalası ve Yale Farengeal Rezidü Kalıntı Şiddet Skalası-Vallekula/Priform Sinüs ile terapi öncesi ve terapi sonrası bir hafta, bir ay ve üç ayda değerlendirildi. Fonksiyonel Oral Alım Skalası ve Türkçe Yeme Değerlendirme Aracı-10 (T-EAT-10) sonuçları gruplar arasında karşılaştırıldı. Kısa dönem ve uzun dönem terapi gruplarına sırasıyla bir ve üç ay süreyle uygulanan egzersiz tabanlı bireysel yutma terapi programı uygulandı.

Bulgular: Uzun dönem ve kısa dönem terapi alan bireylerin terapi sonrası penetrasyon aspirasyon skorları ve farengeal rezidü şiddet skorları karşılaştırıldığında, kısa dönem terapi alan grupta uzun dönem gruba göre daha yüksek skor bulunmuş olup anlamlı farklılık olduğu saptandı ($p<0,001$). Yirmi yedi (%88,4) hastada farengeal faz anormallikleri, 23 (%75,3) hastada larengeal penetrasyon/aspirasyon durumu saptanmış olup kısa dönem grubunda her iki değişkende de anlamlı olarak daha yüksek bulundu (sırasıyla, $p=0,015$, $p=0,014$). Uzun dönem terapi grubunda terapi öncesi elde edilen T-EAT-10 skorları terapi sonrası üçüncü ay elde edilen T-EAT-10 skorlarından anlamlı derecede yüksekti (sırasıyla, $p=0,004$, $p<0,001$, $p<0,05$). Terapi öncesinde hastaların %78'inde ince sıvı, nektar ve katı kıvamında sessiz aspirasyon yaşandı.

Sonuç: Disfajisi olan geriatrik bireylerde, uzun dönem yutma terapisi programının kısa döneme göre daha etkili olduğu görülmektedir.

Anahtar sözcükler: Aspirasyon pnömonisi, disfaji, fiberoptik endoskobik yutma değerlendirmesi, geriatrik birey, bireysel yutma terapisi programı.

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Safe and effective swallowing is a highly complex neuromuscular process. Oropharyngeal dysphagia, disturbances in consciousness, and cognitive function impairments can lead to the development of malnutrition. There is a close relationship between swallowing and respiration. The regulation of swallowing and respiration by closely located oromotor central pattern generators and their use of similar neural pathways and similar oral-pharyngeal structures necessitate a highly advanced level of coordination. The swallowing-respiration style of adults takes place in the pattern of breathing-swallowing-breathing. This swallowing-respiration pattern is thought to minimize health risks, such as aspiration and penetration, that could occur during swallowing. The possibility of the swallowing-respiration coordination being disrupted by impaired respiration and, consequently, the swallowing being affected should not be overlooked. The rapid movement of the pharynx becomes important in maintaining this coordination.[1] In geriatric individuals, instrumental assessments reveal unsafe swallowing (with the bolus entering the laryngeal vestibule, carrying a risk of aspiration into the lungs) and inefficient swallowing (presence of residue).[2] Dysphagia issues in the geriatric group include difficulties in the pharyngeal phase of swallowing, a reduction in the posterior movement of the tongue base, impairment in velopharyngeal closure, delayed swallowing reflex, reduced pharyngeal contraction, decreased hyolaryngeal elevation, impaired closure of the laryngeal vestibule, decreased opening of the upper esophageal sphincter, increased pharyngeal residue, and problems such as aspiration.[2] Due to impairments in the timing, strength, and coordination of velopharyngeal structures, pharyngeal clearance cannot be fully achieved and residue and aspiration can be observed.[2] Furthermore, silent aspiration can occur due to sensory impairment.

Dysphagia management involves the application of compensatory strategies or rehabilitation exercises to optimize an individual's swallowing safety and efficiency.[1,2] The prevalence of dysphagia in the geriatric population varies between 7 and 22%, and this rate increases to 40 to 50% in patients requiring long-term care.[3] Age-related atrophy in swallowing muscles (sarcopenic dysphagia/dysphagia due to sarcopenia) is widely accepted as a common explanation for the decline in swallowing function with age. Weakness is observed in the tongue, geniohyoid muscle, and pharyngeal constrictor muscles.[3] Therefore, age-related changes in swallowing physiology and accompanying comorbid conditions in the geriatric population make these individuals more susceptible to aspiration risk.[3]

Fiberoptic endoscopic evaluation of swallowing (FEES) is a procedure that allows for the direct, easily accessible, and practical visualization of pharyngeal function during swallowing.[4] It is frequently employed as an instrumental method in clinical settings. In geriatric individuals, FEES can identify typical patterns of impairment in swallowing phases, enable earlier diagnosis of dysphagia, accurately detect aspiration events, and facilitate early intervention.[4] The effectiveness of compensatory strategies is assessed, and the patient's swallowing safety is determined. The assessment is conducted with a flexible endoscope by an otolaryngologist or a neurologist, in collaboration with speech and language therapists, according to the application guidelines in both our country and Europe. Patients are administered food and drinks containing the dye methylene blue in various consistencies and quantities. This allows for the observation of bolus transit and physiology during the pharyngeal phase of swallowing.[4] The FEES test as an instrumental method helps determine the penetration-aspiration scale (PAS) and Yale Pharyngeal Residue Severity Rating Scale (YPRSRS)-Vallecula/YPRSRS-Pyriform Sinus outcomes, and thus, an appropriate dysphagia management plan is formulated. Diet modification and functional oral intake are most commonly evaluated using the Eating Assessment Tool-10 (EAT-10) and the Functional Oral Intake Scale (FOIS) in routine practice.[3,4]

There are a limited number of studies investigating the effects of swallowing therapy in the dysphagic geriatric population.[4-6] Koyama et al.[7] found that a long-term swallowing rehabilitation program shortened the transition time to oral intake in patients with sarcopenic dysphagia. In addition, Momosaki et al.[8] reported low mortality rates following a 12-week swallowing rehabilitation program in the group with dysphagia due to aspiration pneumonia. In another study, Park et al.[9] observed decreased PAS scores, increased FOIS scores, and an enhanced cough reflex following swallowing therapy in the group with dysphagia due to respiratory disorders. The study aimed to compare the effectiveness of short-term (one month) and long-term (three months) individual swallowing therapy programs in geriatric individuals diagnosed with dysphagia through instrumental assessment.

PATIENTS AND METHODS

This prospective study was conducted at the Ankara City Hospital, Departments of Otolaryngology and Thoracic Diseases. Clinical swallowing assessments, instrumental swallowing evaluations, and swallowing rehabilitation sessions were conducted for consultations for dysphagia managed with a multidisciplinary collaboration between the Department of Otolaryngology and the Department of Thoracic Diseases between April 1, 2019, and September 30, 2022. The design of the study involved enrolling patients into individualized rehabilitation programs based on their clinical assessments and FEES findings and examining the difference in the effect of these personalized therapies over short and long periods. Inclusion criteria were being over the age of 65 and being referred for FEES due to the complaint of swallowing difficulty. Out of 45 participants, 31 (16 females, 15 males; mean age: 66.8±16.4 years; range, 66 to 83 years) who volunteered for therapy were included in the study. Patients were evaluated at four times: before therapy and at one week, one month, and three months after therapy. In this study, the scales FOIS, PAS, Turkish EAT-10 (T-EAT-10), YPRSRS-Vallecula, and YPRSRS-Pyriform Sinus measured at different times before and after therapy (one week, one month, and three months) were utilized in both the long-term and short-term therapy groups. The exclusion criteria were patients who could not comply with the test due to severe psychiatric conditions (schizophrenia), mental retardation, and unsuitable wakefulness or cognitive status or a positive COVID-19 (coronavirus disease 2019) polymerase chain reaction test result. At the beginning of the study, FEES recordings were reviewed, and patients observed to have problems with swallowing safety and efficacy were randomly divided into two groups according to dysphagia severity (PAS score=7).

Findings of silent aspiration (the appearance of liquid or puree bolus beneath the true vocal folds without coughing) were examined. The short-term group received swallowing therapy up to the first month, while the long-term group received swallowing therapy up to the third month. Severe impairment of oral intake was defined as a FOIS score <5.[10]

In this study, the methods used in clinical swallowing assessment are outlined as follows.[11] There were three main stages in the clinical evaluation of a geriatric patient: medical history, physical examination of structures associated with swallowing, and observation of the patient's swallowing efficiency during test swallows. The patient's age, sex, and diagnosis were the initial pieces of information noted. Subsequently, the presence of congenital, neurological, systemic, and metabolic diseases, esophageal problems, or respiratory disorders were also inquired. Additionally, family history, including health issues in the family that could lead to dysphagia, was noted. The medications being used, treatments received or planned, results of existing laboratory tests, past surgical operations on the cardiopulmonary, gastrointestinal, and respiratory systems, and chronic diseases were inquired. If there were previous swallowing assessments, the results of these tests and treatments received for swallowing disorders were inquired. The primary complaints, when and how they started, with which types of food they occurred, and how they manifested, as well as possible history of pneumonia, eating habits, and reflux symptoms, were questioned. The route of nutrition, dietary level, presence of a tracheotomy tube, history or presence of an endotracheal tube, need for aspiration (suction), complaints such as coughing, voice change, sticking, and choking sensation during eating and drinking, weight loss, nutritional deficiency, whether sufficient fluids were consumed, physical condition, and additional disabilities were inquired. During the physical examination of the oral cavity, the condition of the anatomical structures in the oral cavity, oral hygiene, moisture level inside the mouth, and lesions were observed. The sensation inside the mouth was evaluated, and the range of mouth opening was measured. An oral motor assessment was conducted to evaluate the strength of the tongue, lips, and facial muscles, and an oropharyngeal examination was performed by observing the movements of the velum and uvula at rest and during phonation and the presence of the gag reflex. During the clinical laryngeal examination, the patient's ability to initiate and sustain phonation, the quality and intensity of the voice during phonation, the presence of the swallowing reflex detected by palpation during dry swallowing, and the amount of laryngeal elevation were examined. A cranial nerve examination was conducted during the oral motor examination. The condition and strength of jaw movements and chewing muscles, the status and strength of facial muscles at rest and during movement, lip movements, and lip closure strength were assessed, and the presence of the gag reflex, velar movement, phonation, and the presence and

strength of voluntary cough were evaluated. The state of the tongue at rest (unilateral or bilateral atrophy, fasciculations, and spasticity), the range of tongue movement, and the strength of tongue muscles were examined. Following the physical examination, test swallows were evaluated. Foods of different consistencies were tried based on the patient's condition in test swallows to assess swallowing ability. The ability to hold the bolus in the mouth, chewing movements and duration, bolus formation, and manipulation were observed. The presence of oral residue after swallowing was examined, and information on the presence and timing of the swallowing reflex as well as the amount of laryngeal elevation was obtained by laryngeal palpation during swallowing. The presence of symptoms such as coughing, throat clearing, voice change, and the sensation of sticking during and after swallowing and while holding the bolus in the mouth was assessed, and it was noted when these symptoms occurred, as well as with which consistency and amount of food presented they occurred.

The results of individuals' clinical swallowing evaluations, dysphagia severity outcomes, the presence of swallowing assessment scales used, route of nutrition (e.g., nasogastric and percutaneous endoscopic gastrostomy), and the time to transition to oral feeding were recorded.

Outcome measures

Functional oral intake scale

The FOIS is a scale developed by Crary et al.[10] in 2005 to represent the functional levels of patients' nutrition intake. It categorizes the functional level of oral intake based on solid and liquid foods into seven stages. The patient's oral intake status is inquired to determine the FOIS level (1-3: nonoral feeding; 4-7: oral feeding; 7: normal).

Eating Assessment Tool-10

Eating Assessment Tool-10 is a self-administered scale that measures the patient-perceived severity of swallowing difficulty. It consists of 10 questions that are simple and straightforward, providing information on dysphagia symptoms and helping estimate the risk of aspiration. The items are phrased in clear and simple language. The total score received is a significant indicator of the patient's swallowing disorder. Scoring is done on a scale of 0 to 4 for each question, ranging from no issues to severe disability. The maximum possible score is 40. Higher scores indicate more severe swallowing difficulties. The Turkish validity and reliability of this scale were established by Demir et al.[12] in 2016.

Penetration-Aspiration Scale

In the assessment of swallowing disorders for determining treatment indications, identifying the severity of penetration and aspiration is crucial. Various rating scales have been developed to enhance the utility of instrumental techniques in describing clinical conditions and the severity of aspiration. The PAS provides information on the presence, as well as the severity, of aspiration and penetration. It was chosen for this study due to its widespread clinical use. The PAS, developed by Rosenbek et al.[13] in 1996, rates the penetration-aspiration score on a scale from 1 to 8, with 1 indicating no penetration or aspiration, 2-5 indicating penetration, and 6-8 indicating aspiration. The interrater reliability study of this scale in Turkish was conducted by Karaduman et al.[14] in 2012.

Yale Pharyngeal Residue Severity Rating Scale

The YPRSRS, developed by Neubauer et al.[15] in 2015, provides a reliable, anatomically defined, and image-based assessment of the severity of pharyngeal residue after swallowing, as observed during FEES, and has been validated after standardization. It is a 5-point ordinal scale rated according to the severity and amount of pharyngeal residue in the vallecula and pyriform sinuses (0=none, 1=minimal, 2=mild, 3=moderate, and 4=severe). The researchers who developed the scale indicated its use for accurately classifying the severity patterns of vallecula and pyriform sinus residue for diagnostic purposes and as a tool for identifying functional therapeutic changes. The Turkish validity and reliability study was conducted by Atar et al.[16] in 2021.

Videoendoscopic swallowing assessment

Fiberoptic endoscopic evaluation of swallowing:

The necessary equipment for conducting the test are a fiberoptic endoscope, light source, camera, monitor, video recording device, and microphone. The procedure involves presenting materials of different consistencies and quantities made visible by adding methylene blue or food coloring. The materials are prepared according to the guidelines provided by the International Dysphagia Diet Standardisation Initiative (IDDSI).

Preperation of test materials

Consistencies specified in the IDDSI protocol, including thin liquid, nectar, honey, pudding, and solid textures, were utilized for test materials.

For thin liquids, water mixed with a commercial thickener (Resource Thicken Up Clear 22510000; Nestlé Health Science Türkiye, Maslak, Istanbul, Türkiye) was used to adjust to nectar, honey, and pudding consistencies. Blue food coloring was used for visualization. Subsequently, the thickener was added to 100 mL of water in amounts specified in the product brochure to achieve the desired consistencies: one scoop for nectar-like, two scoops for honey-like, and three scoops for pudding-like consistencies. The IDDSI flow test was applied to ensure that the prepared materials met the desired consistency levels.[11]

The level of penetration-aspiration for each consistency was simultaneously determined while scoring with PAS, as recommended by the protocol. Total scores were calculated and recorded.

Twenty percent of all tests were reevaluated by a second speech and language therapist who was blinded to all other variables to assess the reliability of test interpretation. The reliability of the analyses

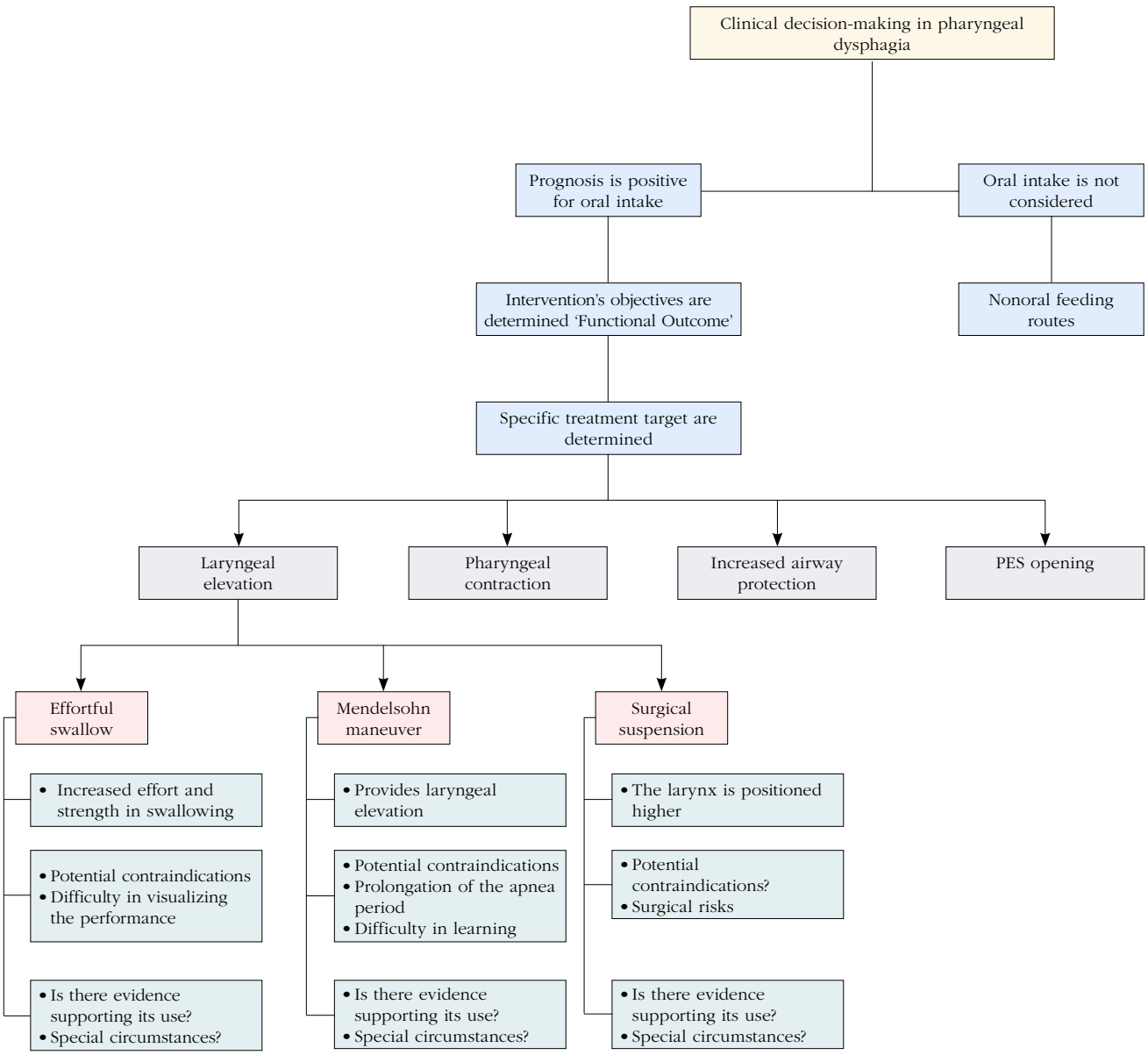

Figure 1. Dysphagia management plan[13,14]

PES: Pharyngoesophageal segment.

was ensured by identifying a correlation between the findings of both evaluators.[11] The kappa test was used to test interrater reliability.

Dysphagia management plan: Swallowing therapy protocol

An individualized swallowing therapy program, involving oral hygiene, thermal tactile stimulation, diet modification, postural changes, swallowing strategies, compensatory maneuvers (effortful swallow, super-supraglottic maneuver, supraglottic maneuver, and Mendelsohn maneuver), and swallowing exercises (Shaker exercise, resistive tongue-base exercise, effortful pitch glide, and vocal fold adduction exercises), was applied to both groups.[14,17] In our study, the set repetition numbers and duration for the dysphagia plan were as follows. Therapy sessions of 45 min were scheduled once a week for each participant, with 20 repetitions for all but the effortful pitch glide, and daily home programs were set at three repetitions (Table 1).[18] The management of the dysphagia plan is presented in Figure 1.[14,17] The types of swallowing maneuvers and exercises applied to the dysphagic patient were determined after FEES based on the specific dysphagia problem. The type of swallowing disorder and the specific exercises and maneuvers planned for the disorder are displayed in Figure 2.

Statistical analysis

The sample size was calculated using the G*Power version 3.1.9 (Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany). It was determined that short-term group required a total of 24 samples, while long-term group required a total of 17 samples, with an 80% power, α=0.05 type 1 error, and β=0.20 type 2 error.

Data were analyzed using IBM SPSS version 26.0 software (IBM Crop., Armonk, NY, USA). The conformity of variables to normal distribution was assessed using the Shapiro-Wilk test. Descriptive statistics were presented as mean ± standard deviation and median (interquartile range), along with minimum and maximum values. The categorical variables were expressed as frequency (n) and percentage (%). Scores of the T-EAT-10 scale higher and lower than 3 were aggregated into two separate groups. The distribution according to assessment times was given in number (n) and percentage (%). A paired sample t-test was conducted to compare long-term and short-term

TABLE 1
Repetition times and durations of exercises and maneuvers in the swallowing therapy protocol[16]

Exercise	Sets, repetitions, duration	Expected outcome	Instructions
Effortful swallow	20 (8-10 repetitions)	Increasing pharyngeal constrictor and tongue base muscle activation	1. Press the tongue against the palate 2. Swallow robustly and with effort 3. Imagine swallowing a golf ball
Masako	20 (8-10 repetitions)	Improved contraction of the upper pharyngeal constrictor muscle	1. Hold your tongue gently between your teeth 2. Swallow your saliva in this position
Supraglottic swallowing	20 (8-12 repetitions)	Voluntary closure of the laryngeal vestibule	1. Take a breath and hold it 2. Swallow with effort 3. Cough
Shaker exercise	20 (8-10 repetitions)	Strengthening of the hyolaryngeal elevation muscles.	1. Lay on your back 2. Elevate only your head (not the shoulders) and look at your toes 3. Hold this position for 1 sec and then lower your head
Mendelsohn maneuver	20 (8-10 repetitions)	Voluntary prolongation of hyolaryngeal elevation and upper esophageal sphincter opening.	1. As you feel your larynx moving upwards, tighten your muscles 2. Hold this position for 5 sec 3. Relax and finish swallowing
Effortful pitch glide	20 (8-12 repetitions)	Shortening and narrowing of the pharynx	1. Take a deep breath 2. Say “eee” starting from a low pitch to a high pitch

For each participant, a weekly therapy session lasting 45 min was conducted.

before and after therapy factors for the T-EAT-10 score. In both the long-term and short-term therapy groups, the significance of differences between the values of FOIS, PAS, T-EAT-10, YPRSRS-Vallecula, and YPRSRS-Pyriform Sinus measured at different times before and after therapy was assessed using the Friedman test. For each time point, the presence of differences in these evaluation values between the long-term and short-term groups was evaluated using the Mann-Whitney U test. The level of statistical significance was set at $p<0.05$.

RESULTS

Patients who received therapy for three months were included in the long-term group (51.2%, n=16), and those who received therapy for one month were included in the short-term group (48.8%, n=15). Four participants were excluded due to death, eight were excluded for not fully demonstrating general well-being and exercise tolerance during the test swallow therapy phase before the protocol (this was due to the need for total assistance, as indicated in Figure 2), and two participants were excluded for not being able to tolerate the endoscopy procedure. Figure 3 presents the inclusion flowchart of the study. Of the patients, 22.4% (n=7) had aspiration pneumonia, 18.7% (n=6) had respiratory disorders, 15.8% (n=5) experienced swallowing difficulties due to dependency on mechanical ventilation, 21.1% (n=7) showed signs of dysphagia related to chronic neurological diseases, 14.7% (n=4) were preliminarily diagnosed with iatrogenic aspiration pneumonia, and 7.3% (n=2) had long-term tracheostomy. In 26 (84.6%) patients, penetration or aspiration was observed during the pretherapy FEES evaluation. The median penetration score for oral and pharyngeal phases in 12 patients was found to be 5. The number of patients with aspiration scores indicating problems (a PAS of 6 and above) in the pharyngeal phase was 16 (residue at the subglottic level). In the FEES study, abnormalities in the pharyngeal phase were detected in 24 (88.4%) patients (Table 2).

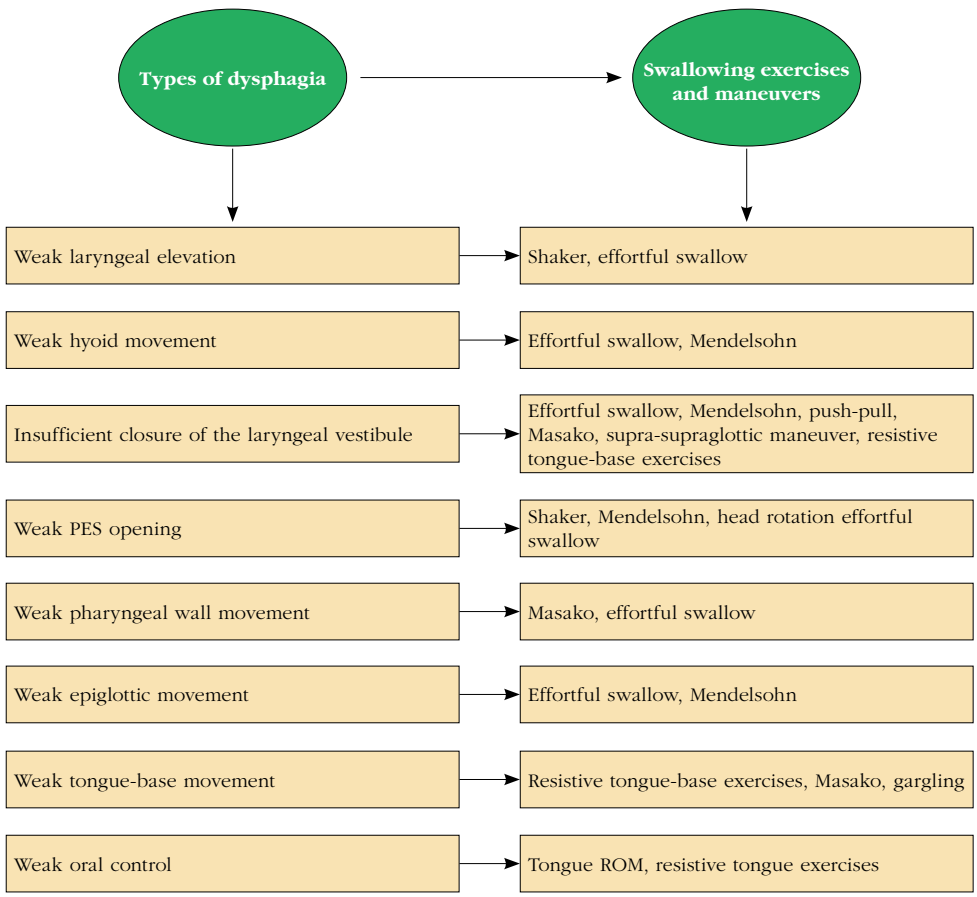

Figure 2. Swallowing disorder and the specific exercises and maneuvers planned for the disorder.

PES: Pharyngoesophageal segment; ROM: Range of motion.

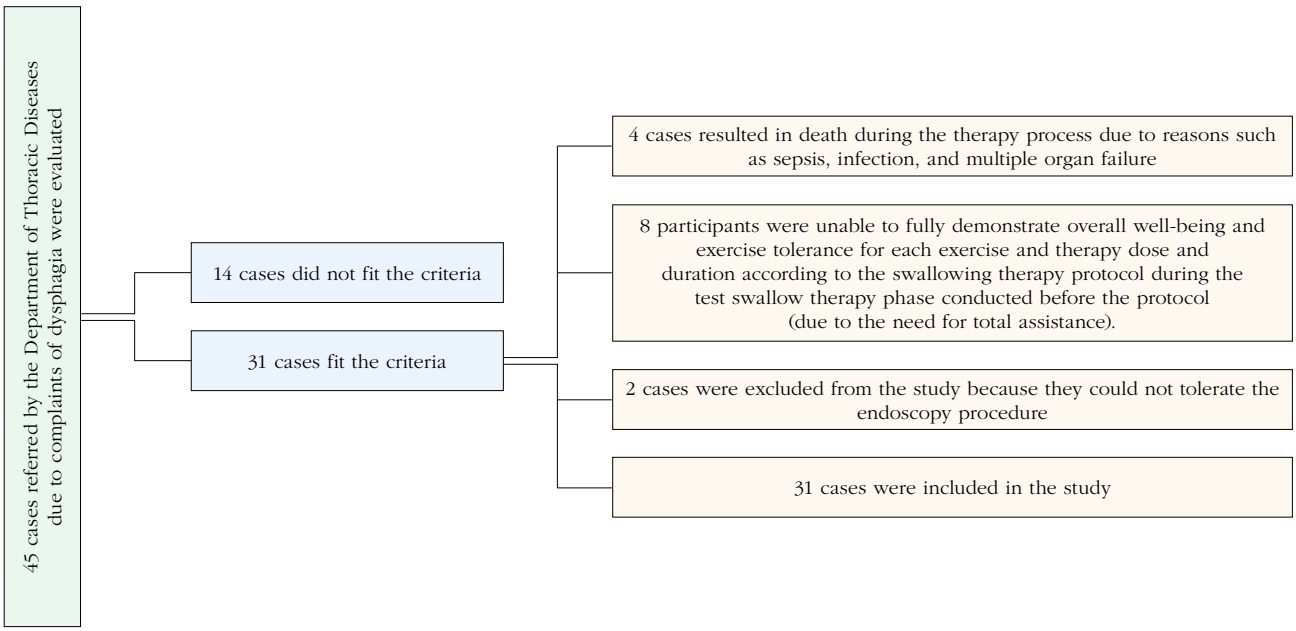

Figure 3. Flowchart of the study.

Table 3 displays the percentage of assistance given by the therapist during the test swallow therapy phase as the criterion for continuation in the study process.[19-22] Every participant included in the study completed the swallowing therapy program for one month (three to four sessions) and three months (9 to 10 sessions). The individualized swallowing therapy program consisting of oral hygiene,

TABLE 2
The timing of swallowing therapy, the type of disorder, and distribution of swallowing phases of individuals

	n	%	Mean±SD	Min-Max
Group				
Long-term				
Male	8		51.2±1.4	66-81
Female	8			
Short-term				
Male	7		48.8±2.3	67-83
Female	8			
Type of disorder				
Aspiration pneumonia	7	22.4		
Respiratory disorders	6	18.7		
Dysphagia related to chronic neurological diseases*	7	21.1		
Dysphagia due to mechanical ventilation	5	15.8		
Early diagnosis of iatrogenic aspiration pneumonia	4	14.7		
Dysphagia due to mechanical ventilation	2	7.3		
Swallowing phases before therapy				
No issues	0	0.0		
Oral phase abnormalities		23.4		
Pharyngeal phase abnormalities	14	42.2		
Oral and pharyngeal phase abnormalities	10	22.3		

SD: Standard deviation; * Six different diagnostic groups were included in the study: Parkinson's disease (PD), amyotrophic lateral sclerosis (ALS), multiple sclerosis (MS), stroke, brain trauma, and spinal cord injury.

TABLE 3
The percentage of assistance given by the therapist during the test swallow therapy phase as the criterion for continuation in the study process[20-23]

	%
Minimal assistance Therapist assistance	25
Moderate assistance Therapist assistance	50
Moderate assistance Therapist assistance	75
Total assistance Therapist assistance	100

thermal tactile stimulation, diet modification, postural changes, swallowing strategies, compensatory maneuvers (effortful swallow, super-supraglottic maneuver, supraglottic maneuver, and Mendelsohn maneuver), and swallowing exercises (Shaker exercise, resistive tongue-base exercise, effortful pitch glide, and vocal fold adduction exercises) was comprehensively applied to every individual included in the study.

There was a statistically significant difference between the times of instrumental evaluation in both the long-term and short-term therapy groups regarding the PAS scores obtained from individuals with thin liquid consistency aspiration (χ^2=46.120, p<0.001, and χ^2=48.975, p<0.001, respectively; Table 4). The results of pairwise comparisons demonstrated that the PAS scores obtained before therapy in the long-term group were significantly higher than the PAS scores obtained at three months after therapy (p<0.001). The PAS scores obtained one week after therapy were significantly higher than the scores obtained at three months after therapy (p<0.001, Table 4). Pharyngeal phase abnormalities were found to be significantly higher in the short-term group (p=0.015). Laryngeal penetration/aspiration was observed in 24 (78%) of 31 patients. Laryngeal penetration/aspiration was significantly higher in the short-term group (p=0.014). While the rate of severe aspiration problems in the short-term group was 75%, swallowing issues in the long-term group were found in 40% of cases. Silent aspiration was more frequently observed in the short-term group. In the geriatric individuals participating in the study, loss of strength in the pharyngeal constrictors during the pharyngeal phase was observed in all individuals before therapy after FEES. Additionally, there was a need for multiple swallows to clear the pharynx, reduced propulsion force (tilt), prolonged oral and pharyngeal transit times, decreased hyolaryngeal elevation, delayed closure of the laryngeal vestibule, and decreased opening of the upper esophageal sphincter. Furthermore, there was a decrease in sensitivity in the pharynx and supraglottic area, slowing of oral and pharyngeal bolus movement, weakness/minimal force in jaw rotary chewing pattern, and an increase in the amount of pharyngeal residue. An increase in chewing duration was detected.

After therapy, the YPRSRS-Vallecula scores obtained at one week, one month, and three months were significantly lower in the long-term therapy group compared to the short-term therapy group (Z=4.881, p<0.001; Z=3.002, p=0.003; Z=3.248, p=0.002, respectively; Table 5).

A statistically significant difference was found between the times of instrumental evaluation for YPRSRS-Vallecula scale scores in both the long-term and short-term therapy groups (χ^2=53.329, p<0.001, and χ^2=50.985, p<0.001, respectively; Table 5). In pairwise comparisons, the YPRSRS-Vallecula scores obtained before therapy in the long-term therapy

TABLE 4
Distribution of PAS thin liquid values according to time points

	Long-term group		Short-term group			
	Median	Min-Max	Median	Min-Max	Z	*p*
Before therapy	3.00	3.00-5.00	4.00	3.00-5.00	3.735	**<0.001**
One week after therapy	4.00	2.00-6.00	5.00	4.00-6.00	2.838	**0.003**
One month after therapy	3.00	2.00-4.00	4.00	3.00-5.00	3.539	**0.001**
Three months after therapy	2.00	1.00-3.00	3.00	2.00-4.00	3.627	**<0.001**
χ^2	46.120		48.975			
p	**<0.001**		**<0.001**			

PAS:Penetration-aspiration scale; Z: Mann Whitney U test; χ^2: Friedman test.

group were significantly higher than those obtained at three months after therapy (p=0.001 and p<0.001, respectively). The YPRSRS-Pyriform Sinus scores obtained at one week after therapy in the long-term therapy group were significantly higher than those obtained at three months after therapy (p=0.010 and p<0.001, respectively). The YPRSRS-Vallecula scores obtained at one month after therapy were higher than those obtained at three months after therapy (p=0.015, Table 5).

There was a statistically significant difference between the times of instrumental evaluation for YPRSRS-Pyriform Sinus scores in both the long-term and short-term groups (χ^2=49.882, p<0.001, and χ^2=42.009, p<0.001, respectively; Table 6).[22] Examining the results of pairwise comparisons, the YPRSRS-Pyriform Sinus scores obtained before therapy in the long-term therapy group were significantly higher than those obtained at three months after therapy (p=0.001 and p<0.001,

TABLE 5
Distribution of YPRSRS-Vallecula values in the long-term therapy and short-term therapy groups

	Long-term group		Short-term group			
	Median	Min-Max	Median	Min-Max	Z	*p*
Before therapy	4.00	3.00-5.00	4.00	3.00-4.00	0.392	0.613
One week after therapy	4.00	3.00-4.00	5.00	4.00-5.00	4.881	**<0.001**
One month after therapy	2.00	2.00-4.00	4.00	2.00-4.00	3.002	**0.003**
Three months after therapy	2.00	1.00-3.00	3.00	2.00-4.00	3.248	**0.002**
χ^2	53.329		50.985			
p	**<0.001**		**<0.001**			

YPRSRS: Yale Pharyngeal Residue Severity Rating Scale; Z: Mann-Whitney U test; χ^2: Friedman test.

TABLE 6
Distribution of YPRSRS-Pyriform Sinus values among study and control groups

	Long-term group		Short-term group			
	Median	Min-Max	Median	Min-Max	Z	*p*
Before therapy	4.00	2.00-4.00	3.00	2.00-4.00	1.667	0.086
One week after therapy	3.00	3.00-5.00	5.00	4.00-5.00	2.510	**0.012**
One month after therapy	2.00	2.00-3.00	3.00	2.00-4.00	3.105	**<0.001**
Three months after therapy	2.00	1.00-2.00	2.50	1.00-3.00	3.021	**0.002**
χ^2	49.882		42.009			
p	**<0.001**		**<0.001**			

YPRSRS: Yale Pharyngeal Residue Severity Rating Scale; Z: Mann-Whitney U test; χ^2: Friedman test.

TABLE 7
Three months after therapy correlation of PAS, FOIS, YPRSRS-Vallecula, and YPRSRS-Pyriform Sinus values

	FOIS	Yale vallecula	Yale pyriform
PAS fine liquid	−0.603**	0.622**	0.719**
PAS nectar	−0.513**	0.464*	0.598**
PAS honey	−0.393*	0.180	0.273
PAS pudding	−0.293	0.237	0.341
PAS solid	−0.755**	0.733**	0.790**

PAS: Penetration aspiration scale; FOIS: Functional oral intake scale; YPRSRS: Yale Pharyngeal Residue Severity Rating Scale; * p<0.05; ** p<0.01.

TABLE 8
Distribution of EAT-10 values among long-term and short-term therapy groups

	Long-term group			Short-term group				
	Mean±SD	Median	Min-Max	Mean±SD	Median	Min-Max	Z	*p*
Before therapy	19.57±4.02			22.19±4.93			2.111	**0.034***
One week after therapy		22.00	14.00-38.00		33.50	22.00-38.00	2.812	**0.006****
One month after therapy		12.00	8.00-21.00		19.00	9.00-22.00	3.189	**0.001****
Three months after therapy	8.52±2.16			13.07±4.01			3.682	**0.004***
χ^2		58.031			54.365			
p		**<0.001**			**<0.001**			

EAT-10 Eating Assessment Tool-10; SD: Standard deviation; Z: Mann Whitney U test; χ^2: Friedman test.

respectively). The YPRSRS-Pyriform Sinus scores obtained at one week after therapy were significantly higher than those obtained at one month and three months after therapy (p=0.035, p<0.010, and p<0.001, respectively; Table 6).

In the values obtained at three months after therapy, a high and negative correlation was found between PAS thin liquid and FOIS (rho=–0.603), and a high and positive correlation was observed with the YPRSRS-Vallecula and YPRSRS-Pyriform Sinus (rho=0.622 and rho=0.719, respectively). Similarly, there was a high and negative relationship between PAS solid and FOIS and a high and positive relationship between the YPRSRS-Vallecula and YPRSRS-Pyriform Sinus (Table 7).

The kappa level for the scoring of the PAS and YPRSRS by the two evaluators was found to be above 0.90 (thin liquid PAS: 0.932, p<0.01; thin liquid YPRSRS: 0.908, p<0.01), indicating an excellent level of agreement between the two evaluators for each parameter.

The T-EAT-10 scores obtained before therapy and at one week, one month, and three months after therapy were significantly lower in the long-term therapy group compared to the short-term therapy group (t=2.111, p=0.034; Z=2.812, p=0.006; Z=3.189, p=0.001; t=3.682, p=0.001, respectively; Table 8).

A statistically significant difference was determined between the evaluation times for T-EAT-10 scores in both the long-term and short-term therapy groups (χ^2=58.031, p<0.001, and χ^2=54.365, p<0.001, respectively; Table 8). In pairwise comparisons, the T-EAT-10 scores obtained before therapy in the long-term therapy group were significantly higher than those obtained at three months after therapy (p=0.004 and p<0.001, respectively). The T-EAT-10 scores obtained at one week after therapy were significantly higher than those obtained at one month and three months after therapy (p=0.010, p<0.001, and p<0.001, respectively). The T-EAT-10 scores obtained at one month after therapy were higher than those obtained at three months after therapy (p=0.004, Table 8).

DISCUSSION

Dysphagia results in adverse changes in the swallowing function in geriatric individuals.[14,17] Therefore, as this places the geriatric individual at risk for the development of dysphagia, achieving optimal swallowing physiology through long-term swallowing therapy has a positive effect.[14,17,23] In geriatric patients, the literature indicates that individually tailored exercise-based swallowing therapies with a high number of repetitions increase muscle activity and accelerate slow recovery in terms of cerebral reorganization and neuroplasticity.[23] For this reason, an individualized exercise-based swallowing therapy program was applied in this study.

In the evaluation of swallowing functions, the use of endoscopic assessment is considered a frequently employed method in clinical practices.[23] In the present study, 31 participants who had issues with effective or safe swallowing following FEES evaluation were included. While the PAS scores obtained before therapy were similar in both the long-term and short-term therapy groups (PAS=7), the PAS scores obtained after therapy were higher in the short-term swallowing therapy group compared to the long-term swallowing therapy group (p<0.001). In the FEES study, pharyngeal phase abnormalities were detected in 27 patients, and laryngeal aspiration/penetration was detected

in 23 patients. Pharyngeal phase abnormalities and laryngeal aspiration/penetration were significantly higher in the short-term group. The T-EAT-10 scores were lower in the long-term group after therapy.

Balou et al.[18] implemented an eight-week swallowing therapy protocol in geriatric individuals, which included effortful swallow, Mendelsohn maneuver, resistive tongue-base exercises, supraglottic swallow, Shaker exercises, and effortful pitch glide exercises. Additional daily home practices were performed alongside therapy sessions. Following the swallowing therapy program, positive outcomes in optimal swallowing physiology were achieved in elderly adults. This finding was supported by the study of Zhang et al.[24] Kim et al.[25] demonstrated the positive effect of the Mendelsohn maneuver, included in a 20-session long-term swallowing therapy program, on swallowing physiology in elderly adults with dementia. In another study, Zhang et al.[26] observed positive effects on optimal swallowing physiology following a long-term swallowing therapy program that included effortful swallow and Mendelsohn maneuver in elderly adults with dementia who had suffered a stroke. In our study involving geriatric patients, the use of an individualized swallowing therapy program consisting of oral hygiene, thermal tactile stimulation, diet modification, postural changes, swallowing strategies, compensatory maneuvers (effortful swallow, super-supraglottic maneuver, supraglottic maneuver, Mendelsohn maneuver), and swallowing exercises (Shaker exercise, resistive tongue-base exercise, effortful pitch glide, vocal fold adduction exercises) was found beneficial in both the long-term and short-term therapy groups; however, it was observed to be much more effective in the group that underwent long-term swallowing therapy.

Carnaby et al.[19] found that a 12-week exercise-based swallowing therapy resulted in reduced severity of dysphagia, decreased EAT-10 scores, and accelerated the process of transitioning to early oral intake in geriatric individuals. An increase in the amount of laryngeal elevation and closure of the laryngeal vestibule was observed after long-term therapy. They found a significant difference comparing PAS score results after long-term therapy to the initial pretherapy levels.[19] In another study, Eltringham et al.[21] highlighted the critical importance of early dysphagia therapy intervention in intensive care patients with dysphagia complaints and aspiration pneumonia among geriatric adults with various comorbid diagnoses. In the present study, significant reductions in PAS and EAT-10 scores, improvements in swallowing reflex, a decrease in oral transit time, and a reduction in multiple swallowing movements were detected in the group receiving long-term swallowing therapy compared to the group receiving short-term therapy. Thus, an improvement in swallowing function was observed.[20,21]

Sura et al.[22] found that long-term swallowing therapy led to improvements in nutritional levels and a significant decrease in the risk of pneumonia in geriatric individuals diagnosed with dysphagia and respiratory disorders. They noted decreases in PAS scores, EAT-10 scores, and the amount of pharyngeal residue.[22] In our study, the posttherapy T-EAT-10 results were lower in the long-term therapy group compared to the short-term therapy group in geriatric patients receiving swallowing therapy.

Dysphagia is observed in 30 to 50% of patients in the acute phase of stroke. Related literature reviews have found that 6.2 to 85.7% of patients with amyotrophic lateral sclerosis experience difficulty swallowing.

The prevalence of aspiration pneumonia has been found to be around 15.0%.[27] Aoyagi et al.[27] investigated the relationship between FOIS scores and the severity of dysphagia in 216 geriatric stroke patients. They found that patients in the tube feeding group (FOIS level 1-2, n=68) exhibited more adverse quality of life indicators and lower functional skill levels/worse dysphagia severity than those in the oral feeding group (FOIS level 3-7, n=68). The study mentioned that the nutritional status could worsen within the first week after a stroke. It also highlighted that these patients face a significant risk as they could develop aspiration pneumonia, a life-threatening complication. Therefore, they emphasized the significance of early detection of dysphagia and inclusion of a swallowing rehabilitation program to reduce the incidence of malnutrition, dehydration, and aspiration pneumonia. Additionally, they noted that, as with patients diagnosed with multiple sclerosis and other neurological diseases experiencing dysphagia severity, the use of texture-modified foods and liquids is necessary to ensure safe swallowing according to the individualized needs of stroke patients. In our study, the FOIS rate showed a tendency to decrease with a positive change in the long-term therapy group (FOIS=7 at three months

after therapy in the long-term group; FOIS=5 in the short-term therapy group). In the short-term group, four patients had certain restrictions on foods, and one patient required some preparation (follow-up with diet modification).

Kelly et al.[28] reported that in patients with oropharyngeal dysphagia, pharyngeal residue levels of YPRSRS >3 signaled a dysphagia issue, whereas YPRSRS=2 indicated an adult population with healthy swallowing physiology. Ninfa et al.[29] compared FOIS outcomes with PAS and YPRSRS results obtained after FEES and a videofluoroscopic swallow study in patients with oropharyngeal dysphagia. They reported that patients with PAS >2 indicated penetration for all consistencies (PAS >2 and ≤5; $p<0.01$) and aspiration for liquids and semi-solids (PAS >5; $p<0.001$). They also observed residue in the pyriform sinuses (YPRSRS >3). Additionally, patients with signs of malnutrition (body mass index ≤18.5; $p=0.019$) were found to have low FOIS scores across all consistencies. Researchers discussed that the YPRSRS scale was a prominent tool for predicting the safety and efficiency of swallowing, as well as forecasting nutritional statuses. Their findings on swallowing performance supports this stance.

The history of coughing while eating or drinking increases the risk of aspiration; however, silent aspirations are frequently observed in geriatric individuals.[22,27] In a study conducted by Ding and Logemann,[30] silent aspiration was detected in 46.2% of elderly adult patients at risk of aspiration based on videofluoroscopic swallowing study findings. In the current study, silent aspiration of thin liquid, nectar, and solid consistencies was observed in 78% of the 31 patients based on pretherapy FEES results. This significant finding of silent aspiration among geriatric individuals hospitalized in the thoracic diseases clinic with major dysphagia complaints and multiple prognoses has shown a negative impact on swallowing physiology. Therefore, the importance of long-term monitoring and rehabilitation of dysphagia in geriatric individuals with accompanying conditions, such as aspiration pneumonia and respiratory disorders, is emphasized.

In conclusion, geriatric patients require more comprehensive rehabilitative, physical, psychological, and social care. This patient group needs a holistic approach to prevent partial or total loss of independence. The primary goal of treatment and rehabilitation related to geriatrics is to optimize the functional status of the elderly person, thereby enhancing autonomy and quality of life as much as possible. Long-term swallowing therapy applied to patients with recognized dysphagia that can lead to outcomes as severe as aspiration pneumonia with high mortality is critical, with public health benefits, positive economic impact, and reduction in the duration of hospital stay. There are few studies in the literature examining the effectiveness of long-term swallowing therapy in geriatric patients. Additionally, this study is significant due to the extensive number of instrumental swallowing evaluation periods and the application of procedures across all swallowing consistencies in this patient population. Investigating the impact of preventive rehabilitation programs and individualized swallowing therapy programs on optimal swallowing physiology is of high importance, considering overall health and quality of life in disorders associated with dysphagia in a rapidly aging society. In geriatric individuals with various diagnoses and prognoses experiencing dysphagia, long-term swallowing therapy programs are more effective compared to short-term therapy programs.

Ethics Committee Approval: The study protocol was approved by the Ankara City Hospital Clinical Research Ethics Committee No. 1. (date: 21.09.2022, no: E1-22-2917). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: A written informed consent was obtained from each patient.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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