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Effect of thickened water swallow training in tube-feeding and dysphagia patients in the acute and early subacute phases of stroke: A quasi-experimental study

Jianping Su[1,2] | Yijing Li[3] | Zhihua Xu[4] | Dan Sun[4] | Xiangning Zhu[1] | Yueyang Dong[1] | Meng He[1] | Buyin Bu[1] | Jiao Sun[1]

[1]School of Nursing, Jilin University, Changchun, Jilin, China

[2]School of Nursing, Xinjiang Medical University, Urumqi, Xinjiang, China

[3]Evidence-based Nursing Center, West China Hospital, Sichuan University/ West China School of Nursing, Sichuan University, Chengdu, China

[4]China-Japan Union Hospital of Jilin University, Changchun, Jilin, China

Correspondence
Jiao Sun, School of Nursing, Jilin University, No. 965 Xinjiang Street, Changchun, 130021 Jilin, China.
Email: sunjiao@jlu.edu.cn

Abstract

Background: Thickened water has been widely used in patients with dysphagia who receive oral feeding, but there is little evidence for tube-feeding patients.

Objective: To explore the effects of thickened water swallow training in tube-feeding and dysphagia patients in the acute and early subacute phases of stroke.

Methods: A quasi-experimental study. Hospitalised patients with acute and early subacute stroke who received tube feeding due to dysphagia were recruited from March to December 2021. Patients assigned to the intervention group ($n=23$) received thickened water swallow training three times daily until the feeding tube was removed or they were discharged, and patients in the control group ($n=23$) received usual care. The main outcomes were duration of tube feeding and rates of weaning at discharge.

Results: Patients in the intervention group had a shorter tube-feeding duration ($p=.046$) and a higher rate of weaning at discharge ($p=.017$) than those in the control group. Significant interaction effects between time and group were detected regarding quality of life except for the swallowing burden dimension.

Conclusions: Thickened water swallow training is feasible and effective for stroke patients with tube feeding and can shorten the duration of tube feeding and improve the rates of weaning and quality of life. Healthcare providers in nonrehabilitation units should actively conduct swallowing function intervention training to maximise the potential for acute and early subacute phase rehabilitation.

KEYWORDS
dysphagia, nursing, rehabilitation, stroke, tube feeding

1 | INTRODUCTION

Dysphagia is highly prevalent among patients with stroke, ranging from 28% to 65% depending on the time of assessment and the assessment tool used.[1] A meta-analysis showed that the presence of dysphagia increased health care costs by 40.36%.[2] In addition to causing dehydration, malnutrition, aspiration pneumonia, prolonged hospital stays[3] and reduced quality of life,[4] patients with dysphagia have an 8.5-fold higher risk of death than those with normal swallowing.[5]

For patients with severe dysphagia after stroke, the European Society of Clinical Nutrition and Metabolism,[6] the National Institute for Health and Care Excellence in the United Kingdom[7] and an expert consensus on dietary nutrition management of dysphagia in

Registration: This study was registered in the Chinese Clinical Trial Registry (registration number: ChiCTR2100043793). http://www.chictr.org.cn/showproj.aspx?proj=121956.

China[8] all emphasised the importance of early tube feeding. Tube feeding can provide adequate nutrition and serve as a route for medication administration. However, prolonged tube placement can cause nasal wing lesions, chronic sinusitis and gastroesophageal reflux, and it has a negative impact on swallowing function, mainly in the pharyngeal phase.[9,10] An international expert panel[11] suggested that the treatment of dysphagia should be started as early as possible, and the presence of tube feeding should not interfere with swallowing training. The risk of respiratory infections could be higher in the chronic phase of stroke if the nasogastric tube cannot be successfully removed in the acute phase.[12]

The first Stroke Recovery and Rehabilitation Roundtable (SRRR) classified 1–7 days poststroke onset as 'acute', 7 days–3 months as 'early subacute', 3–6 months as 'late subacute' and more than 6 months as 'chronic', suggesting that the first week until the first month poststroke (acute and early subacute phases) should be the target for recovery.[13] Previous studies have reported the effects of the chin tuck against resistance exercise,[14,15] neuromuscular electrical stimulation,[16,17] biofeedback therapy[18] and balloon dilatation[19] on the swallowing function of stroke patients with tube feeding. However, patients recruited in these studies were in the late subacute and chronic phases or did not have time information mentioned. There might be an enormous research gap regarding how to perform swallowing function training in the acute and early subacute phases of stroke.

Adding a thickening agent to a liquid will increase the viscosity of the liquid and slow the bolus speed, which can minimise the risk of aspiration and enhance the safety of swallowing.[20] Therefore, a thickened liquid is recommended for people with dysphagia. It should be emphasised that a thicker liquid is not necessarily automatically safer. Excessive viscosity and bolus volume have been shown to increase the risk of penetration and aspiration secondary to increased postswallow residue.[21,22] Therefore, it is necessary to identify the most appropriate viscosity and bolus volume for the patient to swallow. The volume–viscosity swallow test (V-VST)[23] is a sensitive clinical bedside test that can be used to not only identify dysphagia but also determine an optimal feeding volume and viscosity for patients by evaluating the safety and effectiveness of swallowing liquids of different viscosities and volumes.

Thickening liquids have been widely used in patients with dysphagia who fed orally.[20] A study conducted in the Republic of Korea[24] showed that replacing tube feeding with food and liquid modified with thickening agents did not increase the risk of aspiration pneumonia; therefore, this strategy was concluded to be safe for tube-feeding patients. However, the specific effects of thickener use on swallowing rehabilitation in patients with tube feeding have rarely been reported. Asian patients are more likely to have stroke-associated dysphagia than non-Asian patients.[25] In China, Asia's most populous country, the burden of dysphagia after stroke can be very high. In recent years, some Chinese researchers[26–28] have begun to develop swallow training using thickening agents and have observed improvements in swallowing function in tube-feeding patients with stroke. However, the phase of stroke in these patients and the effect of training on other important outcomes remain unknown.

This study aimed to implement thickened water swallow training for patients with dysphagia in the acute and early subacute phases of stroke to facilitate early removal of the feeding tube and recovery of oral feeding. Additionally, this study provides clinical evidence for the application of thickening agents to tube-feeding patients.

2 | MATERIALS AND METHODS

2.1 | Design

A quasi-experimental study was conducted and reported following the Transparent Reporting of Evaluations with Non-Randomized Designs (TREND) statement.[29] This study was registered in the Chinese Clinical Trial Registry (Registration number: ChiCTR2100043793).

2.2 | Participants

From March to December 2021, patients with nasogastric tubes in the neurology units of a hospital in China were recruited through purposive sampling. The inclusion criteria were as follows: (1) clinical diagnosis of haemorrhagic or ischaemic stroke; (2) patients with dysphagia of grade III or greater screened by the water swallowing test[30]; (3) patients within 1 week–3 months after stroke onset; and (4) patients conscious and able to communicate orally. The exclusion criteria were as follows: (1) severe cognitive impairment; (2) the presence of severe concomitant medical conditions (i.e. serious cardiac insufficiency, serious dystonia or end-stage severe disease); (3) dysphagia caused by other nonstroke diseases; and (4) a pre-existing nasogastric tube before admission.

2.3 | Sample size

The sample size was calculated using G*Power software, version 3.1.9.7, and the *t* test was adopted. Based on a related study,[26] an effect size of 1.08 was calculated according to the outcome of the tube-feeding duration. Finally, a sample of 23 participants per group was required to detect a difference between groups at a 5% significance level with 90% power, allowing for a 20% attrition rate.

2.4 | Procedures

This study was performed in two units that treat stroke, and the medical and nursing conditions were very similar between the two units. Nurses in both units had received systematic training for the management of swallowing issues. Patients in one of the units were recruited as the intervention group, and patients from the other unit were recruited as the control group.

The control group received usual care according to China's 'Clinical Practice Guidelines for Adults with Nasogastric Tube Feeding'. In terms of care for swallowing, the patients were instructed to perform exercises daily to improve oro-facial muscular force, including cheek bulging, tongue stretching and empty swallowing. The swallowing exercises were performed three times a day and each movement repeated 10 times.

The intervention group received thickened water swallow training performed by nurses on the basis of usual care. This training involved preparation, evaluation and implementation as follows:

1. *Preparation*: Xanthan gum thickening agents were added to drinking water and modified to three viscosities according to the criteria proposed by the Japanese Society of Dysphagia Rehabilitation, namely, mildly thick (50–150 mPa·s), moderately thick (150–300 mPa·s) and extremely thick (300–500 mPa·s).
2. *Evaluation*: The patient was in the sitting or semi-sitting supine position. Peripheral blood oxygen saturation (SpO_2) was obtained from a wearable finger pulse oximeter. The evaluation began with a volume of 3 mL (different from the most commonly used volume of 5 mL, considering the poorer swallowing function of tube-feeding patients) at the moderately thick viscosity. If the patient did not show signs of impaired safety of swallowing (i.e. changes in voice quality, cough and decrease in $SPO_2 \geq 3\%$ from the basal level), the patient was evaluated as having swallowed safely; the volume could then be increased. When the patients completed the moderately thick drink without signs of impaired safety, the mildly thick and extremely thick viscosities were also assessed with boluses of increasing volume (Figure S1). The evaluation will be halted and reassessed the next day if the patient shows signs of impaired swallowing safety at the initial viscosity and volume (i.e. a volume of 3 mL at the moderately thick viscosity).
3. *Implementation*: The lowest viscosity and largest volume that could be safely swallowed constituted the training bolus. The training bolus was administered on a smooth spoon, and the patient was instructed to swallow on the stronger side of the mouth if there was unilateral weakness. Subsequent training was performed when the complete swallowing process was observed and showed no signs of impaired safety. Training was interrupted immediately, and percussion was applied to the back if the patient had aspiration or choking. The training was performed three times per day. The total volume of the first day was limited to 20 mL, gradually increasing to 100–200 mL per day according to the patient's tolerance until the feeding tube was removed or the patient was discharged.

2.5 | Measures

2.5.1 | General information

Sociodemographic (age, sex, education, source of medical funds, primary caregiver, body mass index [BMI]) and disease-related information (history of chronic disease, stroke type and grade of water swallowing test) were collected from medical records.

2.5.2 | Tube-feeding duration and rates of weaning

The duration of tube feeding, namely the number of days from tube insertion to weaning, and the rates of weaning at discharge were the main outcomes. Feeding status was tracked daily through mobile Internet-based communication software for patients who had not been weaned at discharge. Since no clear indications for tube-feeding weaning were found in current guidelines or expert consensus, this research considered that feeding tube could be removed when patient could achieve the required nutrients through oral diet without enteral nutrition (assessed by dietitian)[31] and did not show signs of impaired swallowing safety while swallowing (assessed by speech and language pathologist).[32,33]

2.5.3 | Nutritional status

Haemoglobin (Hb), albumin (ALB), prealbumin (PA) and total protein (TP) levels were recorded.

2.5.4 | Oral functions

Lip function, tongue mobility and gargling ability, which play important roles in chewing and swallowing, were evaluated according to a previous study.[34]

Lip function: Patients who could close their lips completely were defined as 'better', whereas those who could not were defined as 'worse'.

Tongue mobility: Patients were asked to stick out their tongues and move them from side to side. If the patients could move their tongue from side to side and the progloss passed beyond the dental arch, they were defined as 'better', whereas those who could not do so were defined as 'worse'.

Gargling ability: Patients were instructed to take a mouthful of water, look upwards and gargle. If the participants cleared it with no coughing, they were defined as 'better', whereas those who could not do so were defined as 'worse'.

2.5.5 | Quality of life

The Swallow Quality of Life Questionnaire (SWAL-QOL)[35] is a specific scale for patients with dysphagia that includes 11 dimensions and 44 items. The scale is a 5-point Likert scale. Considering that the participants in this study were patients with tube feeding, the dimension of 'eating duration' was excluded since it refers to oral feeding. This study ultimately assessed psychological burden,

eating desire, dysphagia symptoms, food selection, communication, feeding fear, mental health, social function, fatigue and sleep, with a total of 10 dimensions and 42 items. The total score for each dimension was calculated and then linearly transformed to a score from 0 to 100, with higher scores indicating greater quality of life. The Chinese version of the SWAL-QOL[36] (Cronbach's α ranged from 0.815 to 1.000 for the individual dimensions) was used in this study.

2.5.6 | Caregiver burden

The Zarit caregiver burden interview (ZBI)[37] includes 22 items on a 5-point Likert scale. The total score ranges from 0 to 88, with higher scores indicating a greater care burden. The Chinese version of the ZBI[38] (Cronbach's α was 0.875) was used in this study.

2.5.7 | Adverse events

The times of aspiration and choking were recorded during the training, and the patients were followed up after discharge to ask whether the feeding tube was inserted again.

2.6 | Data collection

Nutritional status, oral function, SWAL-QOL and ZBI completed by caregivers were evaluated after feeding tube insertion and before discharge. Reasons for discharge were also recorded. The patients were followed up using mobile Internet-based communication software at 7 and 14 days after discharge to record the occurrence of adverse events.

2.7 | Validity, reliability and rigour

Rehabilitation physicians, neurologists and nursing experts were invited to review and guide the intervention protocol. The responsible nurses in the two units were assessed before the intervention to ensure that usual nursing was consistent.

During the intervention, nursing managers with a licence in swallowing rehabilitation were present to supervise the effectiveness and safety of the training. The patients and caregivers in each unit were prohibited from entering other units according to the hospital's COVID-19 prevention and control measures.

The researchers responsible for data collection had no information about the patients' group status. When the patients or caregivers were unable to complete the questionnaires themselves, researchers assisted them. The items of the questionnaire were checked immediately after completion to ensure that there were no missing items.

2.8 | Data analysis

Analyses were performed using IBM SPSS software (version 25.0). An intention-to-treat analysis was applied, and missing data were addressed using baseline observations carried forward. Variables are presented as the mean ± standard deviation, median (P25, P75) or frequency (percentage) according to the distribution.

The *t* test, the Mann–Whitney *U* test and the chi-square (χ^2) tests were conducted to compare the baseline characteristics between the intervention group and control group. For the main outcomes, a general linear model was used to analyse intergroup differences by adjusting for covariates, including sociodemographic data and baseline swallow-associated variables. A generalised estimating equation was used to analyse the changes across the pretest and posttest study periods since it considered internal correlations between pre- and postmeasurements. A $p < .05$ was deemed statistically significant.

2.9 | Ethical considerations

Ethical approval was obtained from the Ethics Committee of Jilin University (No. 2020092101). The researcher explained the purpose, process and significance of the study to the patient and promised that patients could withdraw from the study at any time without penalty. Written informed consent was provided by all the participants.

3 | RESULTS

3.1 | Recruitment, attrition and adherence

A total of 52 patients were recruited; six patients did not meet the inclusion criteria; 46 patients were enrolled and completed the baseline assessment. During the study, one patient in the control group was transferred to the ICU due to sudden deterioration of the condition, and one patient in the intervention group was discharged without posttesting. According to the principle of intention to treat, 46 participants were included in the analysis (Figure 1).

3.2 | Baseline characteristics

The mean age of the patients was 64.50 ± 9.29 years old. The patients in the intervention group ranged from 49 to 87 years old, and those in the control group ranged from 51 to 81 years old. Most of the patients were male ($n = 33$, 71.7%), with 78.3% having ischaemic strokes. No significant differences were observed in the baseline characteristics between the two groups, as shown in Table 1.

FIGURE 1 Study flow diagram.

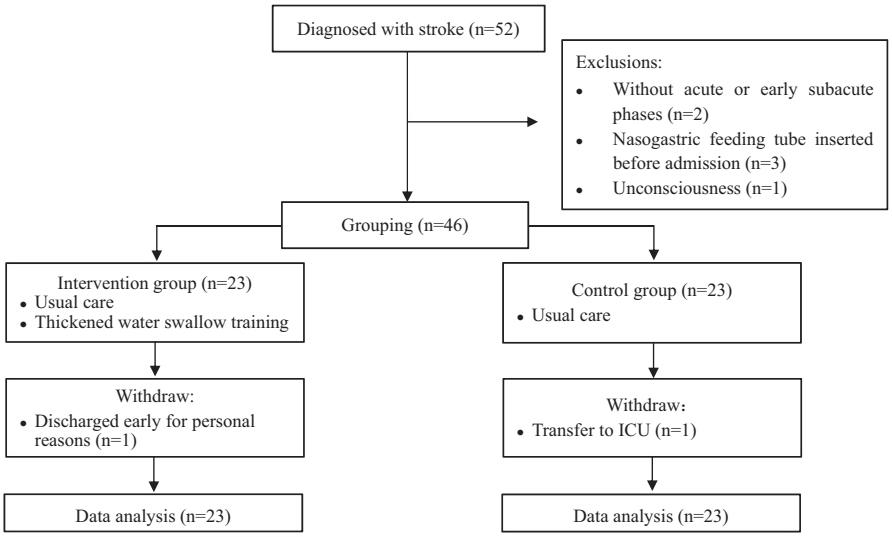

TABLE 1 General information and outcome variables at baseline.

Variable	Overall ($n=43$)	Intervention ($n=23$)	Control ($n=23$)	$t/\chi^2/U$	p
Age (years)	64.50 ± 9.29	65.17 ± 10.378	63.83 ± 8.228	−0.488[a]	.628
Sex (*n*, %)					
Male	33 (71.7)	15 (65.2)	18 (78.3)	0.965[b]	.326
Female	13 (28.3)	8 (34.8)	5 (21.7)		
Source of medical funds (*n*, %)					
Provincial medical insurance	12 (26.1)	6 (26.1)	6 (26.1)	0.845[b]	.766
Municipal medical insurance	28 (60.9)	15 (65.2)	13 (56.5)		
Self-funded	6 (13.0)	2 (8.7)	4 (17.4)		
Education level (*n*, %)					
Less than middle school	20 (43.5)	9 (39.1)	11 (47.8)	0.506[b]	.924
Middle school	18 (39.1)	10 (43.5)	8 (34.8)		
More than middle school	8 (17.4)	4 (17.4)	4 (17.4)		
Type of stroke (*n*, %)					
Ischaemic	36 (78.3)	17 (73.9)	19 (82.6)	0.511[b]	.475
Haemorrhagic	10 (21.7)	6 (26.1)	4 (17.4)		
Number of chronic conditions ≥2 (%) (*n*, %)					
Yes	34 (73.9)	16 (69.6)	18 (78.3)	0.451[b]	.502
No	12 (26.1)	7 (30.4)	5 (21.7)		
Grade of water swallowing test (*n*, %)					
Grade III	5 (21.7)	9 (39.1)		2.286[b]	.368
Grade IV	15 (65.2)	10 (43.5)			
Grade V	3 (13.0)	4 (17.4)			
BMI	22.51 ± 1.47	22.40 ± 1.70	22.62 ± 1.23	0.512[a]	.611
Primary caregiver (*n*, %)					
Son	17 (37.0)	6 (26.1)	11 (47.8)	2.371[b]	.343
Daughter	20 (43.5)	12 (52.2)	8 (34.8)		
Spouse	9 (19.6)	5 (21.7)	4 (17.4)		
Oral functions (better, *n*, %)					
Lip function	34 (73.9)	16 (69.6)	18 (78.3)	0.451[b]	.502
Tongue mobility	30 (65.2)	16 (69.6)	14 (60.9)	0.383[b]	.536
Gargling ability	19 (41.3)	11 (47.8)	8 (34.8)	0.807[b]	.369

(Continues)

TABLE 1 (Continued)

Variable	Overall ($n=43$)	Intervention ($n=23$)	Control ($n=23$)	$t/\chi^2/U$	p
Nutritional status					
Hb	132.09 ± 18.43	133.48 ± 15.79	130.70 ± 21.01	−0.508[a]	.614
ALB	41.09 ± 4.63	42.11 ± 4.72	40.06 ± 4.40	−1.522[a]	.135
PA	279.47 ± 29.66	281.09 ± 31.13	277.85 ± 28.72	−0.366[a]	.716
TP	68.74 ± 5.42	69.56 ± 4.99	67.92 ± 5.80	−1.026[a]	.311
SWAL-QOL					
Psychological burden	37.5 (34.4, 50)	37.5 (25, 62.5)	37.5 (37.5, 50)	236.000[c]	.516
Eating desire	42.03 ± 14.05	41.67 ± 15.08	42.39 ± 13.28	0.173[a]	.863
Dysphagia symptoms	42.47 ± 7.71	40.30 ± 7.28	44.64 ± 7.65	1.974[a]	.055
Food selection	50 (37.5, 50)	37.5 (25, 50)	50 (37.5, 62.5)	188.000[c]	.083
Communication	50 (25, 62.5)	37.5 (25, 62.5)	50 (37.5, 62.5)	204.000[c]	.176
Feeding fear	40.35 ± 12.06	38.86 ± 11.30	41.85 ± 12.84	0.838[a]	.407
Mental health	44.35 ± 14.28	40.43 ± 16.44	48.26 ± 10.72	1.912[a]	.062
Social function	45.11 ± 15.62	44.13 ± 18.81	46.09 ± 11.96	0.421[a]	.676
Fatigue	42.39 ± 12.77	40.58 ± 14.28	44.20 ± 11.08	0.962[a]	.342
Sleep	37.5 (25, 53.1)	37.5 (25, 62.5)	37.5 (37.5, 50)	224.000[c]	.364
ZBI	49.04 ± 8.99	47.13 ± 10.14	50.96 ± 7.39	1.462[a]	.151

Abbreviations: ALB, albumin; Hb, haemoglobin; PA, prealbumin; SWAL-QOL, Swallow Quality of Life questionnaire; TP, total protein; ZBI, Zarit Caregiver Burden Interview.

[a]*t* test.

[b]Chi-square (χ^2) test.

[c]Mann–Whitney *U* test.

3.3 | Tube-feeding duration and rates of weaning

The duration of tube feeding in the intervention group (13.17 ± 7.10) was significantly shorter than that in the control group (16.91 ± 5.10) ($t=2.051$, $p=.046$). At discharge, 60.9% of the patients in the intervention group had their feeding tubes removed at discharge, compared with 26.1% in the control group, with a significant difference ($\chi^2=5.662$, $p=.017$).

A general linear model was used to control for covariates that could impact the effect of the intervention (Table 2). In Model 1, oral functions and the grade of the water swallowing test were selected as covariables. The results showed that there were still significant differences; that is, the duration of tube feeding in the intervention group was significantly shorter than that in the control group ($p=.036$). In Model 2, age, stroke type and chronic history were selected as covariables, and the results also showed significant differences ($p=.040$).

3.4 | Oral functions and nutritional status

Generalised estimating equation analyses showed no significant group × time interaction for oral functions and nutritional status ($p>.05$), indicating that the oral functions and nutritional status of the two groups changed no differently from tube insertion to discharge (Table 3).

3.5 | Quality of life and caregiver burden

Except for the dimension of psychological burden (Wald$\chi^2=1.323$, $p=.250$), the group × time interaction was significant for the other dimensions of the SWAL-QOL, that is, the dimensions of eating desire (Wald$\chi^2=4.332$, $p=.037$), dysphagia symptoms (Wald$\chi^2=10.862$, $p=.001$), food selection (Wald$\chi^2=10.024$, $p=.002$), communication (Wald$\chi^2=5.971$, $p=.015$), feeding fear (Wald$\chi^2=7.219$, $p=.007$), mental health (Wald$\chi^2=18.274$, $p<.001$), social function (Wald$\chi^2=8.009$, $p=.005$), fatigue (Wald$\chi^2=7.666$, $p=.006$) and sleep (Wald$\chi^2=4.851$, $p=.028$) of the two groups changed differently from tube insertion to discharge (Table 4 and Figure S2). Generalised estimating equation analyses showed no significant group × time interaction for caregiver burden ($p>.05$).

3.6 | Observational outcomes

The average hospitalisation length was 15.13 ± 4.53 days in the intervention group and 15.57 ± 4.47 days in the control group, with no significant difference ($t=0.328$, $p=.745$).

Most patients in the intervention group ($n=13$, 56.5%) and control group ($n=17$, 73.9%) were discharged due to improvement in their disease condition. There was no significant difference in the reasons for discharge between the two groups ($\chi^2=1.937$, $p=.386$).

3.7 | Adverse events

During the intervention, no patients experienced aspiration or choking caused by the training. During the follow-up period, one patient in the intervention group who had been weaned at discharge had a feeding tube reinserted due to insufficient intake after being transferred to the rehabilitation department.

4 | DISCUSSION

This study found that thickened water swallow training was feasible and effective for patients with dysphagia in the acute and early subacute phases of stroke, and it could significantly shorten the duration of tube insertion and rates of weaning at discharge. In addition, it contributed to improving the patients' quality of life.

The decision of tube removal requires interdisciplinary evaluations.[39] In our study, the speech and language pathologist decided the diet level on the basis of bedside swallowing assessments. The dietitian was responsible for assessing the patient's oral nutrient intake. Finally, the physician made the medical order of feeding tube removal based on the combination of multidisciplinary recommendations. However, it should be noted that the removal of feeding tube is a comprehensive decision that also takes into account the wishes of the patients and caregivers.[40] The rate of feeding tube removal in this study might not fully reflect the recovery of swallowing function. Future studies should use instrumental testing (e.g. videofluoroscopic or fibreoptic evaluation) or bedside screening tool (e.g. the Gugging Swallowing Screen) as swallowing function evaluation method to further verify the effectiveness of thickened water swallow training.

Although various studies related to dysphagia after stroke have been reported, studies of tube-feeding patients are limited. Due to dietary restrictions, the oral movement and swallowing muscle activity of feeding tube-dependent patients are reduced, easily leading to disuse atrophy. Additionally, there are many risks associated with prolonged feeding tube placement. Therefore, healthcare providers should

TABLE 2 Comparison of tube-feeding duration after adjustment according to the general linear model between the two groups.

Model	Intervention (days)	Control (days)	*F*	*p*
Model 1	13.18	16.91	4.696	.036*
Model 2	13.05	17.03	4.523	.040*

*$p < .05$.

TABLE 3 Generalised estimating equation analyses of oral functions and nutritional status.

Variable	Intervention	Control	Time effect		Group effect		Group × time effect	
			Waldχ^2	*p*	Waldχ^2	*p*	Waldχ^2	*p*
Oral functions (better, *n*, %)								
Lip function								
Pretest	16 (69.6)	18 (78.3)	9.047	.003*	0.063	.802	0.112	.737
Posttest	22 (95.7)	22 (95.7)						
Tongue mobility								
Pretest	16 (69.6)	14 (60.9)	10.960	.001*	1.051	.305	0.519	.471
Posttest	22 (95.7)	20 (87.0)						
Gargling ability								
Pretest	11 (47.8)	8 (34.8)	13.268	<.001*	2.383	.123	1.301	.254
Posttest	18 (78.3)	12 (52.2)						
Hb								
Pretest	133.48 ± 15.79	130.70 ± 21.01	1.103	.294	0.891	.345	1.103	.294
Posttest	133.48 ± 13.39	127.61 ± 15.61						
ALB								
Pretest	42.11 ± 4.72	40.06 ± 4.40	0.097	.775	3.446	.063	0.629	.428
Posttest	42.73 ± 5.04	39.79 ± 5.89						
PA								
Pretest	281.09 ± 31.13	277.85 ± 28.72	1.515	.218	0.160	.689	0.028	.868
Posttest	284.22 ± 24.70	281.96 ± 16.42						
TP								
Pretest	69.56 ± 4.99	67.92 ± 5.80	2.262	.133	1.034	.309	0.045	.833
Posttest	68.29 ± 4.38	66.97 ± 7.10						

Abbreviations: ALB, albumin; Hb, haemoglobin; PA, prealbumin; TP, total protein.

*$p < .05$.

TABLE 4 Generalised estimating equation analyses of quality of life and caregiver burden.

			Time effect		Group effect		Group × time effect	
Variable	Intervention	Control	Waldχ^2	*p*	Waldχ^2	*p*	Waldχ^2	*p*
SWAL-QOL								
Psychological burden								
Pretest	37.5 (25, 62.5)	37.5 (37.5, 50)	38.981	<.001*	0.172	.678	1.323	.250
Posttest	62.5 (50, 75)	62.5 (50, 62.5)						
Eating desire								
Pretest	41.67 ± 15.08	42.39 ± 13.28	48.405	<.001*	1.954	.162	4.332	.037*
Posttest	69.20 ± 21.09	57.25 ± 19.35						
Dysphagia symptom								
Pretest	40.30 ± 7.28	44.64 ± 7.65	66.997	<.001*	1.679	.196	10.862	.001*
Posttest	65.45 ± 13.93	55.36 ± 12.76						
Food selection								
Pretest	37.5 (25, 50)	50 (37.5, 62.5)	12.185	<.001*	1.796	.180	10.024	.002*
Posttest	62.5 (50, 75)	50 (37.5, 50)						
Communication								
Pretest	37.5 (25, 62.5)	50 (37.5, 62.5)	44.249	<.001*	0.606	.436	5.971	.015*
Posttest	75 (62.5, 100)	62.5 (50, 75)						
Feeding fear								
Pretest	38.86 ± 11.30	41.85 ± 12.84	31.289	<.001*	4.213	.040*	7.219	.007*
Posttest	64.40 ± 17.82	50.82 ± 12.96						
Mental health								
Pretest	40.43 ± 16.44	48.26 ± 10.72	22.013	<.001*	2.235	.135	18.274	<.001*
Posttest	68.48 ± 22.08	49.57 ± 16.09						
Social function								
Pretest	44.13 ± 18.81	46.09 ± 11.96	13.658	<.001*	3.586	.058	8.009	.005*
Posttest	65.43 ± 22.56	48.91 ± 14.77						
Fatigue								
Pretest	40.58 ± 14.28	44.20 ± 11.08	18.608	<.001*	2.435	.119	7.666	.006*
Posttest	60.51 ± 15.12	48.55 ± 12.97						
Sleep								
Pretest	37.5 (25, 62.5)	37.5 (37.5, 50)	16.731	<.001*	2.201	.138	4.851	.028*
Posttest	62.5 (50, 87.5)	50 (37.5, 75)						
ZBI								
Pretest	47.13 ± 10.14	50.96 ± 7.39	31.465	<.001*	9.687	.002*	1.884	.170
Posttest	33.09 ± 11.55	42.43 ± 10.91						

Abbreviations: SWAL-QOL, Swallow Quality of Life questionnaire; ZBI, Zarit Caregiver Burden Interview.
*$p < .05$.

strengthen training, monitoring and evaluation of swallowing function to promote early and safe removal of a feeding tube. A study of previous neuromuscular training of approximately 5 weeks[18] showed that 80% of patients with dysphagia after stroke were successfully weaned from tube feeding. Notably, all of the patients in this study had received speech therapy for more than 1 month before enrolment. Dysphagia is an interdisciplinary issue, and speech therapists play a leading role in its assessment, diagnosis and management.[41] However, there is a large gap between speech therapist practitioners and clinical demand in many countries, especially in China, where there is a high burden of rehabilitation after stroke, and practitioners account for less than 4% of demand.[42] The nurses responsible for the V-VST assessment in this study were all trained in courses related to swallowing issues. This study emphasises the significant value of nurses in the management of dysphagia, especially in nonrehabilitation units with limited speech therapists. It is suggested to provide training relevant to dysphagia for nurses in the future to provide more timely and effective management for patients with dysphagia in the acute unit.

Despite the widespread use of thickening agents in the community and hospitals, some guidelines and reviews have expressed concern about insufficient evidence for clinical application due to the lack of randomised controlled trials and the use of international terminology for thickened liquids.[6,43] In recent years, studies conducted in China have shown positive effects of thickening agents in tube-feeding patients. It was reported that all patients with stroke were weaned from tube feeding after 4 weeks of thickened water swallow training, although there were no available data on the duration of tube feeding.[27] A similar intervention involving patients with neurological disease reported 10.14 ± 4.26 days of tube feeding.[28] In this study, 60.9% of the patients had tube feeding removed at discharge, and the length of tube feeding was 13.17 ± 7.10 days, indicating a lower weaning rate and longer tube-feeding duration. The difference could be attributed to the fact that the participants recruited in this study were all acute unit inpatients who mainly received disease-related medical treatment and lacked systematic and comprehensive swallowing interventions. However, they were all within 1 month after stroke onset, consistent with the optimal recovery time proposed by the SRRR, and still had a great potential for recovery. The swallow training in this study could be considered an early prophylactic intervention. In addition, patients in the intervention group had greater access to regain oral feeding since the daily training can reveal the swallowing safety timely. It led to the performance bias and the findings need to be interpreted with caution. Rigorously designed, randomised controlled trials are needed to further confirm the clinical efficacy of this training.

Nutritional status is an important indicator affecting rehabilitation or clinical outcome,[44] which can have a certain influence on the recovery of dysphagia in stroke patients. The nonsignificant effect on nutritional status in this study was not accidental because thickening agents were only used as training necessities that were not nutritional supplements themselves, and we did not control for enteral and parenteral nutrition intake in the two groups. Foods with pure textures contain less energy, protein and micronutrients than those with regular textures. Previous studies[45,46] have reported an association between modified textures of food and thickened liquids and malnutrition risk. Conversely, in patients with maxillary carcinoma and dysphagia who were orally feeding, a significant improvement in BMI was observed 3 months later using liquid foods with thickening agents.[47] This outcome suggests that thickening agents could be combined with liquid food in future studies to improve the nutritional status of tube-feeding patients while promoting safe eating.

Swallowing involves not only physiological food intake but also social, psychological and cultural experiences. The experience of drinking thickened fluids was described as 'awful' and 'shameful'.[48] The use of thickened fluids significantly reduced the patient's quality of life, as measured by the scale,[49] contrary to the findings of this study. Despite the poorer experience associated with thickened fluids, this training increases the chances of oral intake, regarded as hope of recovery for tube-feeding patients, which could compensate for the adverse effects of tube feeding on their quality of life.[50,51] However, caregiver burden did not show improvement at discharge. Symptoms of dysphagia can persist for a long time, regardless of whether the tube feeding is removed at discharge. Most patients return home after discharge, and managing this chronic symptom at home is a very complex activity, placing a heavy burden on caregivers.[52] Given the short duration of intervention in this study, care burden might not improve in the short term. Educational counselling for stroke caregivers reduced the burden of care in previous studies.[52,53] Therefore, counselling postdischarge should be strengthened in study designs rather than terminating interventions immediately after the target outcome is observed so that patients and caregivers can receive continuity of care.

There were some limitations in this study. First, as a quasi-experimental study, the level of evidence was inferior to that of a randomised controlled trial. Second, this study failed to develop more accurate and clear indications for tube-feeding weaning because no relevant guidelines or expert consensus were found. Although fibreoptic endoscopic evaluation of swallowing and videofluoroscopic swallowing study are considered the best tests for objectively evaluating oropharyngeal dysphagia, they were not performed as a criterion for determining feeding status in this study due to the high cost. Third, oral function evaluations based on visual inspection could vary among researchers and were not as accurate as instruments. However, we conducted uniform training for evaluators, and the measurement methods were validated in previous studies. Fourth, only patients with nasogastric tube feeding were recruited in this study, and the effect on patients with gastrostomy tube feeding is unknown. Finally, face-to-face follow-up was not achieved in this study due to the impact of COVID-19. Although the researchers could not directly observe the outcomes of the patients after discharge, the information that we captured through regular communication online was reliable.

5 | CONCLUSION

Thickened water swallow training significantly shortened the duration of tube insertion and increased rates of weaning at discharge, with an improvement in quality of life. These results emphasise the importance of early intervention in tube-feeding patients with dysphagia in the acute and early subacute phases of stroke. However, the outcomes should be interpreted with caution given the quasi-experimental study design. Future studies must confirm the findings of this study and provide evidence supporting the clinical use of thickening agents in tube-feeding patients using more objective and accurate measurements.

AUTHOR CONTRIBUTIONS

Conceptualisation, methodology, writing–review and editing: Yijing Li, Zhihua Xu and Jiao Sun. Formal analysis: Yijing Li, Zhihua Xu and Dan Sun. Resources: Jianping Su. Software and investigation: Zhihua Xu, Dan Sun, Xiangning Zhu, Yueyang Dong, Meng He and Buyin Bu. Writing—original draft: Jianping Su and Yijing Li.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author.

ETHICS STATEMENT

This study was approved by the Ethical Review Committee of the School of Nursing, Jilin University (No. 2020092101).

ORCID

Yijing Li https://orcid.org/0000-0002-0677-2664

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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