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Research article

Effect of modified facial paralysis rehabilitation nursing on patients with facial paralysis after vestibular schwannoma surgery

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ABSTRACT

Background and objective: After vestibular schwannoma (VS) surgery, some patients exhibit different degrees of peripheral facial paralysis, which can seriously affect their quality of life. The recovery of facial nerve function after surgery typically takes a considerable amount of time; therefore, the recovery of facial nerve function depends mainly on the rehabilitation treatment and nursing after discharge. In the past, we implemented conventional paralysis rehabilitation nursing program for patients with facial paralysis due to VS surgery. However, several patients with facial paralysis have bad compliance and do not achieve ideal facial nerve function recovery. Therefore, this study aimed to investigate whether modified facial paralysis rehabilitation nursing improves the effectiveness of rehabilitation of facial paralysis after VS surgery by analysing the clinical data of patients.

Methods: We screened the patients with facial paralysis after VS surgery from December 2019 to May 2023. The patients were divided into the conventional and modified groups based on the different nursing programs (conventional vs. modified facial paralysis rehabilitation nursing program) to compare the differences in facial nerve function, quality of life of patients, and compliance of rehabilitation between the two groups.

Results: We analysed 128 patients with facial paralysis after VS surgery who met the inclusion and exclusion criteria; 65 and 63 patients in the conventional and modified group, respectively. The number of patients in the modified group with House–Brackmann grade changes >0 in facial nerve function was significantly higher than that in the conventional group 3 months after surgery (82.5 % vs 63.1 %, $p = 0.01$). Except for the lacrimal control score, the mean scores of the Chinese version of the FaCE scale were significantly higher in the modified group than those in the conventional group at 1 and 3 months postoperatively.

Conclusions: The modified facial paralysis rehabilitation nursing, i.e., integrated use of facial expressive muscle exercises and facial massage with video-assisted education, substantially improved the facial nerve function, quality of life, and compliance of rehabilitation nursing of patients with facial paralysis after VS surgery.

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1. Introduction

After vestibular schwannoma (VS) surgery, some patients exhibit different degrees of peripheral facial paralysis, which can seriously affect their quality of life [1–3]. Facial paralysis includes facial movement disorders caused by facial nerve physiological function and anatomical structure abnormalities, such as crooked mouth, eyelid insufficiency, lacrimal discharge, masticatory disorder, and drooling; moreover, it causes individual sensory and behavioural abnormalities stemming from facial disability and a decline in quality of life, including in social function and mental health [4–6]. Generally, patients with VS are discharged from the hospital 7–10 days after surgery. They have a short hospital stay, but the recovery of facial nerve function after surgery typically takes a considerable amount of time; therefore, the recovery of facial nerve function depends mainly on the rehabilitation treatment and nursing after discharge. Physical treatments, such as facial motor rehabilitation training [6], electrical stimulation [7], mime therapy [8], facial massages [9], and biofeedback [10], promote the rehabilitation of patients with facial paralysis [11]. However, the physical rehabilitation technology for facial paralysis mentioned above is very sophisticated, and the treatment process is complicated and needs to be provided by rehabilitation therapists in professional medical institutions. Owing to medical and family conditions, personal factors, and several other reasons, many patients with facial paralysis give up or fail to receive sustained and effective rehabilitation treatment, thereby not achieving ideal facial nerve function recovery and experiencing a decline in their quality of life.

In the past, we implemented conventional paralysis rehabilitation nursing program for patients with facial paralysis after VS surgery, which involved verbally instructing patients in simple facial muscle exercises and providing regular follow-up after discharge, during the follow-up, several patients with facial paralysis showed poor compliance and did not reach ideal facial nerve function recovery, which led to a decline in their quality of life. Therefore, a rehabilitation nursing program that is easy to operate; independent of the hospital, treatment staff, economic factors, and other variables; can be adopted at home; and enables patients to receive continuous and effective rehabilitation needs to be established. Facial massages play a positive role in the improvement of the symptoms of facial paralysis, depression, and pain, as well as reducing facial edema and improving muscle function [8,9,12,13]. Video-assisted education has become an emerging health education strategy, and it has a better effect than oral education alone [14,15]. It is not limited by economical, time, space, and age considerations and can be easily performed by anyone. Therefore, we modified the conventional facial paralysis rehabilitation nursing program by combining it with facial massages and video education to create a modified facial paralysis rehabilitation nursing program. This study aimed to investigate whether the modified facial paralysis rehabilitation nursing can improve the effectiveness of rehabilitation for facial paralysis after VS surgery by analysing the clinical data of patients.

2. Materials and methods

2.1. Study design and participants

This was a retrospective cohort study. From December 2019 to May 2023, 128 patients with facial paralysis after VS surgery who met the inclusion and exclusion criteria were included; 65 patients in the conventional group and 63 patients in the modified group. The study was approved by the Ethics Committee; the patients were provided an explanation of the purpose and methodology of the study and written informed consent was obtained from the patients. The inclusion criteria were as follows: ① unilateral facial paralysis after VS surgery (HB ≥ Grade 2), ② aged between 18 and 70 years, regardless of sex, ③ conscious and cooperative, with activities of daily living (ADL) [16] score ≥60, and ④ did not receive other rehabilitation treatments for facial paralysis, besides rehabilitation nursing for facial paralysis, after surgery. The exclusion criteria were as follows: ① diagnosis of neurofibromatosis type 2 (NF2), ②

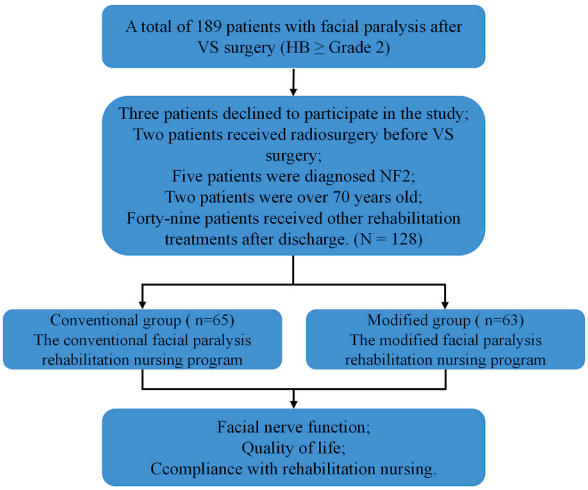

Fig. 1. A flow diagram of this study.

history of any forms of therapies, such as VS surgery or radiosurgery, ③ presence of cognitive impairment or a simultaneous hearing and visual impairment, and unable to cooperate with training and questionnaire after surgery, and ④ declining to participate in this study. None of the participants withdrew from the study. Fig. 1 shows the flow diagram of this study.

2.2. Interventions

Conventional group: The patients in this group underwent the conventional facial paralysis rehabilitation nursing program, including facial expression muscle exercises, teaching material, and oral instructions. The comparison of the two rehabilitation nursing programs can be found in Table 1.

Modified group: Based on the clinical practice of the conventional group and data in the literature [4–6,8–10,13,17,18], we modified the facial expression muscle training methods and combined it with facial massage. Finally, we developed a comprehensive facial expression muscle exercise method and improved the training points and matters needing attention. Facial Expressive Muscle Comprehensive Exercise comprised the two parts facial massage and facial expressive muscle exercise. The facial massage regimen consisted of six parts, and the facial expressive muscle exercise routine consisted of four parts. The nurse in charge provided guidance about the facial expressive muscle comprehensive exercise to the patients who experienced facial paralysis occurred after surgery, until they were discharged from the hospital. The exercise required four repetitions per day at 10:00 a.m., 1:30 p.m., 4:30 p.m., and 7:30 p.m. Each movement was repeated five times and lasted 5 s. The entire training movement exercise routine required approximately 10 min. In order to make it easier for patients to master the training methods, the team members filmed rehabilitation training videos for patients to learn. The head nurse and a doctor supervised the filming of the video, whereas it was demonstrated by a teaching nurse and explained by a neurosurgical specialist nurse. In the video, the purpose, key points, and training methods were specified clearly. Before each training movement, the teaching nurse demonstrated the movement, and the patient had 3 s to get familiar with each movement, after which the patient could follow the nurse in the video to complete each training movement. Since patients could feel uncomfortable or be interrupted during the video training process, they were not required to complete all the movements consecutively during the training process. When ready, the patient could resume training by following the video. Patients were considered to have completed the exercise as long as they could complete all the movements in the video as required. (Details of the modified facial expressive muscle comprehensive exercise can be found in Table 2 and Supplementary Materials-Video).

Table 1
Comparison of two rehabilitation nursing programs.

	Conventional group	Modified group
Research team	One head nurse (Group leader) and four neurosurgical specialist nurses	One head nurse (group leader), a senior neurosurgeon (Deputy group leader), four neurosurgical specialist nurses, one teaching nurse, and two neurosurgeons
Training	The research team is responsible for training and assessing all nurses in the ward, and each can only implement this program for patients after being trained and qualified.	The research team is responsible for training and assessing all nurses in the ward. Every nurse can implement this program for patients only after being trained and qualified. The training is conducted once a month to ensure that all nurses can proficiently implement this program.
Intervention criteria	When the patient developed facial paralysis after surgery, the nurse in charge and the neurologist (third-party evaluation) jointly assessed the patient's general status and facial nerve function. After the evaluation, the research team decided whether to implement the protocol.	
Educational method	Teaching material and oral instructions	Video education by using laptops, mobile phones, and other mobile video playback devices
Exercise content	NA	Facial massage (Frontal belly of the occipitofrontalis, Orbicularis oculi, Levator labii superioris, Zygomaticus major and minor, Orbicularis oris, Depressor labii inferioris)
	Facial expression muscle training (Forehead, eyes, nose and mouth)	Facial expression muscle training (Forehead, eyes, nose and mouth)
	The following aspects should be paid attention to during exercise: ① Patients should concentrate on training in a quiet environment. ②For an action that cannot be completed or is subpar, the hands must be used to perform it correctly.	The following aspects should be paid attention to during exercise: ① Patients should concentrate on training in a quiet environment. ② Each training movement should be up to standard but not exaggerated. ③ For an action that cannot be completed or is subpar, the hands must be used to perform it correctly. ④ Before training, patients should clean their faces and hands and properly apply moisturizer to reduce friction. Both hands should apply moderate strength to avoid pain caused by excessive exertion. ⑤ Patients should stop and rest when their face feels tired.
Frequency	Each movement lasts 5 s for 5 reps. Do 5 min of exercise 4 times a day	Each movement lasts 5 s for 5 reps. Do 10 min of exercise 4 times a day
Follow-up	The nurse distributed the instruction manual for facial expression muscle exercises to patients. Within 3 months after surgery, the researchers conducted online supervision and follow-up through the Wechat group and sent exercise information to the patients 4 times a day. After completing each training, the patients were required to send a message to the researchers. The researchers recorded the number and time of training the patients completed daily.	The researchers sent videos of facial expression muscle comprehensive exercises to the patients. Within 3 months after surgery, the researchers conducted online supervision and follow-up through the Wechat group and sent exercise information to the patients 4 times daily. The problems encountered in the rehabilitation training process were answered during the follow-up visit. After completing each training, the patients were required to send a message to the researchers. The researchers recorded the number and time of training the patients completed daily.

Table 2
Facial expressive muscle comprehensive exercise for patients with facial paralysis.

Category	Step	Practice Method
Facial massage	**1–1 Frontal belly of the occipitofrontalis**	Use the finger pulp of the thumb or index finger to gently massage back and forth between the superciliary arch and the top of the head along the frontal belly of the occipitofrontalis muscle. When massaging, push and pull gently or rub slowly from the superciliary arch to the hairline on the top of the head.
	1–2 Orbicularis oculi	Use the finger pulp to massage along the upper and lower eyelids or the depressions near the infraorbital margin. Use the finger pulp of the thumb or index finger to push and pull gently along the upper eyelid from the middle to the side, and then gently push and pull along the lower eyelid from the side to the middle.
	1–3 Levator labii superioris	Massage from the superior orbicularis oris to the ala nasi and the zygomatic region on the affected side. Use the finger pulp of either the thumb or index finger and middle finger to massage along the nasolabial folds or corners of the mouth toward the zygomatic region.
	1–4 Zygomaticus major and minor	Pull the mouth corner up and outward. Push and pull or rub along the muscle fibers from the corners of the mouth to the zygomatic bone.
	1–5 Orbicularis oris	Superior orbicularis oris: using the thumb and the pulp of the index finger, massage along the corners of the mouth on the affected side toward the philtrum, then along the philtrum toward the corners of the mouth. Inferior orbicularis oris: using the thumb and the pulp of the index finger, massage along the corners of the mouth on the affected side toward the center, then back to the corners of the mouth on the affected side.
	1–6 Depressor labii inferioris	Using the pulp of the thumb to gently massage, push and pull from the lower corner of the mouth inward and downward.
Facial expressive muscle exercis	**2–1 Forehead**	1. (Frown) Frown intensely and apply pressure to the inner side of the eyebrow to assist the movement. 2. (Raising eyebrows) Raise the eyebrows forcefully and apply pressure to the middle of the eyebrows to assist the movement.
	2–2 Eye	1. (Closing eyes firmly) Close your eyes firmly or use your fingers to apply pressure and assist the movement. 2. (Alternately close your eyes tightly and then gently) Alternately close your eyes tightly and then gently.
	2–3 Nose	1. (Expanding nostrils) Close the lips tightly and expand the nostrils as much as possible. 2. (Narrowing nostrils) Close the lips tightly and inhale to narrow the nostrils as much as possible. 3. (Wrinkling nose) Forcibly contract the nose to form wrinkles at the root of the nose. Use your fingers to help with the movement.
	2–4 Mouth	1. (Making the “u” sound) Press your fingers against the corners of the mouth, stretch your lips forward, and make the “u” sound. 2. (Making the “i” sound) Press your fingers against the corners of the mouth, retract your lips inward, and make the “i” sound. 3. (Moving the upper lip) Move the upper lip to reveal the upper gums and use your fingers to help with the movement. 4. (Moving the lower lip) Move the lower lip to reveal the lower gums and use your fingers to help with the movement. 5. (Holding object with two lips and moving) Hold an object between the lips and try to move the object from left to right and back and forth.

2.3. Assessment

Facial Nerve Function. The House–Brackmann (HB) grade system [19], used worldwide, was employed in this study; it consists of six grades, where Grade I represents a normal function, and Grade VI represents total facial paralysis. It is one of the most widely used scales and has good inter-scale reliability [10,20,21]. Two senior neurologists evaluated the patients' HB grades, but a third neurologist would make a final decision if there were evaluation inconsistencies. All the neurologists involved in evaluating facial nerve function were blinded to the patient's allocation.

Quality of Life of Patients with Peripheral Facial Nerve Palsy. The Chinese version of the Facial Clinimetric Evaluation (FaCE) [22,23] comprises 15 items (score 0–5 points), including six dimensions of facial movement, facial sensation, oral function, eye sensation, tear secretion, and social function. It is the most frequently used tool to assess the impact of facial paralysis on the quality of life. Patients filled in the scale according to their feelings. The total score and that of each dimension (0–100 points) can be calculated using the formula by statisticians. A lower score indicates poorer health. The FaCE scale is a special scale for life quality evaluation of patients with facial palsy, which was validated by Kahn et al., in 2001 [23]. The Chinese version of the FaCE scale has been proven to have good reliability and validity [22].

Compliance. Compliance with the two rehabilitation nursing programs was evaluated by comparing the average number of weekly exercises performed 3 months after surgery between the two groups.

2.4. Data collection

We collected the minimum stimulation intensity of facial nerve proximal to the brainstem to induce action potential after tumour

resection (defined as the stimulation threshold). The data of facial nerve function and quality of life assessment were recorded on postoperative Day 1 and 8 and months 1 and 3. The frequency of rehabilitation training was recorded every day during hospitalisation and follow-up. The same physician assessed facial nerve function for each patient at different stages of recovery to ensure the accuracy of the results. During the follow-up period, the family members recorded videos of the patients' facial movements under the guidance of the researchers and assisted the patients in completing the FaCE scale. The video and results of the face scale were then sent to the researchers.

2.5. Data analysis

The Shapiro–Wilk test was used to test the distribution patterns. The continuous quantitative variables are expressed as numbers, means, standard deviations, and medians. Continuous variables with normal distribution were computed using a *t*-test. Categorical variables were compared using the chi-square test and Fisher's exact test. Ordinal variables and variables following non-normal distribution were analysed using the Mann–Whitney *U* test.

3. Results

The objective of this study was to investigate whether modified facial paralysis rehabilitation nursing improved the effectiveness of rehabilitation of facial paralysis after VS surgery. This study considered 189 patients with facial paralysis after VS surgery (HB $\geq$ Grade 2) from December 2019 to May 2023; of whom, 128 were enrolled based on the inclusion and exclusion criteria. The demographic and baseline data for the two groups are shown in Table 3. All the patients completed the relevant exercises, and follow-ups were performed 3 months after surgery. No significant differences in sex, age, education level, occupation, marital status, tumour diameter, or other general information were observed between the groups ($p > 0.05$).

3.1. Stimulation threshold and postoperative facial nerve function

No significant differences in the proportion of stimulation thresholds between the modified and conventional groups, as detailed in Supplementary Table 1 ($p = 0.242$). The recovery of the patients with facial paralysis after VS surgery in the two groups before and after the intervention is shown in Table 4. The number of patients in the modified group with HB grade changes >0 was significantly higher than that in the conventional group 3 months after surgery (82.5 % vs 63.1 %, $p = 0.01$). Additionally, we conducted an intergroup comparison of changes in facial nerve function 3 months after the rehabilitation nursing intervention for patients with different levels of facial nerve function Day 1 after surgery. The results showed that the facial nerve function in the modified group was superior to that in the conventional group 3 months after surgery, but this was only observed in patients with HB grade III facial nerve

Table 3
Baseline data.

	Conventional group (N = 65)	Modified group (N = 63)	p
Gender			0.75[a]
Male	23 (35.4 %)	24 (38.1 %)	
Female	42 (64.6 %)	39 (60 %)	
Age (Median/interquartile spacing)	46.55/21	46.14/18	0.867[b]
Side			0.707[a]
Lift	50 (51 %)	41 (48.2 %)	
Right	48 (49 %)	44 (51.8 %)	
Maximum axial diameter of the tumor (mean, SD)	33.82 ± 9.48	33.84 ± 8.69	0.989[c]
Preoperative facial nerve function (HB classification)			/
I	65 (100 %)	63 (100 %)	
Marital status			0.70[a]
married	53 (81.5 %)	52 (82.5 %)	
spinsterhood	8 (12.3 %)	9 (14.3 %)	
widowed	4 (6.2 %)	2 (3.2 %)	
Education			0.67[a]
Undergraduate	37 (56.9 %)	37 (58.7 %)	
Senior high school	17 (26.2 %)	19 (30.2 %)	
Junior high school	6 (9.2 %)	5 (7.9 %)	
Elementary school	3 (4.6 %)	2 (3.2 %)	
Illiteracy	2 (3.1 %)	0 (0 %)	
Facial nerve function (HB, one day after surgery)			0.98[a]
II	26 (40 %)	26 (41.3 %)	
III	18 (27.7 %)	17 (27 %)	
IV	21 (32.3 %)	20 (31.7 %)	
V	0 (0 %)	0 (0 %)	

[a] Chi-squared Test.
[b] Mann-Whitney *U* test.
[c] T-test.

Table 4
Postoperative facial nerve function.

Facial nerve function (HB)	Conventional group (N = 65)	Modified group (N = 63)	p
One month after surgery			0.709
I	10 (15.4 %)	13 (20.6 %)	
II	18 (27.7 %)	20 (31.7 %)	
III	19 (29.2 %)	17 (27 %)	
IV	18 (27.7 %)	13 (20.6 %)	
One month after surgery (Variation)			0.07
> 0	17 (26.2 %)	26 (41.3 %)	
≤0	48 (73.8 %)	37 (58.7 %)	
Three months after surgery			/
I	22 (33.8 %)	26 (41.3 %)	
II	16 (24.6 %)	21 (33.3 %)	
III	16 (24.6 %)	9 (14.3 %)	
IV	11 (16.9 %)	7 (11.1 %)	
V	0 (0 %)	0 (0 %)	
Three months after surgery (Variation)			0.01
> 0	41 (63.1 %)	52 (82.5 %)	
≤0	24 (36.9 %)	11 (17.5 %)	

Chi-squared Test.

function on Day 1 after surgery. For patients with HB grade II or IV facial nerve function on Day 1 after surgery, no significant differences in facial nerve function were observed between the modified and conventional groups 3 months after surgery. For more details, see Supplementary Tables 2–4.

3.2. Quality of life in patients with peripheral facial paralysis

Data on the patients' quality of life for both the groups before and after the intervention are shown in Table 5. Day 8 after surgery, the mean facial comfort score was significantly higher in the modified group than in the conventional group (46.29 vs 37.94, p =

Table 5
Patients' quality of life.

	Conventional group (N = 65)	Modified group (N = 63)	p
Day 1 after surgery (mean, SD)			
Facial movement	25.00(50.00)[a]	25.00 (50.00)[a]	0.489
Facial comfort	33.84 (17.42)	36.77 (16.37)	0.186
Oral function	62.88 (26.14)	68.65 (26.26)	0.205
Eye comfort	57.11 (25.95)	61.11 (27.50)	0.387
Lacrimal control	91.54 (16.69)	93.25 (14.34)	0.665
Social function	28.94 (23.71)	35.91 (23.83)	0.084
Total	42.28 (18.77)	46.79 (19.43)	0.172
Day 8 after surgery (mean, SD)			
Facial movement	25.00 (50.00)[a]	25.00 (50.00)[a]	0.458
Facial comfort	37.94 (18.75)	46.29 (19.44)	0.015
Oral function	63.26 (26.32)	69.24 (26.16)	0.193
Eye comfort	57.88 (26.10)	62.50 (27.22)	0.328
Lacrimal control	91.54 (16.69)	93.25 (14.34)	0.665
Social function	35.19 (22.73)	44.74 (23.79)	0.022
Total	45.07 (19.86)	51.50 (20.68)	0.076
One month after surgery (mean, SD)			
Facial movement	37.43 (26.76)	46.69 (25.51)	0.042
Facial comfort	51.41 (19.29)	64.15 (18.06)	0.000
Oral function	66.53 (24.31)	75.00 (22.56)	0.046
Eye comfort	62.88 (23.38)	72.62 (22.32)	0.016
Lacrimal control	92.69 (15.13)	94.84 (11.14)	0.614
Social function	50.86 (21.22)	63.29 (19.03)	0.001
Total	54.76 (19.88)	65.05 (18.45)	0.005
Three months after surgery (mean, SD)			
Facial movement	51.15 (29.42)	66.79 (25.11)	0.003
Facial comfort	63.71 (21.47)	78.96 (18.01)	0.000
Oral function	70.19 (25.26)	83.53 (18.35)	0.002
Eye comfort	69.03 (23.29)	79.76 (18.97)	0.009
Lacrimal control	93.08 (14.99)	96.43 (8.81)	0.310
Social function	62.21(22.97)	78.86 (19.29)	< 0.000
Total	64.33 (21.94)	78.38 (17.91)	< 0.000

[a] Median/interquartile range; Mann-Whitney *U* test; SD = standard deviation.

0.015). Similar results were obtained for social functioning and total scores of the FaCE scale. Except for the lacrimal control score, the mean scores of the Chinese version of the FaCE scale were significantly higher in the modified group than those in the conventional group 1 and 3 months after surgery.

3.3. Compliance

Three months after surgery, the average numbers of weekly exercises in the modified and conventional groups were 1174.917 and 1078.083, respectively. Compliance in the modified group was significantly better than that in the conventional group (*t*-test, $p < 0.001$).

4. Discussion

Facial paralysis can cause great harm to the patient's physical and mental health; it may even negatively impact the patient's family. Several patients with facial paralysis who do not receive sustained and effective rehabilitation treatment experience a significant decline in their quality of life. Common physical rehabilitation treatments for facial paralysis include the techniques facial motor rehabilitation training [6], electrical stimulation [7], mime therapy [8], facial massages [9], and biofeedback [10]. These physical rehabilitation treatments can improve patients' symptoms with facial paralysis and have a positive effect on the rehabilitation effect of facial paralysis; however, some treatments may have disadvantages. For instance, the role of electrical stimulation in the rehabilitation of facial paralysis remains controversial; specifically, facial nerve regeneration may be inhibited if electrical stimulation is used in patients during the first 18 months after the onset of facial paralysis [24]. Facial synkinesis is more severe in patients undergoing rehabilitation with electrical stimulation [25]. Although rehabilitation therapies, such as mime therapy and biofeedback, are effective, they need to be treated in a professional medical institution by a rehabilitation therapist with sophisticated instruments due to the cumbersome procedures involved in the treatment process, leading to the relatively high cost of the rehabilitation treatment and the consequent economic burdens for the patients and their families. Therefore, it is extremely important to establish a program that allows patients to receive continuous and effective rehabilitation treatment regardless of economic conditions, rehabilitation therapists, time, space, and other factors.

Rehabilitation in most hospitals is performed by clinicians and rehabilitation therapists. However, nurses are most closely associated with the patients during hospitalisation, and they can intuitively understand the patient's condition and emotional changes. With the accelerated application of the concept of surgical rehabilitation in clinical work, neurosurgical nurses' theoretical knowledge and professional ability have also further improved. Nurses assume important responsibilities in the facial paralysis rehabilitation team after vestibular schwannoma surgery, such as observation, communication, and health education. Therefore, nurse-led rehabilitation training and nursing play vital roles in the early rehabilitation stages of postoperative facial paralysis and continued nursing care after discharge. During the rehabilitation of postoperative facial paralysis, the nurses can help patients build confidence and master a standard rehabilitation training method, thereby enhancing the rehabilitation effect [14,26,27].

Video-assisted education has recently emerged as a health education program that is increasingly applied to nursing work. It has a better effect than oral education alone [14,15]. It is difficult for patients with facial paralysis after vestibular schwannoma surgery to understand and master the training method for rehabilitation. Furthermore, patients usually experience physical discomfort and psychological pressure from postoperative facial paralysis, and thus, their adherence to rehabilitation training may vary. In addition, learning ability can vary across patients. After receiving education via teaching material and oral explanations, they may forget or understand the content differently, resulting in them performing the exercises incorrectly. Therefore, we proposed combining the rehabilitation treatment of facial paralysis and video-assisted education. The entire process was filmed and turned into a demonstration video that patients could watch online at any time. The video showing a demonstration of the exercises can be easily followed by the patients and can be played repeatedly, enabling them to understand and master the content of rehabilitation training quickly and accurately. It can be beneficial for reducing patients' cognitive errors. Video-assisted education can improve patient compliance, and the speed and ability of patients' mastering the self-rehabilitation training skills.

After the occurrence of peripheral facial paralysis, varying degrees of different forms of facial expressive muscle function exercise can greatly improve facial paralysis symptoms [5,6,17,28–31]. In 2011, Pereira et al. published a meta-analysis showing the significant benefits of facial expressive muscle function exercises for peripheral facial palsy [6]. Facial expressive muscle exercises combined with facial massage can improve facial muscle function and relieve depression in patients with facial paralysis [9]. To avoid muscle atrophy, a few facial movement exercises, such as muscle massage and hand-assisted facial movement, can be performed when facial paralysis occurs [4,5,28,30]. In addition, facial massage and facial expressive muscle exercise are characterised by the ease of achievement at no additional cost and are suitable as family-led exercises after discharge. On having explored hypoglossal–facial nerve "side-to-side" neurorrhaphy using a pre-degenerated nerve autograft for facial palsy after vestibular schwannoma removal, Zhang et al. [29] proposed that high-intensity facial movement promotes central plasticity and the development of new functions for the hypoglossal motoneurons, thereby improving functional outcomes. Meanwhile, they demonstrated that strenuous facial exercises not only delay muscle atrophy but also improve nerve regeneration in paralyzed muscles [29]. Early education on facial muscles can help patients enhance facial proprioception and potentially correct erroneous movements resulting from the sensory-motor discrepancy common in facial paralysis [32]. Therefore, based on the existing literature on facial expressive muscle exercises and facial massages, we made some improvements in the rehabilitation nursing program in line with our clinical experience, resulting in the modified facial expressive muscle comprehensive exercises, combined with video-assisted education.

In our study, the facial nerve function, quality of life, and compliance of rehabilitation nursing in the modified group (modified

facial paralysis rehabilitation nursing) were significantly superior to those in the conventional group (conventional facial paralysis rehabilitation nursing). Owing to differences in factors, such as baseline data, duration of treatment, and assessment tools, our results can only be compared with those of the following two studies: (1) Carien et al. reported that after 3 months of mime therapy, patients experienced reduced severity of facial paralysis by 0.6 grades (HB grade) [8]; (2) a 6-month electrical stimulation trial by Hyvarinen et al. including 10 patients with facial paralysis showed that most patients experienced reduced severity of facial paralysis by 1 HB grade [33]. In our study, patients in the modified group experienced reduced severity of facial paralysis by 1 grade after 3 months of modified facial paralysis rehabilitation nursing. In 2015, in a study by Leong, after electrical stimulation and/or physical therapies, the mean total FaCE scale score of 119 patients with VS with facial paralysis was 53.4 [24]. However, the mean total score of the Chinese version of the FaCE scale in our modified group was 78.38. The results of this study support our hypothesis that modified facial paralysis rehabilitation nursing is effective and not inferior to other rehabilitation treatments. However, this conclusion needs to be further verified, given possible differences in neurological function evaluation among patients.

Most local and community hospitals in China have no special rehabilitation department for facial palsy rehabilitation. The rehabilitation departments are short on rehabilitation therapists and relevant treatment instruments for facial palsy and, thus, unable to provide patients with timely and effective rehabilitation treatment for facial palsy. Secondly, rehabilitation treatment of facial paralysis is a long and complex process requiring patients and their families to invest a lot of energy and financial resources. However, several factors, such as physical conditions, the nature of the work, economic conditions, and family responsibilities, can prevent patients from receiving continuous and effective rehabilitation. Therefore, some patients may give up or be unable to receive the necessary rehabilitation. To address these issues, we propose combining facial paralysis rehabilitation treatment with nursing care. Nurses with significant clinical experience, high professional competence, and professional training can provide effective rehabilitation nursing care to patients with facial paralysis, reducing the cost of medical human resources and the economic burden on the patients. Based on the data in previous studies, we improved the rehabilitation nursing program by simplifying the operation and minimising the number of treatment links. The video education was incorporated in the modified facial paralysis rehabilitation nursing program, which being free from the restrictions of hospitals, treatment personnel, economic resources, and other factors, can be easily followed and completed by anyone at home. Our study proved that the modified program was beneficial and effective. The modified facial paralysis rehabilitation nursing for facial paralysis can not only significantly improve facial nerve function, quality of life, and rehabilitation nursing compliance in patients with VS postoperative facial paralysis but also yield long-term potential clinical benefits for the patients. In addition, our study also provided valuable nursing experience to our colleagues, which effectively improved the role of nurses in the rehabilitation training of facial paralysis, thereby enhancing their professional value.

4.1. Limitations

This study had some limitations. First, our cohort had a limited sample size. Second, selection bias may have been introduced because our patient population is not representative of all patients with facial paralysis after VS surgery. Third, information bias may have been introduced because the study results relied heavily on the retrospective collection and analysis of past medical records and self-reported data, which might have contained errors. Fourth, this was a single-centre study with a relatively short clinical follow-up period. Finally, since the rehabilitation effect is influenced by the quality of patients' actual movements during training, the supervision mechanism should be improved in the future.

5. Conclusion

The modified facial paralysis rehabilitation nursing, i.e., integrated use of facial expressive muscle exercises and facial massage with video-assisted education, substantially improved the facial nerve function, quality of life, and compliance of rehabilitation nursing of patients with facial paralysis after VS surgery. Randomised controlled trials with larger sample sizes should be carried out in the future to verify these results and provide a clinical basis for the promotion and implementation of this rehabilitation nursing program.

Ethical approval

This study was approved by the Ethics Committee of Xuanwu Hospital, Capital Medical University (approval number: [2019]075).

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Data availability

The data of our study are available from the corresponding author upon reasonable request.

Consent for publication

All authors have read and agreed to the published version of the manuscript.

CRediT authorship contribution statement

Wei Fu: Writing – original draft, Visualization, Software, Methodology, Investigation, Conceptualization. **Jiantao Liang:** Writing – review & editing, Project administration, Methodology, Conceptualization. **Mingchu Li:** Methodology. **Gang Song:** Software, Project administration, Methodology. **Jing Guo:** Visualization, Data curation. **Hongyu Zheng:** Visualization, Data curation. **Xiaolei Zhang:** Writing – review & editing, Project administration, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.heliyon.2024.e35060.

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