Review

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Summary of the best evidence for vocal rehabilitation training in adults with unilateral vocal fold paralysis

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Purpose: To search, evaluate, and summarize the relevant evidence of voice rehabilitation training in adults with unilateral vocal fold paralysis (UVFP).

Methods: Using the '6S' model, the database of UpToDate, BMJ Best Practice, domestic and foreign guidelines, and voice rehabilitation training for adults with UVFP were systematically searched. The search includes clinical decisions, guidelines, systematic reviews, randomized controlled trials, and expert consensus. Data search since the establishment of the database to 27 November 2023. The quality evaluation of the literature methodology and the extraction and integration of evidence were carried out independently by two researchers.

Results: A total of 12 literature were included, including 2 systematic reviews, 2 expert consensus, 4 guidelines, 2 clinical decisions, and 2 randomized controlled trials. Four categories of 16 pieces of evidence were summarized: evaluation of vocal cord paralysis, voice rehabilitation training, health education, joint decision-making, and multidisciplinary cooperation.

Conclusion: This study summarized the best evidence of voice rehabilitation training for adults with UVFP and provided evidence-based summary for clinical staff to carry out relevant interventions.

Keywords: evidence-based nursing, summary of evidence, vocal cord paralysis, voice recovery

Introduction

Unilateral vocal fold paralysis (UVFP) is caused by unilateral damage to the vagus or recurrent laryngeal nerve, and the causes may include infection, iatrogenic injury, malignant tumor, metabolic, toxic, or idiopathic influencing factors[1]. The clinical manifestations are dysphonia and hoarseness[2]. Dysphonia affects the daily communication needs of patients and usually requires behavioral or surgical intervention, and some patients still need voice rehabilitation training after surgery to help patients return to normal life as soon as possible[3,4].

At present, there is no optimal evidence summary for voice rehabilitation training for adults with UVFP, and no systematic rehabilitation strategy, which hinders the clinical practice to a certain extent[5]. This study summarized the best evidence for voice rehabilitation of patients with UVFP through systematic retrieval, evaluation, and analysis of domestic and foreign relevant literature, aiming to provide evidence-based support for clinical medical personnel to carry out voice rehabilitation training.

HIGHLIGHTS

- There is less summary of the unilateral vocal fold paralysis (UVFP) rehabilitation. This study summarizes the best evidence for voice rehabilitation training in adult UVFP from four aspects: evaluation of vocal cord paralysis, voice rehabilitation training methods, health education, and joint decision-making and multidisciplinary cooperation. This summary provides a reference for clinical practice.
- It is found that the effective evaluation, individual rehabilitation treatment, training intensity and duration, and follow-up of UVFP can be further explored in the future.

Materials and method

Identification of issues and exclusion criteria

This paper uses the population, Intervention, Profession, Outcome, Setting, and Type of Evidence (PIPOST) model to identify the basic research questions[6]. The inclusion criteria for evidence were as follows: (1) P (population): evidence target population was adults with UVFP, (2) I (intervention): measures aimed at UVFP voice rehabilitation training, (3) P (professional): evidence applicable to medical personnel, adult UVFP patients. (4) O (outcome): Outcomes are outcome indicators related to voice rehabilitation, (5) S (Settings): evidence applicable to all levels of medical institutions, and (6) T (type of evidence): types of evidence resources include clinical decision-making, clinical

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guidelines, systematic reviews, expert consensus, and relevant original research. The exclusion criteria are as follows: 1.The content is incomplete or the full text cannot be obtained; 2. Updated old guidelines and interpretation of the guidelines; and 3. Documents in languages other than English and Chinese.

Search strategy

According to the '6S' model of evidence resources and the principle of top-down retrieval[7], Computer search Web of Science, Cochrane Library, JBI, PubMed, Embase, CNKI, VIP Database, Wanfang database, EBSCO, UpToDate, BMJ Best Clinical Practice, International Guidelines Collaboration, Ontario Registered Nurses Association, UK National Institute for Health and Clinical Excellence, and China Biomedical Literature Database, including systematic reviews, expert consensus, guidelines, and clinical decision-making. When searching guide websites or evidence-based databases, Use the search term 'Voice Training'/'Voice exercise'/'Voice therapy*'/'Speech pathology'/'Speech therapy'/'speech training' or 'speech rehabilitation'. Data search since the establishment of the database to 27 November 2023.

Taking CNKI as an example, the Chinese search strategy is as follows: SU % = ('Vocal cord paralysis/laryngeal paralysis/vocal cord paresis/unilateral vocal cord paralysis') * ('Voice training/articulation training/speech training/vocal rehabilitation/vocal cord training/Voice correction/Voice care/Voice health/voice function training/speech exercise/Pronunciation/speech recovery') * ('Guidelines/Expert consensus/Systematic review/Clinical decision/Summary of evidence /Meta Analysis /RCT').

Taking PubMed as an example, the English search strategy is as follows:

#1 ((((((((((('Vocal Cord Paralysis'[MeSH Terms]) OR ('Vocal fold par*'[Title/Abstract])) OR ('Vocal Cord Palsy'[Title/Abstract])) OR ('Laryngeal Paralys*'[Title/Abstract])) OR ('Unilateral Vocal Cord Par*'[Title/Abstract])) OR ('Acquired Vocal Cord Palsy'[Title/Abstract])) OR ('Unilateral vocal fold paralysis'[Title/Abstract])) OR ('Recurrent laryn*'[Title/Abstract])) OR ('Unilateral recurrent laryn*'[Title/Abstract])) OR ('Vocal fold immobility'[Title/Abstract])) OR ('Voice disorder'[Title/Abstract])), #2(((((((('Voice Training'[MeSH Terms]) OR ('Voice exercise'[Title/Abstract])) OR ('Voice therap*'[Title/Abstract])) OR ('Speech pathology'[Title/Abstract])) OR ('Speech therapy'[Title/Abstract])) OR ('speech training'[Title/Abstract])) OR ('speech rehabilitation'[Title/Abstract])), #3 (Guidelines/Expert consensus/Systematic review/Clinical decision-making/evidence summary/meta-analysis /RCT), and #4 (#1 AND #2 AND #3).

Literature quality evaluation

(1) The quality evaluation criteria for guidelines were from the Appraisal of Guidelines for Research and Evaluation Instrument (AGREE II)[8,9]. AGREE II includes 23 items in 6 areas, including scope and purpose, participants, rigor of formulation, clarity of expression, application, and editorial independence. Each item is scored from 1 to 7 points (1 = strongly disagree, 7 = strongly agree)[10].
(2) The expert consensus was evaluated using the evaluation tool recommended by the Joanna Briggs Institute (JBI) Centre for Evidence-Based Health Care in Australia, and the randomized controlled trial (RCT) articles were evaluated using the JBI Centre for Evidence-Based Health Care randomized Controlled trial evaluation criteria.
(3) The quality of evidence and the level of recommendation were independently assessed by two researchers. When there are differences in evaluation opinions, we will discuss them with the third researcher to decide whether to include them. In the event of discrepancies in the content of evidence, we give priority to the principle of newly published and high-quality evidence.
(4) All evidence is graded A–B according to the 2014 edition of the JBI Evidence-Based Health Care Center's Evidence recommendation level system with A as a strong recommendation and B as a weak recommendation[11].

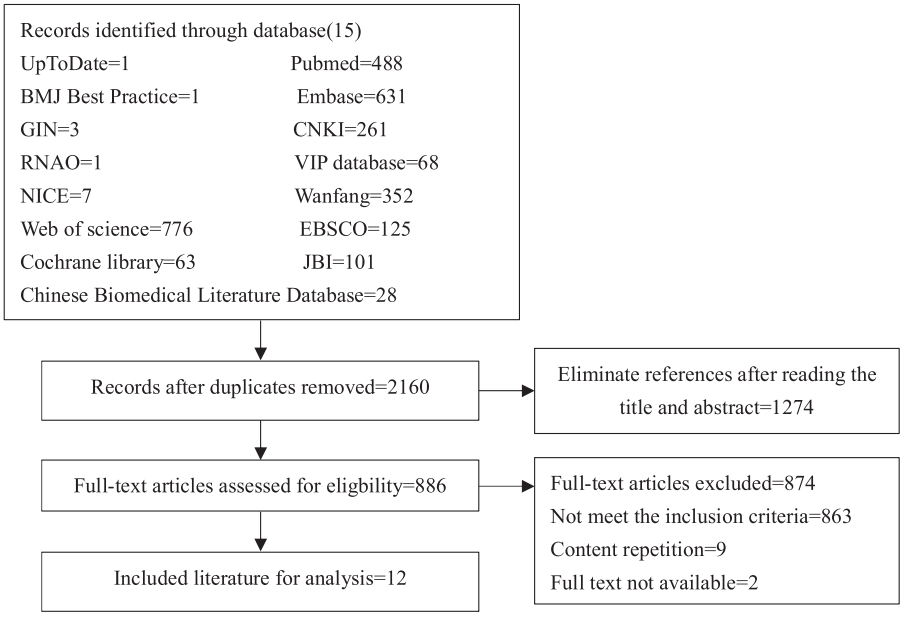

Figure 1. Literature screening process and results.

Table 1

General characteristics of the included literature ($n = 12$).

Included literature	Publication time	Source	Type	Theme
Zelazny *et al.*[12]	2021	BMJ best practice	Clinical decision	Assessment of hoarseness and dysphonia
Bruch *et al.*[13]	2023	Up to date	Clinical decision	The adult's voice is hoarse
Korean Society of Laryngology *et al.*[14]	2020	PubMed	Guide	Management of unilateral vocal cord paralysis
Stachler *et al.*[15]	2018	GIN	Guide	Hoarseness (dysphonia)
Chandrasekhar *et al.*[16]	2013	GIN	Guide	Improves sound effects after thyroid surgery
Korean Society of Laryngology *et al.*[17]	2022	PubMed	Guide	Nursing and management of sound changes during thyroid surgery
Mattei *et al.*[18]	2017	PubMed	Expert consensus	Basic sound assessment of unilateral vocal cord paralysis
Chinese Medical Association Otolaryngology, Head and Neck Surgery Branch, Pharyngology Group *et al.*[19]	2020	Wang fang	Expert consensus	Diagnosis and treatment of vocal cord paralysis
Walton *et al.*[20]	2016	PubMed	Systematic evaluation	Unilateral vocal cord paralysis: speech pathology management
Alegria *et al.*[21]	2020	Web of Science	Systematic evaluation	Effects of speech therapy on unilateral vocal cord paralysis - measurement of visual perception outcomes
Mari *et al.*[22]	2022	PubMed	RCT	Voice tele-rehabilitation of iatrogenic unilateral vocal cord paralysis: From necessity to opportunity in the COVID-19 era
Liu *et al.*[23]	2021	CNKI	RCT	Effect of early voice training on improving voice quality in patients with vocal cord paralysis after thyroid surgery

RCT, randomized controlled trial.

Results

Literature screening results

A total of 2906 literature were retrieved and imported into the Endnote literature manager. After de-duplicated and preliminary screening, 2160 literature remained. Two researchers selected the literature independently, and when there was a conflict of opinion, the third researcher participated in the discussion to decide whether to include them.

In the end, 12 literature were included (Fig. 1). There were two clinical decision-making, four guidelines, two expert consensus, two systematic reviews, and two RCTs. The basic information of the included literature is shown in Table 1.

Quality evaluation results of the guide

A total of four guidelines were included in this study, and their quality evaluation results are shown in Table 2.

Quality evaluation results of expert consensus

A total of two expert consensus articles were included in this study, and their quality evaluation is shown in Table 3.

Quality evaluation results of system evaluation

A total of two systematic reviews[20,21] were included in this study. Except for item 11 of Walton's *et al.*[20], the evaluation result of 'whether the relevant conflict of interest is indicated' was 'unclear', the evaluation result of the other items was 'yes', and the overall quality was high, so inclusion was allowed.

RCT quality evaluation results

A total of two RCTs[22,23] were included in this study, and the evaluation criteria of the JBI Evidence-Based Center randomized controlled trial were used. Item 5 of the literature quality evaluation by Walton's *et al.*[20]was 'no', items 1-2 were 'unclear', and other items were 'Yes'. Items 2, 4–6, and 8 of the literature quality evaluation by Liu *et al.*[23] are 'unclear', and other items are 'yes'.

Evidence description and summary

According to the principle of evidence synthesis, the researchers summarized the evidence. A total of 16 pieces of evidence were summarized, including 4 evidence topics, as shown in Table 4.

Discussion

Voice changes will have a significant impact on patients' work, social activities, psychological state, and social quality of life. As an auxiliary means of voice rehabilitation, the clinical staff should pay attention to voice therapy to improve the quality of voice rehabilitation in UVFP patients.

Selection of appropriate methods to assess vocal cord paralysis

In clinical practice, the clinical specialist should evaluate the tone, tone quality, and vocal function of the patient's voice. Patients with voice disorders should be identified as early as possible and

Table 2

Quality evaluation of guidelines ($n = 4$).

Inclusion guide	Percentage of standardized scores in each area						≥ 60% Number of fields (PCS)	≥ 30% Number of fields (PCS)	Recommended level (level)
	Scope and purpose	Participant	The rigor with which guidelines are developed	Clarity of expression	Application of the guidelines	Independence of the guide editor			
Korean Society of Laryngology *et al.*[14]	100	100	98.9	94.4	87.5	91.6	6	6	A
Stachler *et al.*[15]	100	100	95.8	100	72.9	100	6	6	A
Chandrasekhar *et al.*[16]	100	100	88.5	97.2	75	100	6	6	A
Korean Society of Laryngology *et al.*[17]	66.7	58.3	79.2	83.3	46.9	50	3	6	B

Table 3

Methodological quality evaluation results incorporating expert consensus ($n = 2$).

Included literature	1	2	3	4	5	6
Mattei *et al.*[18]	Y	Y	Y	Y	Y	Y
Chinese Medical Association Otolaryngology, Head and Neck Surgery Branch, Pharyngology Group *et al.*[19]	Y	Y	Y	N	Y	Y

Note: 1: Whether the source of the opinion is clearly stated; 2. Whether the ideas come from influential experts in the field; 3: Whether the proposed viewpoint is centered on the interests of the relevant population; 4: Are the stated conclusions based on the results of the analysis? Are ideas expressed logically? 5: Whether it has referred to other existing literature; 6: Is there any inconsistency between the proposed views and the previous literature?

referred promptly to an ear, nose, and throat specialist (ENT) or speech therapist for professional evaluation[15,16]. Meanwhile, a more detailed physical examination and history assessment should be performed to see if the patient has a history of surgical procedures that may affect future voice training, including the neck and mouth.

The evaluation of voice training should be a combination of subjective and objective. Patient-reported outcome measures such as the Voice Handicap Index (VHI), perceptual voice evaluation such as Grade, Rough, Breathy, Asthenic, and Strained (GRBAS), and Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) are recommended for the subjective evaluation[14–20]. The VHI-30 developed by Jacobson *et al*. consists of three dimensions, Emotional (E), Physical (P), and Functional (F), with 30 items. The VHI-10 established by Rosen *et al*. is based on VHI-30 and simplified into 10 items, which confirmed that can be used as an alternative to the VHI-30 for the assessment of vocal cord paralysis. The Chinese version of the VHI scale mainly evaluates the impact of voice abnormality on patients' quality of life, which is divided into three parts: physiological, functional, and emotional[24]. Perceptual voice evaluation such as GRBAS is proposed by the Japanese Speech and Speech Association and is the most commonly used subjective auditory perception assessment method in the world. CAPE-V was created by the American Speech-Language-Hearing Association (ASHA)[25]. It is an interval scale provided by the 100 mm visual analog line, it also includes the ordinal ratings of mild, moderate, and severe, printed below the measurement line. CAPE-V is shown to better accommodate the task of measurement of multidimensional features, such as vocal quality[25]. Acoustic analysis and aerodynamic evaluation are recommended for objective evaluation. Acoustic analysis includes jitter, shimmer, noise harmonic ratio, and cepstrum peak prominence to objectively assess the patient's sound quality. Aerodynamic assessments, including maximum phonation time and average airflow rate, can be used to assess glottic insufficiency in patients with UVFP[26].

In addition, multiple evidence suggests that laryngoscopy should be used before and after evaluation. To enhance clarity, it would be beneficial to choose the different types of laryngoscope examinations that are available, such as rigid and flexible scopes, laryngeal stroboscopy, and laryngeal high-speed imaging. Furthermore, artificial intelligence (AI) technology also plays its role in this field. Żurek *et al*.[27] found that AI shows very high accuracy, sensitivity, and specificity when using laryngeal endoscopy to evaluate images of laryngeal lesions. AI starts focused on vocal fold vibration analysis, lesion recognition, and vocal cords paralysis[28]. Endoscopic results of laryngeal structure and

Table 4

Summary of the best evidence for vocal rehabilitation training in adults with unilateral vocal cord paralysis.

Item	Content of evidence	Source	Class of evidence	Recommendation level
Evaluation of vocal cord paralysis	1. Early identification of patients with dysphonia, and timely referral for professional evaluation[15,16]	Clinical decisions, guidelines, expert consensus, and systematic reviews	2	A
	2. The patient's medical history should be asked in detail and a more detailed physical examination should be given[12–15]		5	A
	3. Suggest subjective and objective assessments. The selection of assessment tools should be based on the patient's ability to effectively participate and the examiner's ability to equip the assessment tools[14–20]		2	B
	4. The subjective assessment is recommended using the Voice Handicap Index (VHI) and/or Grade, Rough, Breathy, Asthenic, and Strained (GRBAS), and/or Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V)[12,14,16–20]		2	B
	5. Objective evaluation Acoustic analyzer, aerodynamic evaluation, and laryngoscopy are recommended[12,14–20]		2	A
Voice rehabilitation training	6. When to start: ①For patients with mild symptoms, no contraindications, and who are willing to treat, rehabilitation therapy is recommended as soon as possible[14,16,17,22,23]. ②For patients who need surgery, it is recommended to start voice training before surgery[14]. ③ For patients who have undergone surgery, it is recommended to start treatment after the swelling at the surgical site has subsided[14]	Guidelines, expert consensus, systematic review, RCT	1	A
	7. Rehabilitation training twice a week, 30 min each time, at least 15 times, face-to-face treatment by speech therapists, patients repeat the practice every day during treatment[20,22]. Training includes[14,17,19–21]: ①a cough attack: forced expiration with closed glottis. ②a cough with vowel: cough and then release a vowel (/i/ /e/ /a/ /o/). ③a quick and energic emission of a vowel (/i/ /e/ /a/ /o/ /u/) , occlusive dull (/kà/ /kè/ /kò/) and sonant (/gà/ /gè/ /gò/) syllables; (/kaka/ /kekè/ /gogò/ /dedè/) with truncation of the final vowel; a single vowel (/aaaaa/ /eeeee/) or syllable (/kaaaa/ /kiiii/ /ghee/). ④Relaxation training: chest expansion - arm stretching - shoulder relaxation - neck stretching - head and neck rotation - jaw stretching - chin massage - face massage - throat massage, yawn, tongue extension and other sequence relaxation ⑤ Breathing training: the patient is instructed to relax the upper body, shrink the diaphragm, increase the upper and lower diameter of the chest, expand the chest space, shrink the abdominal space, and protrude the abdomen when inhaling. When exhaling, the diaphragm relaxes and restores, the abdominal space recovers, and the abdomen recovers. ⑥Pronunciation training: hold your breath while pushing against a wall or pulling out a chair; Cough vigorously; Sound /i/, /e/, /a/, /o/ after coughing; The hard accent pronounces /e/ with a lower pitch; Exertion exercise: Exertion (sharp rise) to sound vowels in a comfortable pitch, and add sounds, words, and paragraphs. ⑦Resonance training: adjust the relationship between the cavity of the mouth, nasal cavity, chest cavity, etc., to improve the efficiency of pronunciation		1	A
	8. Quality control and efficacy monitoring: ①Use a structured framework treatment plan to control the intensity and duration of treatment[21]. ②Improve patient compliance: for example, establish a trusting relationship with patients, actively follow-up, use smart devices to record, and perform imitation exercises, and fill in training manuals every day[15,19]. ③ At the end of treatment, the patient's response to treatment and voice status were recorded[15]		1	A
Health education	9. During the third week of voice training, the voice function was evaluated again and the training plan was adjusted according to the results[19]	Guidelines, clinical decisions, systematic reviews, expert consensus	2	A
	10. It is suggested that patients should be routinely consulted on the mechanism of voice production and educated on voice health[12,14,15,17,19–21]		1	B
	11. It is recommended to drink more water every day to keep indoor air humidity[15,19]		5	A
	12. Reduce irritating food intake to prevent throat reflux disease[15,19]		4	A
	13. Prevent voice fatigue, exertion, and overuse, and correct bad pronunciation habits[14,15,17,19]		1	A

Table 4

(*Continued*)

Item	Content of evidence	Source	Class of evidence	Recommendation level
Joint decision-making and multidisciplinary cooperation	14. Patients are advised to participate in the decision-making of voice rehabilitation treatment[16]	Clinical decisions, guidelines	1	B
	15. Provide a variety of decision aids, including brochures, photos, videos and/or web-based tools, to promote shared decision-making[15,16]		2	B
	16. Speech therapists should take the lead in voice therapy and cooperate fully with otolaryngologists, psychologists psychiatrists, and other health professionals[12,15,16]		2	B

function provide information on vocal cord motion, glottic closure, vocal cord level differences, and laryngeal compensation in UVFP patients, and these data results correlate strongly with perceptual and subjective voice outcome measures[12,14–19].

However, due to different selection tools in clinical evaluation, there are differences between the same indicators in the same patient. Therefore, the selection of appropriate assessment tools according to the existing tools of the evaluator and the patient's participation can effectively improve the evaluation efficiency of patients with voice disorders[3]. In clinical work, medical staff should closely monitor voice change, appropriate methods should be selected to carry out voice evaluation.

Find the right time to carry out effective training; encourage active participation to improve patient compliance

At present, it is not clear when voice training begins in patients with vocal cord paralysis[29]. High-quality evidence recommends voice training as soon as indicators or clinical symptoms of voice training are present in patients[14,16,17,22,23]. Timely and effective pronunciation training can improve the outcome of voice rehabilitation. For patients who need surgery, the guidelines recommend that voice training be used as adjuvant therapy before surgery to improve the efficiency of voice rehabilitation. Voice therapy for patients after surgery may be effective as soon as the swelling subsides after surgery. At this time, the goal of voice therapy is to help patients adapt to the new vocal system after surgery[14].

Studies by Mattioli *et al*.[30] showed that vocal cord motion recovery rates were higher when voice training was performed within 4 weeks after surgery compared to other groups. The Korean Phonetic Society has shown that atrophic changes in muscle tone are related to the duration of lack of muscle use, and early intervention in patients with voice disorders can prevent or delay muscle atrophy[17].

Two systematic reviews and one RCT recommended that voice therapy should be conducted face-to-face with an experienced speech therapist, and take 30 min twice a week at least 15 times[20–22]. Alegria *et al*.[21]use a structured framework treatment plan to control the intensity and duration of treatment to improve the efficiency of voice rehabilitation. Voice rehabilitation is influenced by many factors, such as individual, environment, and psychology, so compliance and guidance training is the basis for improving rehabilitation efficiency[17]. Evidence shows that the daily recording of patients' voices can provide decision-making information for doctors, and patients actively participate in treatment decisions, which can increase their subjective initiative, improve training compliance, ensure training quality, and help promote the formulation of personalized treatment plans.

Improve health education, promote joint decision-making, and suggest multidisciplinary participation to ensure the comprehensiveness and continuity of rehabilitation treatment

Evidence shows that patients with vocal cord paralysis should pay attention to voice rest. Relevant consultation methods were provided to patients, and patients were suggested to participate in the decision-making of voice rehabilitation therapy.

Most research and evidence in this field are conducted by ENT specialists and speech therapists[20–23]. However, clinical practice is limited to the decision of clinicians, ignoring the recommendations of ENT specialists and speech therapists[12]. In the future, multidisciplinary teams can be formed to further explore the effect of voice rehabilitation training management for patients with UVFP.

This study primarily focuses on phonation function, but the significance of dysphagia and the risk of aspiration pneumonia in patients with vocal paralysis could not be underestimated. Therefore, speech therapy should always be arranged for vocal paralysis.

Conclusions

This study summarized 16 best evidence for voice rehabilitation of adults with UVFP, including the evaluation of vocal cord paralysis, voice rehabilitation training methods, health education, joint decision-making, and multidisciplinary cooperation, providing evidence-based evidence for clinical staff to carry out relevant interventions and providing evidence-based guidance for the optimization of voice rehabilitation programs. At the same time, it is found that the effective evaluation, individual rehabilitation treatment, training intensity, training duration, follow-up, and other aspects of UVFP can be further explored in the future, to update and improve the evidence.

Limitations

This study has certain limitations. This evidence summary only includes published studies in Chinese and English. The literature included in this study was mainly from Asia. Future research should aim to incorporate high-quality original research to gain a deeper understanding of the best protocols for voice rehabilitation therapy.

Ethical approval

This manuscript is a summary of the best evidence and does not require ethical approval.

Consent

This manuscript is a summary of the best evidence and does not require ethical approval.

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Author contribution

C.T. and X.Z.: developed the search strategies; H.H. and L.J.: participated in literature screening, extracting, and recording the information from the enrolled studies; W.T. and X.Z.: evaluation in quality in individual studies; C.T.: responsible for writing the article; Y.S.: responsible for guiding the writing and participating in the revision of the article. All authors read and approved the final article.

Conflicts of interest disclosure

The authors declare that they have no financial conflict of interest with regard to the content of this report.

Research registration unique identifying number (UIN)

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UIN:ES20233886.

Guarantor

Yulan Shi is the one who accept full responsibility for the work and/or the conduct of the study, had access to the data, and controlled the decision to publish.

Data availability statement

The datasets generated during and/or analyzed during the current study are publicly available.

Provenance and peer review

Not commissioned.

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