The Clinical Efficacy of Microsuture Technique Combined With Voice Therapy in Patients with Reinke's Edema

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Summary: Objective. This study aimed to explore the clinical efficacy of the microsuture technique combined with voice therapy in patients with Reinke's edema.

Methods. 46 patients with Reinke's edema admitted between April 2017 and August 2021 were selected and randomly divided into simple surgical and combined therapy groups. The simple surgical and combined therapy group were evaluated preoperatively and at 3 months after surgery using subjective and objective voice analysis.

Results. Compared with the preoperative state, there was a significant improvement in the acoustic parameters 3 months postoperatively. The G and R scores, Voice Handicap index-10 (VHI-10), and jitter parameters of the combined therapy group were lower, whereas F0 and maximum phonation time (MPT), changed significantly in the combined therapy group, fundamental frequency perturbation (jitter), and MPT acoustic parameters of the combined therapy group were lower than those of the simple surgery group ($P < 0.05$).

Conclusion. The microsuture technique is preferable for eliminating vocal folds surgical wounds and promoting mucosal recovery, and combined with voice therapy is more helpful to comprehensive improve the quality of phonation.

Key Words: Micro suture technique−Reinke's edema−Clinical efficacy−Voice therapy.

INTRODUCTION

Reinke's edema remains a cause of chronic dysphonia that is difficult to manage. Its main clinical characteristics include slow accumulation of tissue fluid and filling of the Reinke's space, and a broad-based, smooth, and translucent vocal fold. Clinical manifestations include hoarseness and lowering of the voice, dyspnea of varying degrees may occur in severe cases. It is strongly associated with smoking, frequently with vocal misuse/abuse and occasionally with laryngopharyngeal reflux.[1-3]

Surgery is the primary treatment for severe Reinke's edema, reinke's layers with a resultant serious scar formation in their latter stage, which is not conducive to voice recovery. Therefore, ensuring the integrity of the structure and morphology of the vocal fold epithelium is the key to obtaining good phonation after surgery.[4] In recent years, microsuture technology has introduced to treat Reinke's edema. After removing the submucosal gelatinous tissue, the contraposition suture of the trimmed vocal fold mucosa can completely cover the mucosal epithelium of the wound in the operating area to a large extent leading to the preservation and restoration of the integrity and continuity of the vocal fold mucosa. Many studies have reported that the microsuture technique can significantly improve phonation quality by removing diseased mucosa.[5,6] After surgery, smoking cessation, acid suppression, and other treatments can reduce the recurrence rate.[7] However, there are no reports on the efficacy of voice therapy on voice function after Reinke's edema surgery.

Therefore, this study aimed to treat Reinke's edema through the microsuture technique combined with voice therapy to explore the efficacy of the above comprehensive treatment on the recovery of voice and provide some suggestions for the treatment of this disease.

METHOD

Study population

46 patients with complete data diagnosed with vocal fold Reinke's edema and who underwent surgery between April 2017 and August 2021 were selected as study participants, and randomly divided into a simple surgical group and combined therapy group. All patients were females aged 28-64 years. The disease duration ranged from 10 months to 12 years. All patients had a smoking history of 10-25 years. Reinke's edema was graded according to the clinical graduation standard of Yonekawa.[8] The pathological diagnosis in both groups after the operation was Reinke's edema.

The protocol was approved by the Ethics Committee of Hebei Eye Hospital. All subjects submitted written informed consent in accordance with the Declaration of Helsinki.

Surgical procedure

All patients were under general anesthesia, and a small-caliber endotracheal tube was used for intubation. A supporting laryngoscope (Karl Storz) was introduced through the mouth, the glottis was exposed, and the operating microscope (Zeiss, objective lens distance = 400 mm) was adjusted and used to explore the boundary of the Reinke's edema. Patients with difficult-to-expose edema were operated on by external throat manipulation, segmental exposure, and other methods. The microsuture technique involved cutting

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the upper surface mucosa of the vocal fold longitudinally with laryngeal microscissors, turning up the mucosal flap, and aspirating the viscous edema fluid in the Reinke's space. The excess mucosa was then trimmed and reset, and microsuture instruments were further used to make 2-3 sutures using Prolene 8-0 suture to stitch the stump intermittently with the cut edge of the lateral mucosa of the vocal fold. Notably, during the surgery, the disturbance to Reinke's space was minimized to prevent damage to the acoustic ligament. After the surgery, treated cotton wool containing 1:1000 adrenaline was applied to the local wound to stop bleeding.

Routine treatment

All patients were treated with antibiotics within 48h after operation, ultrasonic atomization inhalation of budesonide suspension(1mg) supplemented by inhalation twice a day for 3-5 days. Patients were instructed to phonate sounds immediately after the surgery. In the follow-up process, the patients strictly followed the doctor's advice and abstained from smoking and drinking, guided the application of acid-suppressing drugs in the population with reflux disease.

Voice therapy procedure

The participants were instructed in this procedure and given vocal hygiene recommendations. The voice therapy was implemented by doctors and nurses on the 14th postoperative day, they had prior clinical experience in voice. A standardized voice therapy protocol was followed. 1. Breathing training. The patient was made to relax naturally all over the body, adopt the abdominal breathing method, inhale deeply and naturally, exhale smoothly, persistently, and rhythmically, and avoid chest elevation and depression, and shoulder elevation. 2. Relaxation training.[9] Including thyrohyoid muscle relaxation, cricothyroid muscle relaxation and throat relaxation training. 3. Phonation training. Mainly use the vibrato method and breathing tube training (Lax Vux)[10,11] in the semi closed vocal tract vocal method. 4. Resonance exercise.[9] Asks the patient to pronounce vowels /a:/ with different tones to find the correct vocal resonance position and tone. In the following session, all of the previous exercises were repeated and reviewed, The participants were expected to repeat their exercises twice a day (morning and night) every day, and the correct phonation action essentials were ensured via video. The patients were supervised and urged to complete the voice therapy via the WeChat Software.

Voice assessment

The patients in the simple surgical and combined therapy groups were concurrently evaluated subjectively and objectively preoperatively and at 2 weeks, 1 month, and 3 months after operation. The GRBAS scale[12] developed by the Japanese Speech Correction and Speech Association was used for scoring the total score of grade (G), roughness (R), and breath (B). Points 0-4 represent the severity of hoarseness from normal to severe abnormality. Simultaneously, the severity of voice disorders was assessed using the Chinese version of the Voice Handicap index-10 (VHI-10).[13] It includes three dimensions: Function, Physiology, and Emotion. Each dimension had 10 questions, and each question had a score of 0-4 points. The higher the score, the greater the voice disorder. Voice recordings of the participants were taken by PHILIPS VTR8080 in a quiet room with the microphone positioned 10cm from the lips of the participants. Acoustics analysis was completed using sustained /i/ phonation. Analysis of the voice samples was conducted by using acoustic analysis software programs PRAAT. The natural and stable vowel /a:/ was pronounced for approximately 3-5 s, and the relatively stable segment was selected for acoustic analysis. The test was repeated three consecutive times, and the average value of the three recorded values was obtained as the final result. The patient's parameters, such as fundamental frequency (F0), fundamental frequency perturbation (jitter), amplitude perturbation (shimmer), and noise harmonic ratio (NHR), were obtained, and the patient was asked to breathe deeply and then make an /i:/ sound steadily until no sound could be made. This was repeated three consecutive times, with a 15s rest after each test. The longest duration of phonation among the three tests was taken as the maximum phonation time (MPT).

Statistical methods

The data were statistically analyzed using SPSS Software (Version 19.0). The voice acoustic parameters were tested for normality to confirm that they conformed to the normal distribution and had homogeneous variance. The data were described as mean ± standard deviation. The results of the voice acoustic analysis before and after treatment in the surgical group and combined therapy group in the same period were compared using the independent sample *t*'test and paired *t*'test. Repeated measurement analysis of variance was used to assess the comprehensive effect of an intervention, and the rank sum test or chi-square test was used for comparison between groups. $P < 0.05$ was considered statistically significant.

RESULTS

Basic characteristics of the study subjects

The simple surgical group comprised 24 patients, who had a disease duration ranging from 2-12 years, and only received microsuture technique and routine treatment after operation. The combined therapy group comprised 22 patients, with a disease duration ranging from 10 months to 10 years, and underwent the microsuture technique and voice therapy 2 weeks after the operation based on the routine postoperative treatment. In addition, among the common causes of Reinke's edema, such as excessive smoking, drinking, and gastroesophageal reflux, there was no significant difference

TABLE 1.
Basic Characteristics of the Simple Surgical and Combined Therapy Groups in Patients With Reinke's Edema

	Simple Surgical Group (n=24)	Combined Therapy Group (n=22)	*P* value
Age	55.7±8.7	54.3±9.1	0.871
Yonekawa classification			0.980
Grade II	11	9	
Grade III	13	13	
History of drinking	9	8	0.960
History of smoking	21	18	0.602
Pharyngeal reflux	11	9	0.622
Abstain from smoking after surgery	20	17	0.922
Abstain from alcohol after surgery	9	8	0.960
Anti-reflux medication	19	21	0.874

between the simple surgical group and the combined therapy group (Table 1).

After surgery, a total of 20 patients in the simple surgical group abstain from smoking, nine patients abstained from alcohol, and 19 patients received anti-reflux medications. A total of 17 patients in the combined therapy group abstain from smoking, eight abstained from alcohol, and 21 patients received anti-reflux medications. There was no statistical significance in the above three aspects between the two groups ($P > 0.05$).

Subjective evaluation of voice function at different times before and after operation in the simple surgical and combined therapy groups

Several patient questionnaires have been validated to provide clinicians insight into a patient's voice disability. The VHI-10 and GRBAS scale is widely used for subjective evaluations of voice quality. The results show that there were no significant differences between the two groups in the subjective evaluation indices of voice, such as GRBAS score and VHI-10 preoperative. However, 3 months after surgery, the G and R scores, VHI-10 scales of the combined therapy group were lower than those of the simple surgery group ($P < 0.05$). There were statistically significant differences in G and R scores between the two groups of patients 3 months after intervention, and had a significant improvement compared with preoperative voice parameters ($P < 0.05$) (Table 2).

Objective evaluation of voice function at different times before and after operation in the simple surgical and combined therapy groups

The result, similar to subjective evaluations, indicated that there were no significant differences between the acoustic evaluation indices of voice, such as jitter, shimmer, F0, NHR, and MPT ($P > 0.05$). However, 3 months after surgery, these important objective acoustic parameters, F0 and MPT, changed significantly in the combined therapy group, jitter, and MPT acoustic parameters of the combined therapy group were lower than those of the simple surgery group ($P < 0.05$) (Table 3).

This study also shows the preoperative state of Reinke's edema and vocal folds morphology at different stages after combined therapy (Figure 1).

DISSCUSSION

It is a preliminary study which we aimed to find out the efficacy of microsuture technique combined with voice therapy in patients with severe Reinke's edema. It is an important study, as there is no other professional study on Reinke's

TABLE 2.
Subjective Evaluation of Voice Function in Patients With Reinke's Edema at Different Times Before and After Operation

Group	Simple Surgical Group			Combined Therapy Group			*P* value		
	Preoperative	3 months After Operation	D-value	Preoperative	3 months After Operation	D-value	P_1	P_2	P_3
G (Score)	2.7±0.4	1.4±0.8	1.3±0.3	2.6±0.7	1.1±0.6	1.7±0.4	0.218	0.031*	<0.01*
R (Score)	2.6±0.7	1.2±0.5	1.1±0.2	2.6±0.5	0.8±0.5	1.9±0.4	0.817	0.019*	0.033*
B (Score)	2.5±0.8	0.7±0.5	1.6±0.2	2.2±0.9	0.6±0.4	1.7±0.5	0.176	0.177	0.341
VHI-10	45.2±13.1	10.6±4.9	29.6±6.1	41.8±10.8	7.0±4.4	31.0±7.1	0.431	0.016*	0.281

Notes: P_1: preoperative simple surgical group vs combined therapy group; P_2: postoperative simple surgical group vs combined therapy group; P_3: simple surgical group D-value vs combined therapy group D-value.
* $P<0.05$.

TABLE 3.
Objective Evaluation of Voice Function in Patients With Reinke's Edema at Different Times Before and After Operation

Group	Simple Surgical Group			Combined Therapy Group			*P* value		
	Preoperative	3 months After Operation	D-value	Preoperative	3 months After Operation	D-value	P_1	P_2	P_3
F0 (Hz)	213.69±15.91	234.49±17.28	22.1±16.17	210.12±11.63	257.51±14.81	38.1±9.8	0.667	0.083	0.043*
jitter (%)	5.53±1.77	3.52±0.38	1.82±1.35	5.43±1.72	2.85±0.29	2.31±0.31	0.878	0.031*	0.055
shimmer (%)	10.72±4.95	3.47±1.87	7.18±2.11	10.51±5.18	3.21±1.03	7.22±1.89	0.672	0.413	0.714
NHR (dB)	0.29±0.13	0.14±0.11	0.13±0.09	0.29±0.17	0.16±0.09	0.15±0.11	0.817	0.131	0.277
MPT (s)	7.33±2.06	16.18±1.60	8.73±2.12	7.28±1.90	14.50±1.38	7.98±2.13	0.344	0.012*	0.018*

Notes: P_1: Preoperative simple surgical group vs combined therapy group; P_2: postoperative simple surgical group vs combined therapy group; P_3: simple surgical group D-value vs combined therapy group D-value.
* $P<0.05$.

edema of vocal folds to determine combined therapy efficacy. We found that microsuture technique combined with voice therapy significantly improved the voice quality of patients with Renke's edema after surgery.

The goal of treatment is symptomatic improvement of dysphonia with a primary emphasis on removal of etiologic factors. Surgical intervention is the first line of treatment when a patient presents with dyspnea, airway compromise, or respiratory distress.[14] Surgical intervention for Reinke's edema can be performed with cold steel technique or with the help of carbon dioxide laser.[15] Nevertheless, microflap techniques is important to restore motion of the epithelial layer over the ligament as well as to avoid development of scar. It not only facilitates vocal functional recovery. but also provides basic tissue structure and function for voice therapy as soon as possible with high quality. Regardless of surgical technique, the dysphonia improves but does not completely normalize.[16] Therefore, preoperatively patients should be counseled that despite surgical intervention, normalization of the voice is rare. Reinke's edema develops from chronic damage to the vocal folds leading to the pathophysiologic changes. Tavaluc et al,[17] found that most patients who underwent voice surgery still have voice disorders to a certain extent, indicating that voice surgery has a limited voice recovery efficacy in some patients. A possible reason for this is that voice overuse may also contribute to the development and worsening of Reinke's edema, and postoperative poor phonation is maintained, which leads to the failure of the postoperative sound to completely return to normal. Hence, voice therapy as the primary treatment of benign laryngeal pathology has been shown to provide patients with an approach to rebuild and rebalance all the subsystems of voice (respiration, phonation, and resonance), and to improve voice handicap and overall outcomes.[18]

The subjective and objective joint evaluation of voice has good synergy, and the evaluation of voice function of patients is more comprehensive, providing a reference basis for voice improvement.[19] This study evaluated the voice quality of the patients using both subjective and objective measures. The results showed that the subjective and objective voice parameters of the surgery combined with the voice therapy group after treatment are better than those of the simple surgery group, indicating that patients with vocal folds edema can also benefit from voice therapy, which facilitates the further recovery of postoperative voice. However, voice therapy cannot be used as the main treatment for Reinke's edema. It can only help improve patients' defective vocal behavior through breathing and vocal practice after Reinke's edema surgery, thus improving the phonation quality and preventing the recurrence of Reinke's edema.[6]

One of the limitations of this study was the number of participants. Another limitation was that Reinke's edema has a complex etiology, so it is necessary to include more research populations and follow-up studies should be conducted.

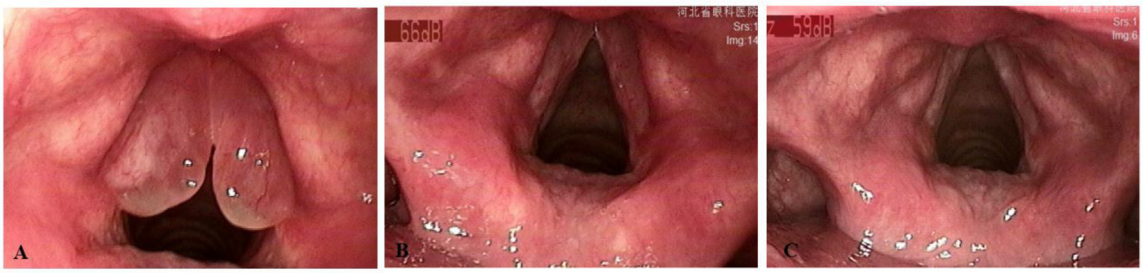

FIGURE 1. Endoscopic manifestations of Reinke's edema. **A.** Preoperative; **B.** 1month after operation; **C.** 3 months after operation.

CONCLUSION

Reinke's edema is often a result of the superposition of various causes. The microsuture technique is preferable for eliminating vocal folds surgical wounds and promoting mucosal recovery, and combined with voice therapy is more helpful to comprehensive improve the quality of phonation.

DISCLOSURE

The data underlying the results presented in the study are available within the manuscript. There is no potential conflict of interest in our paper.

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