



Factors Predicting the Outcome of Voice Therapy in Patients with Polyp or Nodule

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Abstract

Objective: Precedent studies about factors affecting voice therapy are limited. The purpose of this study was to investigate factors predicting the result of voice therapy in patients with vocal fold nodule and polyp.

Materials and Method: Seventy-five patients who underwent voice therapy were included and divided to good response group and less responsive group on the basis of jitter change rate and shimmer change rate. Sex, age, occupation, duration of symptom, drinking alcohol, the smoking history, and intake of coffee were compared between two groups.

Results: Of the 75 patients, 24 were in the good response group and 23 were in the less responsive group. Among seven factors, intake of coffee (odd ratio: 4.243) and duration of symptom (odd ratio 5.552) were significant risk factors for less response to voice therapy. Other factors, including sex, age, occupation, drinking alcohol, and the smoking history, did not significantly affect the responsiveness of voice therapy.

Conclusion: We suggest that evaluation of duration of symptom and intake of coffee can aid in predicting the result of voice therapy in patients with dysphonia.

Keywords: Voice therapy; Voice disorders; Voice quality; Comparative study

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Introduction

Dysphonia causes significant patient discomfort and may have an organic, functional, or psychological cause. Treatments of dysphonia, depending on the cause, include surgical treatment and voice therapy. Regardless of whether surgery is performed, voice therapy has an important role in the treatment of dysphonia. Studies have been performed on the effectiveness of voice therapy. In a randomized controlled trial, voice therapy for dysphonia due to vocal fold nodule, laryngitis, and hyperfunction showed effective in improving voice quality as assessed by self-rated and observer-rated method [1]. In addition, many studies noted the success of treatment with voice therapy in several laryngeal disease including vocal fold nodules and polyp, even contract granuloma and muscle tension dysphonia [2-4].

Vocal cord nodules and polyps are common in organic dysphonia. Vocal nodules are bilateral epithelial lesions, but vocal polyps are unilateral fibrous vascular lesions [5]. These lesions are thought to be mechanical results of vocal abuse and misuse. Vocal abuse includes shouting, speaking in noise environments, and excessive talking, while vocal misuse refers to vibration of the laryngeal muscle due to improper tension [5]. Although the histologic characteristics of the two are different, voice therapy can improve voice by reducing vocal abuse and misuse [6].

Various parameters were selected for evaluating the therapeutic effect in each study. Evaluation techniques included quality-of-life measures, perceptual evaluation, acoustical analysis, video laryngostroboscopy, and aerodynamic measure, among others [7]. Although the effectiveness of voice therapy varies according to the evaluation techniques, many studies suggest positive effects of voice therapy.

Even if voice therapy is significant for voice enhancement, there may be differences in the results depending on patient factors such as age, occupation, duration of symptom, and type of laryngeal disease [8-10]. Few studies have been conducted on the factors affecting the outcome of voice therapy.

Studies on the factors associated with the result of voice therapy have been limited to specific

patient groups [11]. This makes it difficult to generalize the findings to all patients. However, if factors affecting voice therapy outcomes are controllable, correction of these factors may increase the effectiveness of voice therapy. Moreover, patients can be informed of the prognosis of the treatment before performing voice therapy. The purpose of this study was to investigate factors predicting the result of voice therapy in patients with vocal cord nodules and polyps.

Materials and Methods

Patients

The patients who underwent voice therapy for dysphonia due to vocal cord nodules and polyps were included in the study. All patients were diagnosed by laryngoscopy and stroboscopy, as well as voice analysis before and after voice therapy. In the voice analysis, parameters such as jitter, shimmer, Noise to Harmonic Ratio (NHR), Maximum Phonation Time (MPT), GRBAS score, and Voice Handicap Index (VHI), were evaluated. Patient data included sex, age, occupation, duration of symptom, drinking alcohol, the smoking history, intake of coffee, and vocal cord state.

Parameters for analysis

Each patient was examined by using the Multidimensional Voice Program (MDVP, KayPentax; Model 5105) in the Computerized Speech Lab system. Patients were asked to vocalize the vowel /a:/ for as long as possible. The microphone-to-mouth distance was adjusted 15 cm to ensure that the voice was detected by the computer. Jitter, shimmer, and NHR were measured in the steady interval of the recorded voice. Because these parameters could be changed by selection of voice segment [12], therapist selected 'safety interval' which is the most representative of the entire voice of the patient. The GRBAS scale scores were measured by a single therapist per patient. The patient was asked to read the "autumn paragraph," which is a six-sentence paragraph with an appropriate mix of consonants and vowels. The Korean version of Voice Handicap Index (VHI) was used to assess the patients' voice-related quality of life. The VHI consisted of 30 questions, and these were divided into 10 physical, functional, and emotional parts.

Jitter change rate and shimmer change rate

Jitter and shimmer are proposed as the basic acoustic measures that are computed according to a sustained vocalization of /a:/ at a comfortable frequency and intensity. Jitter is computed as the mean difference between the periods of adjacent cycles divided by the mean period. Thus, it is a F0 (fundamental frequency)-related parameter. For shimmer, a similar computation is performed on peak-to-peak amplitudes [13].

Jitter change rate is defined as the ratio of differences on the jitter scale between pre- and post-voice therapy to pre-voice therapy jitter scale. Shimmer change rate is defined as the ratio of differences on the shimmer scale between pre- and post-voice therapy to pre-voice therapy shimmer scale. Post-voice therapy data was obtained from the last voice analysis.

$$\text{Jitter change rate} = \frac{\text{pre_voice therapy jitter} - \text{post_voice therapy jitter}}{\text{pre_voice therapy jitter}}$$

$$\text{Shimmer change rate} = \frac{\text{pre_voice therapy shimmer} - \text{post_voice therapy shimmer}}{\text{pre_voice therapy shimmer}}$$

Definition of the good response group and less responsive group

Patients were divided into two groups. The good response group

included patients whose median jitter change rate was above the median and median shimmer change rate was above the median. The less responsive group included patients whose median jitter change rate was below the median and median shimmer change rate was below the median. The remaining patients were not included in the analysis.

Voice therapy

Patients in this study underwent voice therapy with an experienced speech-language pathologist. Frequency of voice therapy was one session per week for 30 min. Patients were evaluated at outpatient clinic after a treatment of 8 sessions. Data of the last voice analysis were compared to those of the initial voice analysis.

The first session was focused on the improvement of vocal hygiene. Improvement of vocal hygiene included well-hydration, controlling throat clearing, decreasing excessive vocalization, and relaxation of cervical muscles according to vocal cord state. If vocal hygiene improved, appropriate treatment methods such as respiration, resonance, and phonation were determined on the basis of vocal cord state and laryngeal muscle balance. Patients were treated through a massage and manual tension reduction targeting extrinsic laryngeal and strap muscles. Positions such as yawn and sigh were also performed to release muscles tension.

Factors predicting the result of voice therapy

In this study, seven factors which are sex, age, and job, duration of symptom, drinking alcohol, the smoking history, and the intake of coffee were analyzed to identify factors predicting the result of voice therapy in patients with dysphonia. Age was considered a continuous variable for statistical analysis. Patients were divided into talkative and non-talkative groups based on their occupations. Patients in the talkative group included interpreters, travel guides, musical actors, singers, teachers, kindergarten teachers, telephone agents, and others; these occupations were classified by the author with the consensus of a co-worker. Risk factors were classified according to the drinking alcohol (more than 1 time per a week), the smoking history (non-smokers vs. smokers), and the intake of coffee (intake of more than 1 cup of coffee per day or no intake). Duration of symptom was determined by the onset of the chief complaint, and it was used as a continuous variable for statistical analysis.

Results

To determine the improvement in voice due to voice therapy, the parameters of voice analysis before and after voice therapy were compared in 75 patients. Jitter, shimmer, MPT, and VHI were significantly improved. Thus, voice therapy seemed to improve voice in the study subjects (Table 1).

Of the 75 patients, 24 were in the good response group and 23 were in the less responsive group. The other patients (n=28) were those whose improvement was only one of the indicators of jitter or shimmer. They were excluded from the analysis of risk factors. The mean age and sex distribution in the two groups were not significantly different. Jitter, shimmer, NHR, MPT, and VHI before voice therapy were not significantly different between the good response group and less responsive group (Table 2). Comparing the result of voice therapy between the good response and less responsive group, in the good response group, MPT and VHI showed improvement. However, in the less responsive group, there was no significant improvement in this parameter. Comparing the two groups with regard to the GRBAS scale scores, in the good response group, all GRBAS scale scores

Table 1: Comparison of parameters between pre- and post-voice therapy.

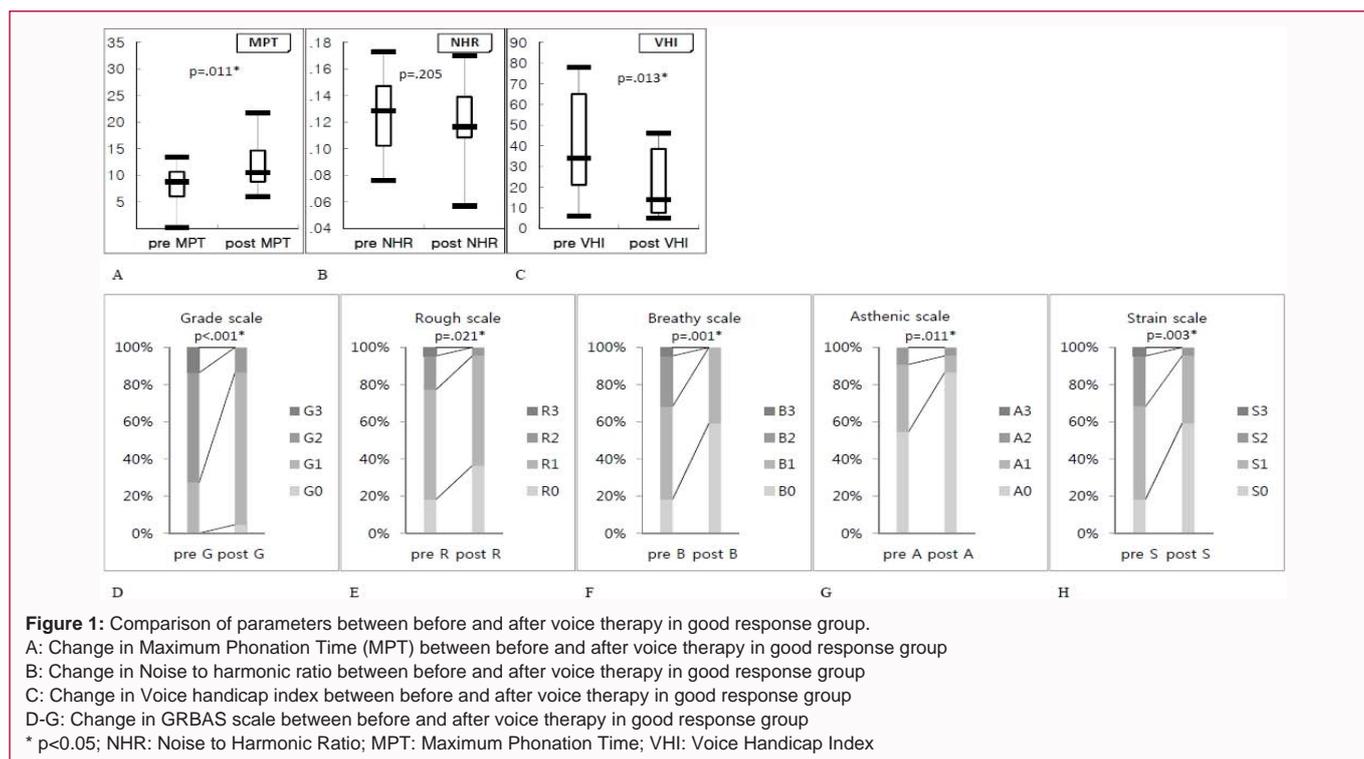
Parameters	Pre-voice therapy parameter	Post-voice therapy parameter	p-value
F0	197.95 ± 41.35	200.82 ± 33.49	0.398
Jitter	1.14 ± 0.64	0.79 ± 0.75	0.001*
Shimmer	2.83 ± 1.34	2.42 ± 1.34	0.001*
NHR	0.127 ± 0.033	0.118 ± 0.026	0.081
MPT	10.41 ± 6.25	11.53 ± 4.21	0.055
VHI (n=53)	42.34 ± 24.65	26.04 ± 21.62	0.001*

* p<0.05; F0: Fundamental frequency; NHR: Noise to Harmonic Ratio; MPT: Maximum phonation time; VHI: Voice Handicap Index

Table 2: Demographic data of the subjects.

	Total	Good response group	Less responsive group	p-value
Patients, N	75	24	23	
Mean age, y	41.71 ± 18.24	46.42 ± 13.21	44.09 ± 21.17	0.651
Sex (Male: Female)	0.5847222	02:22	06:17	0.137
Pre-voice therapy jitter	1.26 ± 0.69	1.37 ± 0.71	1.127 ± 0.63	0.215
Pre-voice therapy shimmer	2.81 ± 1.46	3.15 ± 1.76	2.51 ± 0.93	0.133
Pre-voice therapy NHR	0.127 ± 0.33	0.136 ± 0.043	0.120 ± 0.023	0.12
Pre-voice therapy MPT	10.42 ± 6.25	11.08 ± 7.11	11.48 ± 7.40	0.852
Pre-voice therapy VHI	42.72 ± 24.84	44.54 ± 22.36	41.35 ± 27.59	0.664

* p<0.05; NHR: Noise to Harmonic Ratio; MPT: Maximum Phonation Time; VHI: Voice Handicap Index



improved, including those for the grade scale and asthenic scale. In the less responsive group, however, the scores for the grade scale and asthenic scale did not show significant improvement (Figure 1, 2).

For finding the factor to predict the outcome of voice therapy, we analyzed the factors by logistic regression analysis. The intake of coffee (odd ratio: 4.243) and duration of symptom (odd ratio 5.552) were significant risk factors for less response to voice therapy (Table 3). Sex, age, occupation, drinking alcohol, and the smoking history did not significantly affect the responsiveness of voice therapy.

Statistical analysis

The results are presented as median (interquartile range). Pre- and post-voice therapy parameters, such as frequency, jitter, shimmer, NHR, MPT, and VHI were compared using Wilcoxon signed rank test. Good response group and less responsive group were compared using Mann-Whitney test. To identify the factors affecting the result of voice therapy, logistic regression analysis was used. The differences were considered statistically significant at p<0.05. Statistical analyses were performed using the SPSS 20 package (SPSS Science, Chicago, IL).

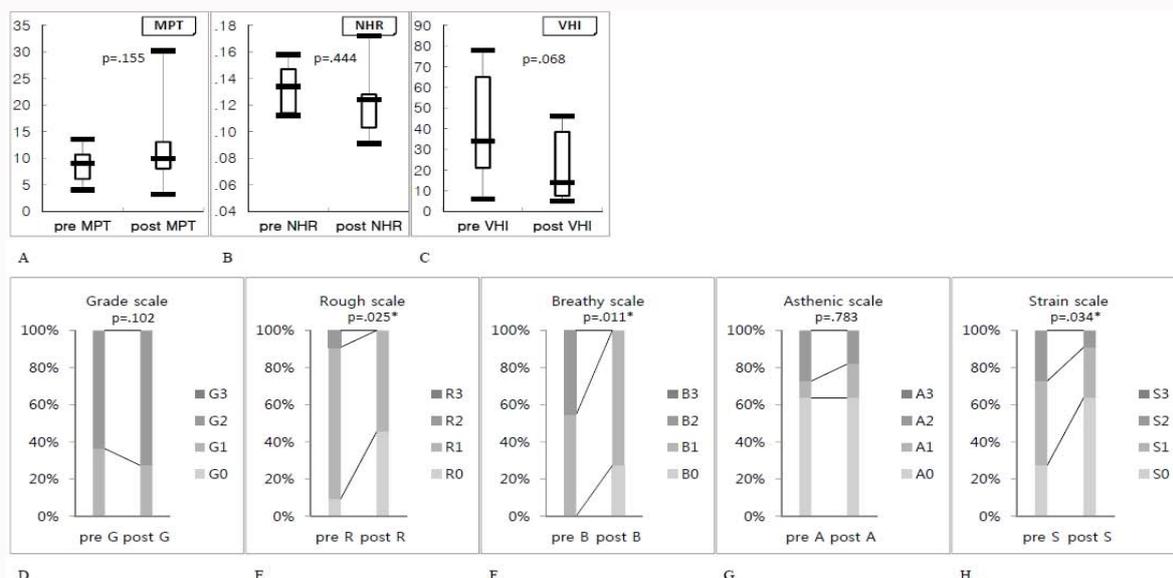


Figure 2: Comparison of parameters between before and after voice therapy in less responsive group.
 A: Change in Maximum phonation time between before and after voice therapy in less responsive group
 B: Change in Noise to harmonic ratio between before and after voice therapy in less responsive group
 C: Change in Voice handicap index between before and after voice therapy in less responsive group
 D-G: Change in GRBAS scale between before and after voice therapy in less responsive group
 * p<0.05; NHR: Noise to Harmonic Ratio; MPT: Maximum Phonation Time; VHI: Voice Handicap Index

Table 3: Comparison of Odds Ratios (OR) for five factors in the less responsive group.

	Adjusted OR	95% CI	p-value
Sex	0.149	0.014-1.605	0.116
Age	0.989	0.945-1.035	0.647
Occupation (non-talkative vs. talkative)	1.018	0.189-5.487	0.984
Drinking alcohol (more than 1 time per a week)	1.83	0.292-11.457	0.518
The smoking history (non-smokers vs. smokers)	0.956	0.040-22.914	0.978
Intake of coffee (vs. no intake of coffee)	4.243	1.010-17.816	0.048*
Duration of symptom	5.552	1.105-27.897	0.037*

* p<0.05; CI: Confidence Interval

Discussion

After voice therapy, improvement in objective indicators of voice such as jitter and shimmer and subjective indicators of voice such as VHI was confirmed in this study. This study investigated whether there is a difference in the factors affecting the result of voice therapy between the good response and less responsive groups, which were divided on the basis of objective indicators. We found that the intake of coffee and the duration of symptom were predicting factor for less response to voice therapy. Changes in the objective indicators including jitter and shimmer were correlated with changes in subjective indicators such as VHI.

When considering the jitter and shimmer scale for determining voice improvement, comparing the difference in the data before and after voice therapy did not reflect voice improvement accurately. Generally, the larger was the score before voice therapy, the larger was the difference in the scale between before and after voice therapy. Owing to this tendency, dividing groups according to difference in the score may have led to a bias in selecting the responsive group. Therefore, we used the concept of change rate. The ratio of difference in the scales between before and after voice therapy to the pre-voice therapy scales was calculated. If jitter change rate and shimmer

change rate were larger than the median, the patients were included in the good response group. In contrast, if jitter change rate and shimmer change rate were smaller than the median, the patients were included in the less responsive group. If the jitter change rate was greater than the median but the shimmer change rate was less than the median, or vice versa, the patients were excluded from the analysis. Unfortunately, this classification method led to a decrease in the number of study patients. In the result, the comparison was conducted in 47 patients; the small study population may be a limitation of this study.

Many studies use a comparison of jitter and Shimmer scales to determine voice improvement. These scales were used to determine voice improvement in cases of various vocal cord conditions such as vocal cord nodule, polyp, and paralysis [14,15]. In addition to voice therapy, these scales were also used as indicators of voice improvement after laryngeal microsurgery [16,17].

We selected certain factors that were suspected to affect the result of voice therapy. Few studies have been conducted on the factors affecting the result of voice therapy. In one study on the factors that cause voice disorder, sex (female), age (40 to 59 years), voice use patterns, esophageal reflux were noted to contribute to chronic

voice disorder [8]. Female have a higher vibrating force because of a higher fundamental frequency. Also, the amount of hyaluronic acid that helps wound repair in female is less [8]. Sex can affect the results of voice therapy. Although not statistically significant in the logistic regression analysis, the number of women in the less responsive group was significantly higher than in the good response group. It is supposed that age may affect the result of voice therapy because of vocal fold changes such as epithelium changes, cartilage ossification, and atrophy of vocal muscles [18]. In addition, when age increases, differences in the result of voice therapy may be attributed to decrease in laryngeal muscle tension. Because vocal behaviors, for example, frequently talking, loudly talking, can effect to dysphonia, patient's occupation was considered to a factor predicting the result of voice therapy. Selection of occupations for classification into talkative and non-talkative groups was performed by an author. Although a consensus was reached with a co-worker, this approach had a limitation in that it can be subjective. The patients in the talkative group were travel guides, kindergarten teachers, singers, musical actors, telephone agents, interpreters, insurance planners, and lecturers. Non-talkative group included students, homemakers, care workers, those with white-collar occupations, and farmers. Drinking alcohol and the smoking history cause chronic inflammation and general dehydration of larynx, leading to hoarseness [19]. This may be because the drinking alcohol and the smoking history reflected the severity of laryngeal dehydration insufficiently.

This study differs from previous studies in suggesting criteria for dividing the good response and less responsive group. In the good response group, the MPT, VHI, and GRBAS scale were significantly improved, while some parameters were not significantly improved in the less responsive group. Based on this fact, the jitter change rate and shimmer change rate can be considered to reflect other parameters of voice quality. We suggest that a longer duration of symptom and a history of intake of coffee are factors predicting result of voice therapy. The longer the symptom persists, the more likely it is that the patient has been using the wrong vocal behavior for a long time. Therefore, it may be difficult to correct habitual vocal behavior. Patients with the intake of coffee were more likely to develop laryngeal reflux even if they were not diagnosed with reflux or might have dehydration of larynx. Duration of symptom is a factor that can be controlled through the education of patients. It may be thought that starting voice therapy as soon as dysphonia begins is likely to lead to good response to voice therapy. Patients also can be given explanation about the prognosis before starting voice therapy. Intake of coffee is also a controllable factor. Preliminary findings show those who consume more than one cup of coffee a day might belong to the less responsive group. Therefore, we might suggest that stopping coffee or drinking more water is recommended during vocal hygiene training.

Conclusion

We suggest that evaluation of duration of symptom and intake of coffee can aid in predicting the result of voice therapy in patients with dysphonia. If a patient has a history of intake of coffee or a longer duration of symptom, the patient might be less responsive to voice therapy compared with a patient who does not.

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