

# Are Vocal Alterations Caused by Smoking in Reinke's Edema in Women Entirely Reversible After Microsurgery and Smoking Cessation?

\*Regina Helena Garcia Martins, †Elaine Lara Mendes Tavares, and †Adriana Bueno Benito Pessin, \*†Botucatu, Brazil

**Summary: Background.** Reinke's edema is a benign lesion of the vocal folds that affects chronic smokers, especially women. The voice becomes hoarse and virilized, and the treatment is microsurgery. However, even after surgery and smoking cessation, many patients remain with a deep and hoarse voice.

**Objectives.** The aim of the present study was to compare pre- and postoperative acoustic and perceptual-auditory vocal analyses of women with Reinke's edema and of women in the control group, who were non-smokers.

**Methods.** A total of 20 women with videolaryngoscopy diagnosis of Reinke's edema who underwent laryngeal microsurgery were evaluated pre- and postoperatively (6 months) by videolaryngoscopy, acoustic voice, and perceptual-auditory analyses (General degree of dysphonia, Roughness, Breathiness, Asthenia, Strain, and Instability [GRBASI] scale), and the maximum phonation times were calculated. The pre- and postoperative parameters of the women with Reinke's edema were compared with those of the control group of women with no laryngeal lesions, smoking habit, or vocal symptoms.

**Results.** Acoustic vocal perceptual-auditory analyses and the maximum phonation time of women with Reinke's edema improved significantly in the postoperative evaluations; nevertheless, 6 months after surgery, their voices became worse than the voices of the women from the control group.

**Conclusions.** Abnormalities caused by smoking in Reinke's edema in women are not fully reversible with surgery and smoking cessation. One explanation would be the presence of possible structural alterations in fibroblasts caused by the toxicity of cigarette components, resulting in the uncontrolled production of fibrous matrix in the *lamina propria*, and preventing complete vocal recovery.

**Key Words:** Reinke's edema–dysphonia–microsurgery–voice–smoking.

## INTRODUCTION

Reinke's edema is a benign lesion of the vocal folds that affects chronic smokers, especially women. The voice becomes hoarse and virilized, explaining why women have more symptoms than men.<sup>1,2</sup> Reinke's edema was classified by Yonekawa<sup>3</sup> into three stages, depending on the extent of the injury, as follows: type 1, superficial edema of vocal folds without obstruction of the glottic lumen; type 2, edema extending to the posterior portion of the vocal folds; type 3, massive edema of the vocal folds that affects its entire length, a small glottic lumen remaining in the posterior region of the larynx.

The treatment of choice in Reinke's edema, especially for types 2 and 3, is microsurgery, which can be performed by various techniques, among them microdebrider, decortication, laser, and microflap.<sup>4–7</sup> Nevertheless, postoperative voice restoration is slow and depends on several factors, especially the success of the surgical removal of the lesion and smoking cessation.

Postoperative voice improvement in Reinke's edema is notorious, especially when compared with that in the preoperative vocal conditions, as recorded by us and many other authors in

perceptual-auditory and acoustic voice analyses.<sup>6–8</sup> The voices of some women, however, remain hoarse, despite having abandoned smoking. To prove this statement, the purpose of the present study was to compare the results of the acoustic voice analysis of women with Reinke's edema before and after microsurgery with those of the control group of nonsmoking women.

## PATIENTS AND METHODS

The present study included 20 women, aged 40–70 years, with videolaryngoscopy diagnosis of Reinke's edema grades 2 or 3 according to Yonekawa's classification,<sup>3</sup> without symptoms of gastroesophageal reflux or vocal abuse and who had abandoned smoking. All patients were assessed before and after surgery (6 months) by means of videolaryngoscopy using laryngeal telescope (70°, 8 mm, Azap, Baden-Württemberg, Germany) coupled to a multifunctional system (video system type XE-30, Eco X-TFT/USB, Germany) with image recording on DVD; computerized acoustic voice analysis (*Multi-dimensional Voice Program*; KayPentax, Lincoln Park, NJ), perceptual-auditory evaluation (General degree of dysphonia, Roughness, Breathiness, Asthenia, Strain, and Instability [GRBASI] scale), and calculation of the maximum phonation time (MPT).

For acoustic vocal assessments, the vocal samples were obtained during sustained emission of the vowel /a/ and of the phonemes /s/ and /z/. The acoustic parameters analyzed were fundamental frequency (F0—number of cycles/second), jitter percentage (%), shimmer percentage (%), pitch perturbation quotient, amplitude perturbation quotient, soft phonation index, and noise-harmony ratio.

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From the \*Discipline of Otolaryngology, UNESP Universidade Estadual Paulista, Botucatu, São Paulo, Brazil; and the †Speech Therapy, Discipline of Otolaryngology, UNESP Universidade Estadual Paulista, Botucatu, São Paulo, Brazil.

Address for correspondence and reprint requests to Regina Helena Garcia Martins, Departamento de Oftalmologia, Otorrinolaringologia e Cirurgia de Cabeça e Pescoço, Faculdade de Medicina da Universidade Estadual Paulista (UNESP), Distrito de Rubião Junior, Botucatu, São Paulo, Brazil CEP 18618-970. E-mail: [rmartins@fmb.unesp.br](mailto:rmartins@fmb.unesp.br)

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All vocal evaluations were conducted in a quiet room by the same speech pathologist; a headset microphone (Shure, São Paulo (SP), Brazil) connected to a computer was used to collect the vocal samples. The GRBASI scale was applied in vocal samples of these women previously recorded for the acoustic measures during sustained emission of the vowel /a/ for the perceptual-auditory evaluations. Data were blindly analyzed by three speech therapists with expertise in voice, and there should be agreement on at least two of the scores. The vocal parameters analyzed were G (General degree of dysphonia), R (Roughness), B (Breathiness), A (Asthenia), S (Strain), and I (Instability). The parameters were quantified from 0 to 3, depending on the intensity of voice disorder: 0 (no voice disorder), 1 (mild voice disorder), 2 (moderate voice disorder), and 3 (severe voice disorder).

All women with Reinke's edema in the present study were operated by the same surgeon, using the same surgical technique for microsurgery: incision of laryngeal mucosa parallel to the free edge, aspiration of mucus content, and removal of redundant mucosa, preserving part of the mucosa coverage and the vocal ligament.

The results of the postoperative vocal assessments of women with Reinke's edema were compared with those of the control group, which consists of 40 healthy women, aged from 40 to 70 years, nonsmokers, and without vocal abuse, gastroesophageal reflux, or other comorbidities that could compromise the voice, such as intubation, inhaled irritants, or neck trauma. The participants in the control group underwent the same sequence of vocal evaluation conducted for patients with Reinke's edema.

The project was approved by the Human Research Ethics Committee of the Botucatu Medical School.

### Statistical methods

The Wilcoxon test (a nonparametric test used to compare two paired samples) was used to compare the pre- and postoperative

values of acoustic parameters, GRBASI scale scores, and MPT. The comparison between the measures of the control group and the postoperative measures of women with Reinke's edema was carried out using Mann-Whitney test (a nonparametric test to compare two independent samples). In all comparisons, the significance level was set at 5%.

### RESULTS

Table 1 depicts the pre- and postoperative values of acoustic voice analyses of women with Reinke's edema and of the control group. An important improvement of vocal parameters could be noted when comparing pre- and postoperative values of women with Reinke's edema; however, these values still differ from those of the control group. The F0 values are still lower than those of the voices of the controls, and other acoustic parameters are still above normal ranges. The only acoustic parameter that did not have statistical significance was soft phonation index.

The same behavior could be observed in the vocal analysis of the GRBASI scale; lower scores were recorded in the postoperative period; the postoperative scores nevertheless remained higher than those in the control group, indicating some degree of remaining dysphonia, except for S and I parameters (Table 2). In Table 3, we can see that the values of MPT increased after surgery, but also remained lower than the values in the control group.

### DISCUSSION

Reinke's edema is a benign laryngeal lesion directly related to smoking. For some authors, vocal abuse and laryngopharyngeal reflux are also predisposing factors;<sup>1,2</sup> there is no evidence, however, to prove that these factors, when isolated, can develop lesions in their most important presentations, as in stages 2 or 3 of the Yonekawa's classification.<sup>3</sup> Most authors are unanimous in recognizing the direct participation of smoking in

**TABLE 1.**  
Acoustic Vocal Parameters: Average, Standard Deviation, and Statistical Analysis of the Pre- and Postoperative Voices of Patients who Underwent Microsurgery for Reinke's Edema, and Those of the Controls

Moment Acoustic Parameters	Preoperative Reinke's Edema	Postoperative Reinke's Edema	Control	P Value
<b>F0</b>	149.8 ± 33.8	182.6 ± 34.1	220.5 ± 28.3	Pre × Post < 0.001* Post × Control < 0.001*
<b>Jitter%</b>	2.9 ± 1.9	1.6 ± 0.8	0.71 ± 0.42	Pre × Post < 0.001* Post × Control < 0.001*
<b>PPQ</b>	1.8 ± 1.3	0.9 ± 0.5	0.40 ± 0.23	Pre × Post < 0.001* Post × Control < 0.001*
<b>Shimmer%</b>	9.3 ± 7.7	5.0 ± 2.1	2.20 ± 1.1	Pre × Post < 0.001* Post × Control < 0.001*
<b>APQ</b>	6.5 ± 5.5	3.6 ± 1.5	1.6 ± 0.7	Pre × Post < 0.019* Post × Control < 0.001*
<b>NHR</b>	0.236 ± 0.158	0.147 ± 0.041	0.117 ± 0.019	Pre × Post < 0.001* Post × Control < 0.004*
<b>SPI</b>	12.0 ± 7.0	11.6 ± 9.9	9.4 ± 4.5	Pre × Post = 0.866 Post × Control = 0.946

\* Statistical significance.

Abbreviations: APQ, amplitude perturbation quotient; F0, fundamental frequency; NHR, noise-harmony ratio; PPQ, pitch perturbation quotient; SPI, soft phonation index.

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