

Outcome of vocal hygiene in singers

Bernadette Timmermans^{a,b}, Jan Vanderwegen^b and Marc S. De Bodt^{b,c}

Purpose of review

In this article, we illustrate the evolution of studies that contribute to a better understanding of vocal care for professional voice users and singers in particular.

Recent findings

Research on vocal hygiene is specific, focusing on concrete solutions. It has commonly been believed that hydration and vocal rest are beneficial; recent research proves this supposition. An exhaustive medical diagnosis and careful therapy is stressed to detect and treat any micro-organic lesions caused by reflux, infection, allergy and environmental circumstances, which can harm a singer's voice. The use of medication is reviewed and side effects are evaluated.

Summary

Vocal coaches, speech therapists and otolaryngologists need to focus more specifically on the management of vocal care. Accurate medical diagnosis and specific guidelines for singers must be provided as higher voice demands imply more profound and structured voice care. In the past, vocal hygiene had a negative connotation; a more positive and supporting approach to voice care, with more attention to the singer, is recommended.

Keywords

singers, vocal hygiene, voice care

Introduction

Vocal hygiene influences voice functioning. Vocal abuse/misuse, vocal overuse, bad vocal techniques, environmental circumstances, wrong diet choices, are hazardous to a professional voice user. Voice professionals such as singers are overwhelmed with lists of 'to-do's' and 'not-to-do's'. The requirements of a performer's voice are specific and imply not only a good voice, but also a beautiful voice; consequently, the demands are higher.

Vocal demands of the professional voice user

The professional voice user is dependent on his/her voice for daily practice. There are, however, differences in vocal demands among the several categories of professional voice users (Table 1). The amount of hours of voice use a day, the demands on the voice quality, the occurrence of mental stress, the required volume and the necessity to travel are five important variables. Teachers and operators use their voices for several hours a day, sometimes up to 6–7 hours. Though the performing artist seems to work less hours a day, the burden is probably higher; the performer is under a great deal of stress. The demands on the voice quality is very high for presenters, actors and singers, although these demands can vary according to the situation (in modern theatre or pop music, voice quality is not the all-important factor). Necessarily, teachers, actors and singers have to speak or sing loud. In addition, travel is a way of life for many singers and actors. Apart from the discomfort of regular travel, air travel holds specific problems. Considerable noise levels (beware of the Lombard effect, i.e., a raise of voice loudness and pitch due to the noisy environment), underhumidified environment, fatigue and stress are a few of the travel-related issues. It is clear that the importance of vocal hygiene is proportional to the professional demands of voice use.

Different singing styles

It is almost impossible to analyze and describe all singing styles. Opera, operetta, choir and musical singers use the classical singing technique (if choir and musical singers received any formal singing training); pop, belt, R&B, jazz, rock and country singers use a more popular voice technique. Popular singing styles can elicit poor vocal behavior as vocal strain and a tense or lifted vocal apparatus is part of the 'sound' and the expressed emotions.

Training versus nontraining

The efficacy of voice therapy has received attention for decades and confidence in the effectiveness of voice therapy and voice training is justified by several studies [1,2]. The efficacy of singing training is studied by Mendes *et al.*

Curr Opin Otolaryngol Head Neck Surg 13:138–142. © 2005 Lippincott Williams & Wilkins.

^aDepartment Rits, Erasmus Institute, Brussels, Belgium, ^bDepartment of Otolaryngology, Head and Neck Surgery and Communication Disorders, Faculty of Medicine, University Hospital Antwerp, UA, Belgium, and ^cDepartment of Speech and Language Pathology, University of Ghent, Belgium

Correspondence to Bernadette Timmermans, Department of Otolaryngology, Head and Neck Surgery and Communication Disorders, University Hospital Antwerp, UA, Wilrijkstraat, 10 B-2650 Edegem, Belgium
Tel: +32 3 454 3501; e-mail: bernadette.timmermans@telenet.be

Current Opinion in Otolaryngology & Head and Neck Surgery 2005, 13:138–142

Abbreviations

AST acid suppressive therapy
GERD gastro-esophageal reflux
HVR hydration and voice rest
LPR laryngopharyngeal reflux

© 2005 Lippincott Williams & Wilkins.
1068-9508

Table 1. Voice loading parameters for the occupational voice users

	High volume	Importance of voice quality	Working hours	Occurrence of mental stress	Travel
Teachers	x		Up to whole day	x	
Operators			Up to whole day	x	
Presenters		x	Part of the day	xx	
Actors	x	x	Part of the day	xx	x
Singers	x	x	Part of the day	xx	x

[3]. Their longitudinal study of voice majors who were recorded while singing revealed that training had a significant effect on the maximum phonation range with respect to the fundamental frequency and the intensity level of the voice. In another study, Mendes *et al.* [4^{*}] proved that singing training does not affect the speaking voice; they confirm the earlier cross-sectional studies that compared singers and nonsingers in this respect. Earlier research shows that untrained singers usually strain their voices more often than trained singers to produce a wide range of frequencies. Singing training prevents singers from voice difficulties as they are more aware of the influencing factors and learned to use their voices correctly. Therefore, special attention should be paid to singing voice students, as they lack experience and do not realise their voice misuse or overuse [5]. Though case reports make clear that professionally trained singers can also be confronted with voice pathology.

Outcomes in vocal hygiene

A review of 'vocal hygiene outcome in singers' implies a discussion on vocal hygiene studies for professional voice users. Analyzing the studies on vocal hygiene education for professional voice users, we noticed that the results are ambiguously (Table 2). Some studies on vocal hygiene outcome are in favour of vocal hygiene education [6–8] while others stipulate that education has small effects on voice functioning [9–11]. As shown in Table 2, more recent studies concentrate on specific aspects of vocal hygiene rather than questioning vocal hygiene as a concept [12–15].

Yiu and Chan found that the vocal hygiene in amateur singers without voice training is worse than in professional voice users, as they have little knowledge of vocal hygiene [10]. But does this mean that the professional singer has no voice problems or that he/she has no vocal complaints? We compiled a vocal hygiene profile of professional choir singers, radio and television presenters and teachers out of our own database on professional voice users (Table 3). Risk factors for voice problems were assessed by means of a questionnaire. Analysis of the vocal profile of choir singers reveals four striking and significant differences: They do not smoke, 62% of them report stress, 6% admit vocal abuse and 37% visit an ENT physician in case of voice problems. It is striking to notice that 93% of the singers experience vocal fatigue and that only 37% of them visit an ENT physician despite their complete dependency on voice.

Table 2. Studies on vocal hygiene education in occupational voice users

Authors	Year	Population	Subject of study	Results
Koufman and Blalock [16]	1988	67 Professional voice users	Vocal fatigue and dysphonia	Bogart–Bacall syndrome: a tension-fatigue syndrome
Novak <i>et al.</i> [17]	1991	45 Actors	Vocal fatigue after performance	Vocal fatigue depends on vocal strain and mental stress
Gotaas and Starr [18]	1993	39 Teachers	Vocal fatigue	Medical history, overuse, allergy and anxiety related to fatigue
Chan [7]	1994	12 Kindergarten teachers	Vocal hygiene education	Education has effect importance of overuse misuse
Sapir <i>et al.</i> [8]	1996	70 Singers, 89 nonsingers	Vocal health and vocal behaviour	Heightened sensitivity of singers regarding voice
Roy <i>et al.</i> [6]	2000	27 Actors	Effect hygienic laryngeal release	Vocal training could defend the laryngeal system
Broaddus-Lawrence, Treole, McCabe, <i>et al.</i>	2000	11 Untrained singers	Effect of vocal hygiene education	Little effect, but high degree of benefit and learning
Van Der Merwe <i>et al.</i> [19]	2000	183 Educators, 50 ministers, 20 singers	Voice problems and prevention	Little knowledge, little voice care
Timmermans <i>et al.</i> [11]	2000	86 Professional voice users	Voice quality and vocal hygiene	Bad vocal hygiene profile
Yiu, and Chan [10]	2003	20 Amateur karaoke singers	Vocal rest and hydration	Hydration and vocal rest are useful strategies
Mibrath and Solomon [12]	2004	8 Women	Effect of warm-up on vocal fatigue	High between-subject variability
Duffy and Hazlett [13]	2004	55 Teachers	Impact of preventive voice care program	More effect with direct training
Pederson <i>et al.</i> [14]	2004	30 Patients	Medical voice hygiene advice	Plea for rigorous medical and treatment
Solomon <i>et al.</i> [15]	2004	4 Men	Effect of hydration in men	Probably gender difference more effect of hydration in woman

Table 3. The vocal hygiene profile of radio and TV presenters, choir singers and teachers

	Radio (n = 53)	TV (n = 47)	Choir (n = 16)	Teachers (n = 59)	p-value
Allergy	36%	28%	37%	29%	0,741
Reflux	7%	6%	25%	7%	0,106
Abuse	15%	34%	6%	39%	0,005
Hoarse	21%	28%	31%	32%	0,576
ENT visit	23%	28%	37%	5%	0,004
Stress	28%	23%	62%	14%	0,001
Fatigue	62%	70%	93%	63%	0,091
Smoke	28%	23%	0%	7%	0,003

The data for singers show that they indeed have a particular lifestyle more adapted to their vocal demands. Despite this, they are not immune to vocal fatigue or hoarseness. This study however, is not representative for the singing population as a whole.

Until now, vocal hygiene stressed mainly the behavioural aspects of voice use, what was to be done and not done. We propose voice care as a future concept to counsel and support voice professionals such as singers. Voice care broadens the concept of vocal hygiene to include lifestyle and medical guidelines, repertoire and career planning.

Warm-up exercises

The purpose of warm-up exercises is to prepare the vocal folds of the voice user for the upcoming task. Warm-ups, as in weight training, are used to stretch the muscles to prepare them to work without injury and can prevent or delay vocal fatigue. In addition to the standard nasal buzz—known to provide maximum vocal economy and overall resonance—singers include descending and ascending melodic patterns on /mu:/ with varying pitches and loudnesses. Vocal fatigue is a known problem to any professional voice user [16–19]. Two recent studies questioned the effect of vocal warm-up on vocal fatigue. The first study involved nontrained singers; the second study focused on trained singers. Milbrath and Solomon sought to determine if vocal warm-up could alleviate vocal fatigue [12]. The voices of eight young women were measured after tasks to warm-up, to fatigue and to rest the voice. The authors concluded that a single brief session of vocal warm-up is inadequate for effecting changes in vocal function. The selected women were not trained and so lacked sufficient skills to benefit from a single warm-up exercise; they reverted to their habitual voicing strategies as soon as loud reading began. In our opinion, the vocal function exercises used by Milbrath and Solomon were not designed to warm-up the singers, but to train them in vocal endurance.

Welham and Maclagan asked trained singers who were undertaking a singing specialization course to simulate a performance task of 40 minutes [20*]. Before the simulation there was a prescribed warm-up of 10 minutes and after

the simulation a vocal rest of 10 minutes. The authors report that vocal history is important in predisposing the onset of fatigue. Participants with previous vocal difficulties consistently experience vocal deterioration. This could mean that subtle variations in laryngeal anatomy and physiology between singers could influence vocal endurance, rather than vocal technique. The second explanation for the individual variation in vocal endurance concerns the repertoire demands; a technically less demanding repertoire was felt to be less taxing on the vocal mechanism.

These studies evoke more questions than answers because there is no uniformity in the procedures and assessment strategies. However, we do believe that the psychological effect of vocal warm-up is underestimated. Voice athletes need to be prepared for a demanding and stressful task. The contradiction between mental rest to prevent muscular tension and a powerful need to achieve best results can result in performance anxiety, a lack of confidence and psychological stress that cannot be neglected.

Hydration and vocal rest

Hydrating the vocal apparatus is an important issue in voice care. The laryngeal tissue viscosity may decrease by drinking water. Yiu and Chan randomly assigned 20 amateur karaoke singers into two groups [10]. One group was given hydration and voice rest (HVR) and were allowed to drink 100 ml water and voice rest for 1 minute after each song. The other group (non-HVR) sang without voice rest or water. Both groups were asked to sing continuously until they felt voice fatigue. The HVR group sang significantly longer than the non-HVR group. This experiment indicated that intermittent hydration and voice rest are useful in prolonging singing time without a fatigue feeling. No gender effect was found in contradiction with the findings of Solomon *et al.* [15].

Research on the effect of vocal rest before, during or after performance is sparse. Common sense tells us that resting the voice is beneficial, as good voice performance cannot last for hours. Future research should determine the optimal regime of HVR before, during and after a performance to prevent vocal fatigue.

Harmful substances on stage

Literature on harmful substances on stage is sparse. Singers commonly complain about a dry, dusty working environment. Richter *et al.* describe several toxic substances to which singers are exposed while working and their medical consequences [21]. The authors conclude that whenever singers complain about deleterious conditions such as dry and hot climate on stage or suspicion of the presence of harmful substances, the specific conditions should be investigated. Greatest weight should be placed on statements made by artists even against possible resistance

on the part of directors, theatre administrators and stage managers.

Medical considerations

Pedersen *et al.* showed the importance of an accurate medical diagnosis and treatment of so-called ‘micro-organic disorders’ [14], such as allergy, reflux, infections and problems caused by environmental irritants. Some functional voice problems do not need voice therapy as medical therapy provides the appropriate solution. Unfortunately, Pederson does not define the medical treatment or the micro-organic disorders of each subject, so it is difficult to evaluate the results of this study. Despite this, we do believe that a more precise diagnostic work-up is mandatory for every professional voice user.

Laryngopharyngeal reflux (LPR) and gastro-esophageal reflux (GERD) are two important causes of laryngeal and voice disorders. Although there are no recent data on reflux-associated voice disorders in professional singers, one can only assume it is at least as high as in the normal population. A survey of asymptomatic singing students revealed a high incidence of symptoms and videostroboscopic findings suggestive for LPR [22]. The lifestyle (e.g., late working hours) and the intense use of the diaphragm promote GERD in singers, which then would interfere with breath control and/or laryngeal muscle function. For singers and professional voice users, other symptoms may include increased time necessary to achieve adequate vocal warm-up, restricted vocal tone placement, and decreased pitch range [23].

Patients typically report multiple symptoms of LPR on clinical presentation, especially chronic throat clearing, globus, hoarseness and vocal fatigue. This diversity—combined with poor specificity of any individual complaint—warrants the use of validated questionnaires, like the Reflux Symptom Index [24]. Although there might be a poor correlation between patient-reported symptoms and results of pH probe testing [25]. Due to the high demands of the singing voice, the development of a specific LPR-questionnaire for professional voice users would be welcomed.

Laryngoscopic validation of suspected LPR remains challenging because several laryngeal findings initially associated with LPR [26] were questioned in the past year. Williams *et al.* found no correlation between the degree of laryngitis and hypopharyngeal reflux episodes evaluated by pH probe [27]. Ylitalo *et al.* found the single presence of pseudosulcus (i.e., bilateral infraglottic oedema) not a very sensitive predictor of LPR [28]. Hill *et al.* investigated one of the hallmarks of LPR, posterior commissure hypertrophy, also called pachydermia, and found no significant difference in 17 patients with LPR, when compared at diagnosis and after long-term acid suppressive therapy

(AST) [29**]. Pachydermia as an isolated finding could indicate the patient’s exposure to LPR in the past without indicating active disease.

The additional data of a pH study may be useful both to avoid overdiagnosing LPR and underdiagnosing LPR, avoiding inappropriate prolonged cycles of AST, anti-inflammatory therapy [30*]. Exciting new ways to assess reflux are currently being developed; a direct assessment of pepsin in airway secretions may provide a noninvasive biochemical test for assessment of reflux [31**].

Medication

Any medication should be evaluated for side effects potentially affecting the vocal tract and the voice. Unfortunately, no recent work focusing on professional voice users has been performed. Several studies have investigated the effect of two commonly used drugs. The literature on the effect of oral contraceptives on voice is limited, mostly outdated, and based mainly on subjective evaluation. Their usage used to be discouraged due to the adverse effects on the female voice (i.e., virilization resulting in a lowered frequency and increased harshness).

Amir and Kishon-Rabin showed that new-generation birth control pills do not exert an adverse effect on the voice; in fact, by eliminating the natural hormonal fluctuations of the menstrual cycle, the voice quality of pill users was found to show lower frequency and amplitude perturbation and a better noise-to-harmonics ratio [32]. The authors attribute these improvements to an improved regulation of vocal fold vibration.

The relation between dysphonia and asthma is twofold; untreated asthma is detrimental to the voice because phonation requires well-functioning breathing, and voice problems as a side effect from asthma treatment have long been recognized. Combination treatment with corticosteroids and long-acting beta 2 agonists are currently being used earlier and for milder disease than before. Ihre *et al.* found a 63% prevalence of voice disturbances in 280 patients attending asthma and allergy departments in three university hospitals [33]. Dysphonia occurred after a variable treatment time, or after a change in inhalation medicine. The voice problems were more common in professional voice users, who are sensitive to, and intolerant of, a trivial change in voice quality that may otherwise go unnoticed. Mirza *et al.* examined 9 patients with a new onset of hoarseness after switching from previous inhalers to a combination inhaler therapy [34]. Vocal complaints were a lowering of the pitch and a rough quality of the voice; stroboscopy showed oedema, vascular lesions (dilated blood vessels, capillary ectasias, varices and even small areas of hemorrhages) and areas of thickening, irregularity and leukoplakia of the vocal folds. Discontinuation of the therapy caused a partial to complete reversal of the lesions in

5 patients after 8 to 12 weeks; unfortunately, the complaints are known to recur if treatment is restarted.

Conclusion

Singers are a unique group of performers; they rely almost entirely on their voices for their livelihood. They have to work in a stressful and highly competitive environment, coping with a hectic and demanding life, jet lag and an ever-increasing number of allergens and pollutants on stage. The negative attitude towards vocal hygiene has changed from restrictive measures into a more positive approach to voice care. This positive approach enhances the singer's compliance and may prevent future voice problems.

References and recommended reading

Papers of particular interest, published within the annual period of review, have been highlighted as:

- of special interest
- of outstanding interest

- 1 Carding PN, Horsley IA, Docherty GJ. A study of the effectiveness of voice therapy in the treatment of 45 patients with nonorganic dysphonia. *J Voice* 1999; 13:72–104.
- 2 Timmermans B, De Bodt M, Wuyts F, Van de Heyning P. Training outcome in future professional voice users after eighteen months voice training. *Folia Phoniatri Logop* 2004; 56:120–129.
- 3 Mendes AP, Rothman HB, Sapienza C, Brown WS. Effects of vocal training on the acoustic parameters of the singing voice. *J Voice* 2003; 17:529–543.
- 4 Mendes AP, Brown WS, Rothman HB, Sapienza C. Effects of singing training on the speaking voice of voice majors. *J Voice* 2004; 18:83–89.
Good structured study confirming the earlier cross-sectional studies, that singing training has no effect on the speaking voice. It is possible that the speaking voice is inferior to the singing voice.
- 5 Timmermans B, De Bodt M, Wuyts F, Van de Heyning P. Vocal hygiene in radio students and in radio professionals. *Logoped Phoniatri Vocol* 2003; 28:127–132.
- 6 Roy N, Ryker KS, Bless DM. Vocal violence in actors; an investigation into its acoustic consequences and the effects of hygienic laryngeal release training. *J Voice* 2000; 14:215–230.
- 7 Chan R. Does the voice improve with the vocal hygiene education? A study of some instrumental voice measures in a group of kindergarten teachers. *J Voice* 1994; 8:279–291.
- 8 Sapir S, Mathers-Schmidt B, Larson GW. Singers' and non-singers' vocal health, vocal behaviors and attitudes towards voice and singing: indirect findings from a questionnaire. *Eur J Disord Comm* 1996; 31:193–209.
- 9 Broaddus-Lawrence PL, Treole K, McCabe RB, et al. The effect of preventive vocal hygiene education on the vocal hygiene habits and perceptual vocal characteristics of training singers. *J Voice* 2000; 14:58–71.
- 10 Yiu EM, Chan RM. Effect of hydration and vocal rest on the vocal fatigue in amateur karaoke singers. *J Voice* 2003; 17:216–227.
- 11 Timmermans B, De Bodt MS, Wuyts FL, et al. Poor voice quality in future elite vocal performers and professional voice users. *J Voice* 2002; 16:372–381.
- 12 Milbrath RL, Solomon NP. Do vocal warm-up exercises alleviate vocal fatigue? *J Speech Lang Hear Res* 2003; 46:422–436.
- 13 Duffy OM, Hazlett DE. The impact of preventive voice care programs for training teachers: a longitudinal study. *J Voice* 2004; 18:63–70.
- 14 Pedersen M, Beranova A, Moller S. Dysphonia: medical treatment and a medical voice hygiene advice approach. A prospective randomised pilot study. *Eur Arch Otorhinolaryngol* 2004; 261:312–315 Epub 2003 Oct 14.
- 15 Solomon NP, Glaze LE, Arnold RR, van Mersbergen M. Effects of a vocally fatiguing task and systemic hydration on men's voices. *J Voice* 2003; 17:31–46.
- 16 Koufman JA, Blalock PD. Vocal fatigue and dysphonia in the professional voice user: Bogart-Bacall syndrome. *Laryngoscope* 1988; 98:493–498.
- 17 Novák A, Dlouha O, Capkova B, Vohradnik M. Voice fatigue after theatre performance in actors. *Folia Phoniatri (Basel)* 1991; 43:74–78.
- 18 Gotaas C, Starr CD. Vocal fatigue among teachers. *Folia Phoniatri (Basel)* 1993; 45:120–129.
- 19 Van der Merwe A, Van Tonder M, Pretorius E, Crous H. Voice problems in some groups of professional users of voice: implications for prevention. *S Afr J Commun Disord* 1996; 43:41–51.
- 20 Welham NV, MacLagan MA. Vocal fatigue in young trained singers across a solo performance: a preliminary study. *Logoped Phoniatri Vocol* 2004; 29:3–12.
Small but interesting study, in search of the most optimal parameters to assess onset of vocal fatigue. Definition of possible determining factors influencing voice fatigue.
- 21 Richter B, Lohle E, Knapp B, et al. Harmful substances on the opera stage: possible negative effects on singers' respiratory tracts. *J Voice* 2002; 16:72–80.
- 22 Lundy DS, Casiano RR, Sullivan PA, et al. Incidence of abnormal laryngeal findings in asymptomatic singing students. *Otolaryngol Head Neck Surg* 1999; 121:69–77.
- 23 Ross JA, Noordzji JP, Woo P. Voice disorders in patients with suspected laryngo-pharyngeal reflux disease. *J Voice* 1998; 12:84–88.
- 24 Belafsky PC, Postma GN, Koufman JA. Validity and reliability of the reflux symptom index (RSI). *J Voice* 2002; 16:274–277.
- 25 Powitzky ES, Khaitan L, Garrett CG, et al. Symptoms, quality of life, videolaryngoscopy, and twenty-four-hour triple-probe pH monitoring in patients with typical and extraesophageal reflux. *Ann Otol Rhinol Laryngol* 2003; 112:859–865.
- 26 Belafsky PC, Postma GN, Koufman JA. The validity and reliability of the reflux finding score (RFS). *Laryngoscope* 2001; 111:1313–1317.
- 27 Williams RB, Szczesniak MM, Maclean JC, et al. Predictors of outcome in an open label, therapeutic trial of high-dose omeprazole in laryngitis. *Am J Gastroenterol* 2004; 99:777–785.
- 28 Ylitalo R, Lindestad PA, Hertegard S. Is pseudosulcus alone a reliable sign of gastroesophago-pharyngeal reflux? *Clin Otolaryngol* 2004; 29:47–50.
- 29 Hill RK, Simpson CB, Velazquez R, Larson N. Pachydermia is not diagnostic of active laryngopharyngeal reflux disease. *Laryngoscope* 2004; 114:1557–1561.
This is an excellent study which reconsiders the interpretation of one of the so-called typical laryngeal findings of LPR.
- 30 Cesari U, Galli J, Ricciardiello F, et al. Dysphonia and laryngopharyngeal reflux. *Acta Otorhinolaryngol Ital* 2004; 24:13–19.
An important study presenting exhaustive data on a much-debated topic.
- 31 Johnston N, Knight J, Dettmar PW, et al. Pepsin and carbonic anhydrase iso-enzyme III as diagnostic markers for laryngopharyngeal reflux disease. *Laryngoscope* 2004; 114:2129–2134.
The authors present the first steps towards an exciting and promising new approach to LPR diagnosis.
- 32 Amir O, Kishon-Rabin L. Association between birth control pills and voice quality. *Laryngoscope* 2004; 114:1021–1026.
- 33 Ihre E, Zetterstrom O, Ihre E, Hammarberg B. Voice problems as side effects of inhaled corticosteroids in asthma patients – a prevalence study. *J Voice* 2004; 18:403–414.
- 34 Mirza N, Kasper Schwartz S, Antin-Ozerkis D. Laryngeal findings in users of combination corticosteroid and bronchodilator therapy. *Laryngoscope* 2004; 114:1566–1569.