Effects of Voice Therapy: A Systematic Review

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Summary. Medical as well as paramedical treatments should be evaluated by scientific methods. This systematic review focuses on the effects of voice therapy, excluding pharmacological or surgical treatments. In general, statistically significant positive but modest and varying therapy effects are found. Many of these effect studies cope with diverse methodological problems. Furthermore, the conclusions of most studies cannot be generalized easily or compared to one another. As a consequence, many issues in the field of effects of voice therapy have yet been unanswered.
Key Words: Systematic review–Dysphonia–Voice disorder–Voice therapy–Therapy effect–Therapy outcome.

INTRODUCTION

As it becomes more and more accepted that medical treatments should be evaluated by scientific methods, paramedical therapies as well need objective evaluation according to current standards of evidence-based medicine. Evaluation of voice therapy fits into this growing interest. The number of studies on the effects of voice therapy are still rather rare. In this article, a review of literature on the effects of voice therapy carried out by speech therapists is presented. Pharmacological or surgical treatments are not included. Some major methodological aspects and choice of evaluation tools of these studies will be discussed.

Methodological aspects

The design of an evaluation study depends on its purpose. The most simple design refers to the study of one specific therapy in patients with the same diagnosis under strictly controlled experimental conditions. It will be very unlikely that the therapy effects found in such a study can be generalized to other groups of patients or therapies. If the request for an evaluation study originates from a health care insurance or an organization responsible for health care budgets, the main focus will be the effectiveness of voice therapy in general. A study of this kind should include all possible phoniatric diagnoses—with an indication for voice therapy—as well as consider the diversity of existing voice therapies.[1–4] Most studies will be neither of these extremes, but will represent a mixed design as a compromise between these two options.

Therapy effects can be determined by applying exactly the same measurements before as well as after finishing therapy. To get objective results, no knowledge about the moment of data collection (before or after therapy), must be given to any judge when rating perceptual or visuoperceptual data (eg, perceptual evaluation of voice or visuoperceptual evaluation of videostroboscopy). Furthermore, results have to be compared using statistical analyses. Another issue is the inclusion of a group of patients that do not receive any treatment (placebo group). The results of the placebo group should be compared with the results of those who did have therapy. Sometimes, for ethical or practical reasons, no placebo group is included. In this case, another existing therapy could be used as control group. Which methodology should be used depends on the specific aim of the study. Besides group effects, the individual performances per patient can be of particular interest. Especially, when the patient population is inhomogeneous, therapy effects may be statistically scarcely significant for a whole group of patients, whereas the result can be quite diverse for subgroups of patients.

Multidimensional assessment tools

In literature, the success or lack of success of a voice therapy is assessed using different aspects of voice production. One of the main voice aspects described in literature is voice quality. Voice quality is described with terms such as breathiness, roughness, and harshness. Multiple systems of perceptual classification have been suggested by different authors: for example, the Buffalo Voice Profile,[5] the Vocal Profile,[6] the Grade, Roughness, Breathiness, Astenicity, and Strain (GRBAS),[7] the multidimensional model for voice production by Perkins,[8] the classification of voice qualities by Wendler,[9] and the SVEC.[10] However, perceptual evaluation involves problems such as the unstable internal standards for comparing speech stimuli[11] and the lack of universally accepted definitions for perceptual concepts.[12] Another way of evaluating voice quality in a more objective manner is acoustic analysis. Algorithms describe per analyzed sample, for example, the variability in pitch period and in peak-to-peak amplitude (jitter and shimmer) or the ratio of energy of inharmonic to harmonic components (noise). This method shows imperfections as well, for example, the possibility of errors in pitch tracking, the inadequacy of acoustic analysis in very aperiodic vocal vibrations, and the use of unnatural speech samples such as sustained vowels. The voice range profile, or phonetogram, describes the laryngeal possibilities with respect to the fundamental frequency and the sound intensity.[13,14] The maximal and minimal intensity that the patient can produce is plotted against the fundamental frequency. The voice range profile is considered to be a useful tool in the evaluation of therapy effects, because it represents the maximal vocal capacities.

The technique of laryngostroboscopy provides direct information on the source of sound production: the vocal folds. Video recordings are made of the laryngeal structures and the vocal fold vibration using rigid or flexible scopes. Two sources of light are used: normal light and stroboscopic light. The use of stroboscopic light during the vibration of the vocal folds can provide the optical illusion of a static image, when the frequencies of the light flashes and the vocal fold vibration are equal. When the light flashes at frequencies that differ slightly from the vibration of the vocal folds, the vibration of the vocal folds

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is seen in slow motion. By means of visuoperceptual evaluation, the morphological and functional abnormality of the vocal folds and the glottal waveform can be described. Several protocols have been developed.[15–17] Recent advances in the technique of digital processing of laryngeal images have led toward the development of methods for deriving objective measures from such endoscopic examinations.[1]

Aerodynamic parameters such as maximum phonation time and the phonation quotient (the ratio of vital capacity and maximum phonation time) are widely used clinical measures. These measurements are inexpensive and simple methods for measuring the efficiency of the vocal fold vibration. Only more recently, the quality-of-life measurements have become part of the voice assessment procedures. When the effects of therapy are evaluated, the patient's well being cannot be neglected. The demonstrated therapy effects, using the above-mentioned objective evaluation tools, must be compared with the beneficial or negative changes experienced by the patient him- or herself. In literature, a growing interest is found in the self-evaluation of patient's handicap as a result of the voice disorder.

Many more instruments are available as alternatives for evaluating the vocal fold vibration in an objective way, such as electroglottography, photoglottography, or kymography. Aerodynamic measurements can be completed with averaged airflow measurement during phonation, and diverse measurements can be combined into indexes such as the Dysphonia Severity Index.[18] Usually, the perceptual evaluation of voice quality is considered to be the gold standard for voice assessment. However, it can be expected that patients will not show an abnormality in all aspects of voice, nor an improvement on all these aspects.[4] Voice must be regarded as a multidimensional phenomenon[19,20] and, therefore, the main aspects of voice must be considered when evaluating therapy effects. The Committee on Phoniatrics of the European Laryngological Society made the following recommendations for a minimal set of multidimensional measurements for functional assessment of voice pathology: perceptual rating, videostroboscopy, acoustic analysis, aerodynamic measures, and subjective rating by the patient.[21] Of course, in such a study, the problem of increasing probability of significance has to be addressed.

In this article, a systematic review of the literature on the effects of voice therapy as applied by speech therapists will be undertaken.

METHODS

A literature search was carried out using the electronic databases Pubmed and Embase. All available inclusion dates up to February 2006 were used. The search was limited to English, German, French, Spanish, and Dutch language publications. In Pubmed, the Mesh terms *voice disorders*, *hoarseness*, and *aphonia* were combined with *therapy. Voice training* and the combination *voice* and *treatment outcome* were added. In Embase, the Mesh terms *treatment outcome* was completed with *dysphonia* and *larynx disorders* linked to *therapy.* To identify the most recent publications, the search was supplemented by using free text words (for the period after January 2005): *voice therapy* (Pubmed) and the combinations *dysphonia* or *voice* with *therapy* or *treatment* and *outcome* or *effect* (Embase). A total of 310 articles were found in Pubmed and 197 in Embase. Some articles were obtained from both databases.

Only articles on the effects of voice therapy in case of dysphonia carried out by speech therapists were included, thus, excluding pharmacological or surgical treatments as well as voice training in professional voice users (eg, Timmermans[22]). The search was restricted to therapy of dysphonia on a functional and/or organic base without any neurological origin such as Parkinson's disease. Review articles, case reports, and articles limited to populations smaller than five subjects were excluded. Studies that described only the posttherapy situation without comparable information on the voice status before the onset of therapy were considered of lesser importance and, therefore, excluded as well. The references listed in the selected papers were searched for additional literature. After a first selection based on abstracts, a definitive inclusion was made using the original articles. Finally, 47 studies were included.

RESULTS: THERAPY EFFECTS IN LITERATURE

Studies on therapy effects have become more frequent, especially during the last two decades. Tables 1A–C represent a summary of relevant scientific studies that describe aspects of the effects of voice therapy in dysphonic patients. Only studies that meet the above-mentioned inclusion criteria are listed (see Methods). The studies are classified into three main categories based on phoniatric diagnoses: functional dysphonia, organic dysphonia, and functional plus organic dysphonia (respectively, Tables 1A–C). The first column of the table represents the so-called level of evidence. To rate the study quality, the ABC rating scale according to Siwek et al[23] has been used. Level A refers to high-quality randomized controlled trials, whereas level B refers to well-designed, nonrandomized clinical trials. Level C, consensus or expert opinions, is excluded. These categories are subdivided into two groups according to the way data were handled. The first, largest group uses statistical analyses for comparing pre- *versus* posttherapy data. The second group uses descriptive statistics to evaluate the therapy outcome. Authors are listed in alphabetical order. For each study, the following data are summarized: the number of patients, the diagnostic group(s), the evaluation techniques, the kind of therapy used, and the author's key findings. The number of subjects refers to the group of subjects on which the study results are based, thus, excluding dropouts. Some articles contain extra study groups that fall beyond the purpose of this article. These groups are not mentioned in Tables 1A–C. Sometimes the primary purpose of a study is not to objectify the effects of voice therapy. However, if pre- and posttreatment data are present, the study is included. All studies will be described briefly.

Functional dysphonia

One of the earliest studies on voice therapy effects in patients with functional dysphonia was done by Wedin and Ögren.[24] Their population ($N = 6$) includes only two patients with

phonasthenic symptoms, two professional singers, and two patients with normal untrained voices. After a voice training program, the authors conclude that their training seems to be effective in bringing the pitch to its optimal range. However, the change is greater for the professional and normal subgroup than for the phonasthenic patients. No exact data are available. Furthermore, the group of dysphonic patients is too small to justify generalizations for other patients with dysphonia. A more recent study done by Prathanee[25] describes the positive therapy effects in seven patients with mutational falsetto voices after ear training practice. Once more, the precise data are not mentioned and the number of patients is very small. Enderby and John[26] study a group of 99 patients with nonorganic dysphonia. The patients describe the change after speech and language therapy using 11-point self-evaluation scales that are related to the domains of impairment, disability, handicap, and well being. Outcome scores, representing the percentage of change after therapy, are available for five different speech and language services. However, an unknown number of patients had not yet finished their therapy within the 9-month trial period. It is concluded that different speech and language services have different impacts on the number and type of domains involved and that patients are being discharged at different phases of their recovery.

Eleven studies on functional dysphonia provide statistical analyses of the pre- *versus* posttherapy data to support their conclusions. Hammarberg[27] includes 12 male patients with functional mutational disorders receiving voice therapy (larynx depressing exercises) and psychological counseling. The evaluation tools used are perceptual evaluation and analysis of the distribution of the fundamental frequency as derived from the acoustic signal. After therapy, a statistically significant decrease of the deviant voice qualities, such as instability, breathiness, hypofunction (laxness), and diplophonia, is demonstrated using a Wilcoxon's matched-pairs signed ranks test. The most deviant voice qualities, such as instability, breathiness, and diplophonia, have diminished, whereas the pitch and register have stabilized, showing a reduced variability. These changes result in an improved perceptual impression of the voice. Lim et al[28] evaluate the effects of voice therapy combined with manual laryngeal compression in a similar group of 15 male patients with mutational dysphonia, using aerodynamic, acoustic, and electroglottographic testing. After therapy, subjects' voices lower in pitch and improve in quality significantly (paired t test). Based on the presence of diplophonia and the values of closed quotients, mutational dysphonia can be classified into four categories. The effect of therapy is different for each category; however, those cases with both diplophonia and a nontrained falsetto voice can be treated more readily. Identification of these factors may affect treatment choices, facilitate monitoring of the efficacy of therapy, and aid in estimating prognosis.

In three studies by Roy and Leeper,[29] Roy et al,[30] and Roy and Hendarto,[31] the effects of the manual laryngeal musculoskeletal tension reduction technique are evaluated by means of a perceptual severity rating and acoustic analysis. The second study which can be considered an extension of the first includes a population of 25 women with functional dysphonia and focused on short-term as well as long-term therapy outcomes. By means of repeated-measures analysis of variance, time trends within the data are evaluated. Patients demonstrate consistent and significant improvement across perceptual and acoustic indices of vocal function immediately after therapy and during the follow-up period. The authors conclude on the basis of patient reports that the short-term results are impressive, but the long-term results are less robust. The third study shows in a somewhat larger population of 40 females that as a group no significant change in mean speaking fundamental frequency was observed after successful voice therapy (paired t test). Although no consistent directional pattern was identified, 80% of the subjects experienced pitch changes greater than one semitone; the authors suggest that voice improvement is often accompanied by a shift in speaking fundamental frequency.

In contrast to the rather small group of patients used in the above-mentioned studies, Kitzing and Åkerlund[32] study a large group of 174 patients with nonorganic voice disorders. Tape recordings before and after therapy were analyzed by long-time averaged voice spectrograms (LTAS) and compared with the results of a global perceptual rating of the voice qualities on a three-point scale (t test on paired observations). There is no significant change of the LTAS in voices with negligible perceptual amelioration after therapy. In voices with considerable perceptual changes after therapy, the LTAS shows only an increase in intensity, but the general configuration of the spectral envelope remains unchanged. There is only a weak correlation between the quality ratings and parameters of the spectra.

The next five studies apply random assignment of patients to different treatment groups. In 2002, Roy et al[33] included a group of 44 voice-disordered teachers who are divided into three groups randomly: portable voice amplification, vocal hygiene, and a nontreatment control group. Based on pre- and posttreatment comparisons of patient self-evaluations and acoustic analysis, only the amplification group shows significant improvement (paired t test and Wilcoxon signed ranks test). Although, most pre- to posttreatment changes are in the desired direction in the vocal hygiene group, no significant improvement on any of the measurements is found. Pedersen et al[34] find similar results in a group of 30 dysphonic patients receiving either half an hour of voice-hygiene advice including the use of the Accent method ($N = 10$) or medical treatment for "micro-organic" disorders such as infections, allergies, gastroesophageal reflux, and environmental irritants ($N = 10$). A retrospective group ($N = 10$) having been treated medically before and coming in for supplementary medical treatment, is added as well. Only the first two groups are randomized. All patients are measured twice with 1-month intervals using videostroboscopy, a quality-of-life questionnaire, and phonetography. Although all patients improve, no significant effect on any of the measurements is shown. In three studies done by Carding and Horsley[35] and Carding et al,[36,37] a similar study design is used in a group of nonorganic dysphonic patients ($30 < N < 45$). In these studies, indirect voice therapy is compared with a therapy in which direct and indirect therapies are combined. Indirect therapy techniques focus on managing the aspects which contribute to the voice problem (such as vocal abuse patterns or poor vocal

TABLE 1A.
Systematic Review: Functional Dysphonia

Level of Evidence	Data Analysis	Reference	Subjects*	Evaluation Techniques†	Treatment(s)/Groups (G)	Author(s)'s Conclusions/Key Findings
A (randomized clinical trial)	Statistical analysis	Carding and Horsley[35]	30	1,2,6 (electrolaryngography, F_0-analysis)	G1 indirect therapy ($N = 10$) G2 direct and indirect therapies ($N = 10$) G3 no therapy/controls ($N = 10$)	90% of G2 show successful return to normal voice functioning as compared to 60% of G1 and 10% of G3. Statistically significant differences between the three groups after therapy on perceptual ratings and patient's questionnaires are found. Similar trends are found on electrolaryngography and F_0-analysis.
		Carding et al[36]	45	1,2,3	G1 indirect therapy ($N = 15$) G2 direct and indirect therapies ($N = 15$) G3 no therapy controls ($N = 15$)	Significant differences exist between the three groups on the self-report questionnaire, voice quality ratings, and pitch perturbation measurements. (13/15 patients of G3 show no significant change on any of the measures; 7/15 of G1 and 14/15 of G2 show significant improvement in voice quality.)
		Carding et al[37]	45	1,2,3,4,6 (electrolaryngography, F_0-analysis)	G1 indirect therapy ($N = 15$) G2 direct and indirect therapies ($N = 15$) G3 no therapy/controls ($N = 15$)	Significant differences exist between the three treatment groups in the magnitude of change for voice severity, electrolaryngograph, and shimmer measurements and on ratings from a patient questionnaire. (Other measurements fail to show significant differences between the three groups.) 86% of patients of G3 show no significant change on any of the measurements; 46% of patients of G1 and 93% of G2 show significant changes in voice quality.
		Pedersen et al[34]	30	1,4,6 (Voice range profiles)	G1 first medical treatment ($N = 10$) G2 voice-hygiene advice including Accent method ($N = 10$) G3 (retrospective) medical treatment ($N = 10$)	Subjects with nonorganic dysphonia are either given half an hour of voice-hygiene advice or (supplementary) medical treatment for "micro-organic" disorders such as allergy, infections, and reflux. No significant difference between group effects is found. Both medical treatment and voice-hygiene advice have a (not significant) positive effect on nonorganic dysphonia.
		Roy et al[33]	44 (teachers with history and/or presence of voice problems): Functional dysphonia?	1,3	G1 vocal hygiene ($N = 15$) G2 voice amplification ($N = 15$) G3 no therapy ($N = 14$)	Although most pre- to posttreatment changes are in the desired direction, no significant improvements are observed within the vocal hygiene group on any of the dependent measures. The group using voice amplification shows multiple significant positive changes, whereas the nontreatment group shows significant increase in level of self-perceived vocal handicap. Between-group comparisons show that both treatment groups experience significantly more improvement on specific outcomes measures than the control group; however, no significant differences can be found between both treatment groups.
B (nonrandomized clinical trial)	Statistical analysis	Hammerberg[27]	12 functional mutational disorders (male adolescents/	2,6 (F_0-distribution analysis)	Voice therapy: larynx depressing exercises, psychological counseling	After therapy the most deviant voice qualities have improved, together with a stabilization of the pitch and the register. These changes are statistically significant. (Observations show an improvement of

		adults)			the mutational voice disorder, as can be seen from the stabilization of the prepubertal pitch and normalization of the posttherapy voice.)
	Kitzing and Åkerlund[32]	174 nonorganic voice disorders (functional dysphonia)	2,6 (LTAS)	Voice therapy	Nonsignificant change of the LTAS in voices with negligible improvement after therapy. In the voices with (perceptually) considerable change after therapy, the LTAS shows only an increase in intensity, but the general configuration of the spectral envelope remains unchanged.
	Lim et al[28]	15 mutational dysphonia (males, aged 15–27 years)	3,5,6 (F_0, electroglottography)	Voice therapy combined with manual laryngeal compression	Therapy is effective in most cases. The fundamental frequency (diplophonia) and closed quotient are important factors that help to diagnose and classify mutational dysphonia. These factors can allow treatment options to be more effectively chosen, often avoiding excessive surgical treatment, and can facilitate the monitoring of therapy efficacy.
	Roy and Leeper[29]	17	2,3	Manual laryngeal musculoskeletal tension reduction	Results indicate a significant change to normal vocal functioning of the majority of patients within one treatment session. (82% (14/17) are considered either normal or exhibiting only mildest dysphonic symptoms at perceptual evaluation of connected speech samples.)
	Roy et al[30]	25 (women)	2,3,6 (F_0)	Manual laryngeal musculoskeletal tension reduction	Subjects demonstrate consistent improvement on perceptual and acoustic indices of vocal function immediately after treatment and during the follow-up period. (After therapy, 64% (16/25) are considered either normal or exhibiting only mildest dysphonic symptoms at perceptual evaluation of connected speech samples. Furthermore, significant reductions in jitter, shimmer, and SNR are found, but no significant changes in F_0.) Short-term results are impressive, but on the basis of patient reports, long-term results are less robust.
	Roy and Hendarto[31]	40 functional dysphonia (women)	2,6 (F_0)	Manual circumlaryngeal therapy	After one single treatment session, significant group improvements are found in voice quality but no significant change in mean speaking fundamental frequency.
Descriptive statistics	Enderby and John[26]	99 nonorganic dysphonia	1	Voice therapy	Evidence is given on the differences between the types of patients being referred and different providers of speech and language therapy. Different services have different impacts on the number and type of domains and services discharge their patients at different stages of their recovery.
	Prathanee[25]	Seven mutational falsetto voices (aged 11–26 years)	2	Ear training	Voices of all patients improve: 4/7 become "normal" within five sessions.

(*Continued*)

TABLE 1A. SYSTEMATIC REVIEW: FUNCTIONAL DYSPHONIA

Level of Evidence	Data Analysis	Reference	Subjects*	Evaluation Techniques†	Treatment(s)/Groups (G)	Author(s)'s Conclusions/Key Findings
		Wedin and Ögren[24]	Two subjects with phonasthenic symptoms, two professional singers, two untrained voices	6 (F_0, LTAS)	Intensive 5-day voice training program	Generally, training seems to be effective in bringing the pitch to its optimal range.

* Adult men and women, unless mentioned otherwise.
† Evaluation techniques: 1, quality-of-life measure; 2, perceptual evaluation; 3, acoustical analysis; 4, videolaryngo(strobo)scopy; 5, aerodynamic measure; 6, others.

hygiene). Direct therapy techniques focus on modifying certain aspects of improper voice production to promote appropriate and efficient voice production. A control group receiving no therapy is included. The main findings of the most recent study[37] applying nonparametric tests show statistically significant differences between all three groups in the amount of change in voice severity ratings by experts (no knowledge of the moment of measurement provided, a so-called "blinded" assessment), electrolaryngographic data (visual interpretation of the Lx waveform), shimmer measurements, and ratings provided by a patient questionnaire. Other parameters such as fundamental frequency, signal-to-noise ratio (SNR), and jitter fail to show significant differences between the three groups. Most of the patients of the control group (86%) show no significant change on any of the parameters, whereas 46% and 93%, respectively, of the indirect and combined therapy groups show positive changes in voice quality on all parameters.

Organic dysphonia

As early as in 1981, Gould et al[38] describe the effects of voice therapy according to each patient's need on contact granuloma of the vocal fold ($N = 17$). The evaluation of the success of the therapy is based on laryngoscopic findings, a perceptual rating by a speech pathologist and patient's subjective evaluation. The authors conclude that voice therapy was an effective mode of therapy in many cases of contact granuloma. However, some patients do not improve at all. Leonard and Kendall[39] present a retrospective study of a group of therapy resistant patients with vocal process granuloma related to laryngopharyngeal reflux ($N = 10$). A "phonoscopic approach" is used in which the larynx can be observed endoscopically by the patient as well as the clinician during phonation, providing immediate combined aural and visual feedback. Apart from this voice therapy, medical reflux management is continued. Eight patients experienced disappearance of pathology or marked reduction in its extent. Heuer et al[40] focus on patients with unilateral recurrent nerve lesions ($N = 41$) and form four groups of patients according to gender and type of therapy (voice therapy or combination of laryngeal surgery and voice therapy). Acoustic parameters, aerodynamic measurements, and a measurement of glottal function (the quasi-open quotient using laryngeal electromyography (EMG)) were used in the evaluation of therapy effects. Only pre- and posttherapy data of the so-called representative patients per group are displayed. The authors find their data promising in differentiating between groups of patients with unilateral vocal fold paralysis who could be treated by voice therapy alone and those who require surgery.

Two studies include patients with vocal fold nodules only. McCrory[41] audit clinical files of patients with bilateral or unilateral vocal fold nodule(s) retrospectively over a 6-year period ($N = 26$). Multidimensional outcome measurements, such as laryngoscopy, perceptual rating of a reading text, fundamental frequency analysis, and a patient's overall severity ratings, are used. After therapy, in over 70% of the clinical files audited, elimination and/or reduction of vocal fold nodules are demonstrated and over 80% of the patients present either a normal voice quality or a mild degree of dysphonia. Benninger and

TABLE 1B.
Systematic Review: Organic Dysphonia

Level of Evidence	Data Analysis	Reference	Subjects*	Evaluation Techniques†	Treatment(s)/Groups (G)	Author(s)'s Conclusions/Key Findings
A (randomized clinical trial)	Statistical analysis	van Gogh et al[50]	23 (dysphonia *after* treatment for early glottic carcinoma: radiotherapy or laser surgery)	1,2,3 (plus voice range profiles), 4	G1 voice therapy ($N = 12$) G2 control group = no therapy ($N = 11$)	Voice therapy proved to be effective. Improvement was not only noticed by the patients (quality-of-life measure) but was also confirmed by part of the objective voice parameters.
		Ptok and Strack[49]	24 unilateral vocal fold paresis	5,6 (vocal fold irregularity index)	G1 traditional voice therapy ($N = 12$) G2 electrostimulation voice exercise ($N = 12$)	Only 58% and 69% of the patients of groups 1 and 2, respectively, show an obvious improvement in one dimension (without a deterioration in the other). Statistical analysis indicates slight, though not significant, differences between both groups favoring electrostimulation supported vocal exercises.
B (nonrandomized clinical trial)	Statistical analysis	Holmberg et al[46]	11 bilateral vocal nodules (women)	2,4,6 (mean SPL, F_0)	Behaviorally based voice therapy (five phases): vocal hygiene, direct facilitation, respiration, relaxation, and carryover	The results of decreased nodules and improved voice quality suggest that the voice therapy has a positive effect on most patients. (Significant effects of therapy are found for overall dysphonia, press, instability, gratings, roughness, vocal fry, and "scrape"; nonsignificant group effects are found for breathiness, aphonic instances, and lack of sonority.)
		Hufnagle and Hufnagle[48]	8 vocal nodules (women)	2,6 (F_0)	Voice therapy	Results show no significant change in the speaking fundamental frequency accompanying vocal quality improvement.
		Murry and Woodson[44]	59 vocal fold nodules (including one adolescent)	2	G1 voice therapy ($N = 28$) G2 surgery and therapy ($N = 20$) G3 integrated management procedure by an otolaryngologist-speech pathologist ($N = 11$)	Satisfactory improvement of voice can be obtained using any of the three approaches (therapy groups). 22/59 achieve the maximum rating of improvement (no perceptual indication of a voice disorder), while 4/59 show no improvement; of those who obtain a maximal rating, 55% are in G3, 39.3% in G1, and 25% in G2.
		Treole and Trudeau[47]	13 bilateral vocal fold nodules (women)	5	Voice therapy (tension reduction, abuse identification, and elimination)	Results indicate there is no significant difference in maximum phonation duration or *S*/*Z* ratio before and after treatment.
		Verdolini-Marston[45]	13 laryngeal nodules (women)	2,4,6 (phonatory effort)	G1 confidential voice therapy ($N = 5$) G2 resonant voice therapy ($N = 3$) G3 no therapy/controls ($N = 5$)	On all measures, a greater proportion of therapy subjects improves over the initial 2-week period, as compared with control subjects. The likelihood of benefiting from therapy directly covaries with compliance scores but not with therapy

(*Continued*)

TABLE 1B
Systematic Review: Organic Dysphonia (*Continued*)

Level of Evidence	Data Analysis	Reference	Subjects*	Evaluation Techniques†	Treatment(s)/Groups (G)	Author(s)'s Conclusions/Key Findings
						type. (Statistically supported.)
	Descriptive statistics	Benninger and Jacobson[42]	96 vocal nodules (children and adults)	2,3,4,5	G1 voice therapy ($N = 69$) G2 no therapy ($N = 35$) G3 surgery ($N = 9$; 19 subjects insufficient follow-up)	Overall, of the 96 adult patients with sufficient follow-up, 94% resume normal voice use with voice modification, therapy, or surgery. 41/69 of the patients undergoing speech therapy have complete resolution of their nodules.
		Gordon et al[43]	143 dysphonia resulting from vocal misuse or abuse with a variety of secondary pathologies	6 (% based on 4 and 5: problem resolved, prolongation therapy or monitoring, therapy stop due to noncompliance)	G1 therapy program ($N = 74$): normalization of aerodynamic parameters (subjects with significant disorder of air usage) G2 monitoring program ($N = 69$): voice-hygiene advice and relaxation exercises (subjects without disorder of air usage)	Successful resolution of the problem: 41.5% of G1 and 35% of G2.
		Gould et al[38]	17 contact granuloma	1,2,4	Voice therapy (methods varied according to patient's needs)	As a result of voice therapy: 9/14 granuloma disappear, 4/14 reduce in size, 1 does not change; 4/17 phonation return to normal, 7/17 improve, 6/17 do not change; 4/17 patients feel complete recovery, 10/17 show some improvement, 3/17 show no change.
		Heuer et al[40]	41 unilateral recurrent nerve lesions	3,5,6 (quasi-open quotient): exact data on one representative patient per group	G1 voice therapy (13 women) G2 voice therapy and surgery (six women) G3 voice therapy (14 men) G4 voice therapy and surgery (eight men)	Findings indicate 1, some elements of objective voice assessment may provide useful prognostic information; 2, pre- and posttherapy objective measures are helpful in confirming subjective estimates of improvement; and 3, treatment of a substantial percentage of patients using nonsurgical therapy alone may be satisfactory.
		Leonard and Kendall[39‡]	Ten vocal process granuloma related to laryngopharyngeal reflux (therapy resistant)	4,5,6 (F_0)	Voice therapy plus continuation of medical reflux management: "phonoscopic approach" (observation of larynx endoscopically during phonation)	8/10 experienced resolution or marked reduction of pathology.
		McCrory[41‡]	26 vocal nodules	1,2,4,6 (F_0)	Voice therapy	Results demonstrate elimination and/or reduction of vocal fold nodules in over 70% of patients. Posttherapy over 80% of patients present with either a normal voice quality or a mild degree of dysphonia.

* Adult men and women, unless mentioned otherwise.
† Evaluation techniques: 1, quality-of-life measure; 2, perceptual evaluation; 3, acoustical analysis; 4, videolaryngo(strobo)scopy; 5, aerodynamic measure; and 6, others.
‡ Retrospective nonrandomized clinical trial.

Jacobson[42] evaluate a much larger group of patients with nodules. Initially, 115 patients are included, but only 96 patients have sufficient follow-up. Three treatment groups are formed: voice therapy, surgery, or no treatment. Based on perceptual, videostroboscopic, acoustic, and aerodynamic analyses, the authors state that 94% of the patients resume normal voice use. In 41 out of 69 patients undergoing voice therapy, the nodules disappeared completely.

Gordon et al[43] include even a larger and more diverse group of patients suffering from dysphonia resulting from vocal misuse or abuse, with a variety of secondary pathologies including soft nodules, polyps, Reinke's edema, and fold thickening ($N = 200$). Patients with significant disordered air usage are assigned to a therapy program to normalize the aerodynamic parameters. The other patients undergo a monitoring program including voice-hygiene advice and relaxation exercises. The outcome of the therapy is assessed by airflow test scores and videolaryngoscopy and is translated freely in terms of problem resolved, prolongation of therapy or monitoring necessary, or therapy discontinued due to noncompliance. The assessments show that the outcome is successful for 41.5% of the referrals in the advice and monitoring group, and for 35% of the referrals in the voice therapy group. The program is discontinued without result for 11% of the referrals. Some 12.5% of the patients have received sufficient reassurance and advice from initial attendance at the ENT clinic and reject the offer of further voice assessment.

In contrast to the above-mentioned studies, the following seven studies use statistical analyses to test for significant therapy effects. Five studies focus on patients diagnosed as having vocal fold nodules. Murry and Woodson[44] divide a total of 59 patients into three groups according to the type of therapy: voice therapy ($N = 28$), voice therapy after surgery ($N = 20$), or combined treatment by an otolaryngologist and a speech pathologist ($N = 11$). A global four-point scale of perceptual improvement is used to evaluate therapy outcome. Two judges rate pairs of pre- and posttherapy recordings, without any knowledge of the purpose of the study. They do not know if these patients underwent any therapeutic or surgical procedures. The judgments were subjected to a complex χ^2 analysis (Chi square) and mean differences between pairs of groups were analyzed using a Mann-Whitney *U* test. The authors conclude that a satisfactory, statistically significant improvement in the voice could be obtained using any of the three approaches. These findings are in line with the results of Verdolini et al[45] and Holmberg et al.[46] Verdolini et al assess the effects of two types of voice therapy (confidential and resonant therapy) using measurements of phonatory effort, auditory-perceptual status of voice, and laryngeal appearance. On all measurements, a greater proportion of patients receiving therapy improve (three of eight subjects), as compared with a group of control subjects who receive no therapy (zero of five subjects). Statistical analyses (*z*-scores and corresponding level of significance) indicate that the result for the combined therapy groups exceeds chance levels, but not for the control group. Association tests show that the likelihood of benefiting from therapy directly covaried with estimates of ongoing compliance (continued use of therapy techniques after therapy discontinuation), but not with therapy type. The results, however, are based on a total group of 13 patients. Holmberg et al[46] use a population of patients with vocal nodules that is even smaller ($N = 11$). Analyses of variances tested the effects of a behaviorally based voice therapy protocol. The perceptual and physiological progressive changes suggest that voice therapy has a positive effect for most patients. Contrary to the above-mentioned studies, both Treole and Trudeau[47] and Hufnagle and Hufnagle[48] find no significant changes after voice therapy. Treole and Trudeau use an analysis of variance to test the maximum phonation duration (sustained /o:/) and s/z ratio (sustained /s/ and /z/) before and after therapy in a rather small group ($N = 13$). They could not demonstrate a change as function of the therapy. However, pretherapy measurements are similar to those found in subjects without laryngeal nodules. Hufnagle and Hufnagle investigate the relation between speaking fundamental frequency and vocal quality improvement in an even smaller group of eight patients. The authors state that no significant change in speaking fundamental frequency after therapy is present (*t* test for related measures). Vocal quality improvement is not related to changes in the speaking fundamental frequency.

In a randomized trial by Ptok and Strack,[49] the outcome of traditional voice therapy ($N = 12$) and "electrostimulation voice exercise" ($N = 12$) in patients with unilateral vocal fold paresis is compared. Using vocal fold irregularity and maximum phonation time as dependent variables, statistical analysis (*t* test for related measures, Mann-Whitney *U* test) indicates slight, though not significant, differences favoring vocal exercises supported by electrostimulation. A study by van Gogh et al[50] focuses on patients suffering from dysphonia after treatment for early glottic carcinoma. Patients are assigned randomly either to a voice therapy group ($N = 12$) or to a control group ($N = 11$). Multidimensional voice analyses are used (quality-of-life measurement, acoustic and perceptual voice quality analysis, videolaryngostroboscopy, and phonetography). Statistical analyses (Mann-Whitney *U* test and *t* test) of the difference in scores (postmeasurement minus premeasurement) show significant voice improvement after voice therapy on diverse parameters of the multidimensional measurements, such as, the total score of the voice handicap index (patient's self-evaluation), percent jitter and noise-to-harmonic ratio in the voice signal and the perceptual rating of vocal fry.

Functional and organic dysphonia

There are a number of studies in which mixed groups of patients are included. These groups are populations in which both functional and organic dysphonia are admitted.

Murry and Rosen,[51] Casper,[52] as well as John et al[53] use evaluation instruments that are restricted to quality-of-life measurements. Murry and Rosen study the pre- and posttherapy data on the Voice Handicap Index, a patient self-assessment questionnaire, in a group of 37 patients suffering from muscle tension dysphonia, benign vocal fold lesions, or unilateral laryngeal nerve paralysis. Patients receive surgery and/or voice therapy. In general, a 50% or greater improvement in the mean index is found. Overall, 81% of the patients report a reduced perception of voice handicap. A histogram of

TABLE 1C.
Systematic Review: Functional and Organic Dysphonia

Level of Evidence	Data Analysis	Reference	Subjects*	Evaluation Techniques†	Treatment(s)/Groups (G)	Author(s)'s Conclusions/Key Findings
A (randomized clinical trial)	Statistical analysis	Bassiouny[59]	42 diverse (nonorganic dysphonia, minimal associated pathological lesion, vocal fold immobility)	1,2,3,4,5,6 (inverse filtering)	G1 voice-hygiene advice and accent method ($N = 21$) G2 voice-hygiene advice ($N = 21$)	The difference in improvement for most of the parameters in G1 and G2 after therapy is generally significant in favor of G1. The improvement from pretest to midtest to posttest values follows a linear tendency.
		MacKenzie et al[66]	133 diverse (vocal nodules, laryngitis, incomplete glottic closure, hyperfunction)	1,2,3,4	G1 voice therapy ($N = 70$) G2 no treatment ($N = 63$)	Voice therapy is effective in improving voice quality as assessed by self-rated and observer-rated methods. It does not significantly affect laryngeal pathophysiology or reduce the high levels of psychological distress that characterize patients with dysphonia.
		Rattenbury et al[61]	50 muscle tension dysphonia including minor vocal fold lesions	1,2,6 (electroglottography)	G1 traditional voice therapy: indirect and direct techniques ($N = 26$) G2 visual laryngeal biofeedback: transnasal flexible laryngoscope-assisted voice therapy ($N = 24$)	Subjects in both treatment groups demonstrate statistically significant improvements after voice therapy on all three evaluation instruments. As the median time taken to complete voice therapy in G2 is 2 hours less than in G1, voice therapy with transnasal flexible laryngoscopy as a therapy tool is effective and more efficient than traditional voice therapy.
		Simberg et al[60]	40 (female teacher students with mild voice disorders)	1,2,4	G1 voice ergonomics, voice therapy with so-called "resonance tube," Accent method ($N = 20$) G2 no therapy ($N = 20$)	Pre- to posttreatment data of perceptual evaluation of voice and patient's self-reported vocal symptoms, indicate significant changes in the treatment group compared with the control group. No differences between groups are noted in laryngeal status.
B (nonrandomized clinical trial)	Statistical analysis	Amir et al[65]	Seven vocal nodules and/or incomplete adduction of the glottis	2,3	Voice therapy	After the voice course most acoustic measures improve, whereas no significant effect is found for any of the perceptual scales
		Carding et al[64]	145	3	G1 voice therapy ($N = 90$) G2 surgery ($N = 55$)	After therapy, changes in mean acoustic measures represent effect sizes that can be considered small to moderate. The effect sizes are similar for both interventions but the difference in mean scores reaches statistical significance only for voice therapy and not for surgery (most likely because of the differences in sample size).
		Fex[58]	10 (7 normal vocal cords, 3 bilateral vocal nodules)	3	Accent method	Significant improvement on pitch and amplitude perturbation quotient, normalized noise energy (NNE) for 1–4 kHz and F_0.

	Kotby et al[57]	28 diverse (functional dysphonia, minimal associated pathological lesion, vocal fold immobility)	1,2,4,5	Accent method	Patient's complaint: 89% shows a positive grade shift; Auditory-perceptual assessment: 68% shows a significant degree shift in the overall grade of dysphonia; Indirect laryngovideostroboscopy shows a reduction in nodule size (6/6) and in the maximal phonatory gap (4/6); Aerodynamic parameters vary in the degree of significance.
	Machulla et al[63]	39 diverse (functional dysphonia, chronic laryngitis, endolaryngeal trauma, laryngeal malformation, unilateral vocal fold paralysis, benign vocal fold lesions)	1	Voice therapy	A significant reduction of the Voice Handicap Index summary score (quality-of-life measurement) is achieved by 10 of 39 patients. The inventory is not regarded as a reliable measure to evaluate a voice rehabilitation program on an inpatient basis. Numerous prior treatment regimens constitute a negative prognostic criterion for rehabilitation success.
	Speyer et al[1]	40 diverse (functional dysphonia, submucosal swelling, vocal fold edema, vocal fold nodules, vocal fold polyps, unilateral vocal fold paralysis, other)	4 (objective measurements in digitzed laryngeal stroboscopic images)	Voice therapy	After 3 months of voice therapy, significant improvement in lesion size and degree of maximal closure during vibration can be demonstrated in about 50% of the patients.
	Speyer et al[2]	62 diverse (functional dysphonia, submucosal swelling, vocal fold edema, vocal fold nodules, vocal fold polyps, unilateral vocal fold paralysis, other)	3 (voice range profiles)	Voice therapy	The main finding after voice therapy is a significant enlargement of the voice range profile in the low frequency range. After 3 months of no therapy, the data showed a significant improvement at higher frequencies and intensities.
	Speyer et al[3]	77 diverse (functional dysphonia, submucosal swelling, vocal fold edema, vocal fold nodules, vocal fold polyps, unilateral vocal fold paralysis, other)	1,2,3,4	Voice therapy	After therapy highly significant improvements on two quality-of-life measures are found for the group as a whole. Yet at the individual level, improvement is significant for about half of the subjects. Correlations between these measures and clinical data (perceptual evaluation, acoustic analysis, videolaryngostroboscopy) are low.

(*Continued*)

TABLE 1C. SYSTEMATIC REVIEW: FUNCTIONAL AND ORGANIC DYSPHONIA

Level of Evidence	Data Analysis	Reference	Subjects*	Evaluation Techniques†	Treatment(s)/Groups (G)	Author(s)'s Conclusions/Key Findings
		Speyer et al[4]	78 diverse (functional dysphonia, submucosal swelling, vocal fold edema, vocal fold nodules, vocal fold polyps, unilateral vocal fold paralysis, other)	2,3,4	Voice therapy	The group therapy effects are clearly significant, but the effects for the individual patients are divergent. For each of the evaluation methods, a significant improvement is found for about 40% to 50% of the patients. Relations between these methods for the changes due to voice therapy are very weak. A multidimensional evaluation of the voice is necessary to give a complete picture of therapy outcome.
		Weichbold and Zorowka[62]	25	1	Voice therapy	The Munich List of Quality-of-Life Dimensions is not sensitive enough to detect all effects of logopedic therapy.
	Descriptive statistics	Casper[52]	184 diverse (benign lesions, unilateral vocal fold paralysis, postoperative dysphonia, functional problems)	1	G1 surgery G2 voice therapy	Patient-perceived benefits of voice treatment, whether surgical or behavioral, are great. (On the completion of therapy, 79% of the patients rate their voices as better than before treatment and 8% as back to normal.)
		Filter and Poynor[55]	30 (children: 3 functional dysphonia, 27 vocal nodules)	2,4	Voice therapy	67% of the subjects showed improvement after therapy: lower ratings on perceptual measurements, and for nodular children, absence of vocal nodules.
		John et al[53]	240 (76% completed treatment; 24% still in treatment)	1	Voice therapy	Although there is no significant difference in the profile of the severity of symptomology of patients referred to speech and language therapy in different geographical areas, there is a significant difference in the treatment outcomes across the services.
		Lee and Son[56]	8 (children: muscle tension dysphonia, 7/8 vocal nodules)	2,3,4	Voice therapy	Short-term voice therapy is highly effective in all children.
		Murry and Rosen[51]	37 diverse (muscle tension dysphonia, benign vocal fold lesions, unilateral vocal fold paralysis)	1	Surgery and/or voice therapy	81% of the patients demonstrated a reduced perception of voice handicap, whether they are treated with surgery, voice therapy, or a combination. (50% or greater improvement of the mean Voice Handicap Index)
		Xu et al[54]	91 (41 vocal nodules, 20 recurrent laryngeal nerve paralysis, 30 incomplete glottal closure)	2,4,5,6 (voice range, SPL)	Yawning breath pattern	About 1/3 of the patients master the yawning breath pattern perfectly and their symptoms improve satisfactorily.

* Adult men and women, unless mentioned otherwise.

† Evaluation techniques: 1, quality-of-life measure; 2, perceptual evaluation; 3, acoustical analysis; 4, videolaryngo(strobo)scopy; 5, aerodynamic measure; and 6, others.

the pre- and posttherapy group data per diagnostic category, visualize positive therapy effects. Using norm values from literature, the posttherapy histogram is significantly shifted in relation to the pretherapy histogram. However, in the description of therapy results, the authors do not distinguish between voice therapy and surgery. Neither does Casper[52] while evaluating the therapy effects on two patient self-evaluation scales in a group of 184 adults with dysphonia. Four diagnostic categories are included: benign lesions, unilateral vocal fold paralysis, postoperative dysphonia, and functional problems (muscle tension dysphonia). The overall conclusion that patients perceive great benefits of voice therapy, whether surgical or behavioral, is not further specified per therapy group. After completion of the therapy, 79% of the patients rate their voices better than it was before therapy, and 8% believe that they are back to normal. However, no exact numbers on therapy groups are given, nor any results of a statistical analysis. In a study by John et al,[53] the same design and outcome measurement are used as in an earlier study by Enderby and John.[26] However, the former study includes both functional and organic dysphonia ($N = 240$) in contrast to the latter study that is restricted to functional dysphonia. During a 20-month study period, the outcomes of different speech and language services are measured using a patient's self-evaluation scale. At the end of this period, 76% of the patients have completed their treatment, whereas 24% are still in treatment. Based on the results of a patient's self-evaluation scale, the authors conclude in line with the earlier study in 1999 that there is no significant difference in the severity of symptomology of patients referred to speech and language therapy in different geographical areas. However, there is a significant difference in the treatment outcomes across the services and in the stated reason for discharge from treatment. Most patients with dysphonia have a good outcome and this is associated with completion of the course of treatment.

Xu et al[54] use several outcome measurements to assess the effects of a diaphragm support breath pattern (yawning breath pattern) in voice therapy in patients with incomplete glottal closure ($N = 30$), vocal nodules ($N = 41$), and recurrent laryngeal nerve paralysis ($N = 20$). Based on laryngoscopic examination, vocal function tests, perceptual evaluation, and patient's subjective evaluation, the group changes after therapy are globally described. The authors conclude that about one third of the patients master the yawning breath pattern perfectly, resulting in satisfactory improvement of the symptoms. The performances of the other patients vary between fair, slight, and satisfactory improvement. Two other studies are concerned with dysphonia in children. Filter and Poynor[55] describe the effects of voice therapy in a group of 30 dysphonic children. After voice therapy, 76% of the children show improvement on perceptual evaluation measures and in children with nodules ($N = 27$), the vocal folds became normal as determined by laryngoscopy. Lee and Son[56] too find highly effective short-term voice therapy in a rather small group of children ($N = 8$) with muscle tension dysphonia; seven out of eight subjects have bilateral vocal nodules. Measurements are perceptual, acoustical, and laryngoscopic evaluation.

Fourteen studies on mixed patients provide pre- and posttherapy data that are statistically tested for significant differences. Four of these studies describe the effects of the accent method, a holistic approach for behavior modification of the voice.[57–60] The evaluation instruments used by Kotby et al[57] in a group of 28 patients consist of a patient's grading of the voice function, auditory-perceptual assessment, indirect microlaryngovideostroboscopy, and some aerodynamic values. Positive significant therapy effects (paired *t* tests) support the notion that voice therapy is indicated mainly in cases of habitual functional voice disorders and in selected pathological lesions (nodules), as well as in some organic laryngeal ailments (vocal fold paralysis). Fex et al[58] use acoustic analysis in a small group of 10 patients with functional voice disorders among whom three have developed bilateral vocal nodules. The Wilcoxon signed ranks test is used for statistical analysis. Significant improvement on pitch and amplitude perturbation quotients, normalized noise energy, and fundamental frequency are found. A much more detailed study is done by Bassiouny.[59] These authors compare the results of 42 patients with a variety of vocal pathology divided into two therapy groups: one group receiving only voice-hygiene advice and another group receiving accent exercises as well. A diversity of evaluation instruments is used: a patient's own grading of severity of voice dysfunction, auditory-perceptual assessment, visuoperceptual evaluation of videolaryngostroboscopy, aerodynamic measures, acoustic analysis, and inverse filtering measures. The difference in improvement in both therapy groups at the end of the observation period is generally significant (paired *t* test) in favor of the group receiving accent exercises as well. Simberg et al[60] use the accent method in combination with other voice treatment techniques. A group of teacher students with mild voice disorders are randomly assigned to either a treatment ($N = 20$ women) or a no treatment group ($N = 20$). Perceptual evaluation of voice quality and a patient's questionnaire on the occurrence of vocal symptoms indicate significant changes in the treatment group compared with the control group (respectively, analysis of variance and Fisher exact tests). No differences between groups are noted in the laryngeal status (Fisher exact tests). Like in the previous studies, Rattenbury et al[61] focus on one specific therapy: transnasal flexible laryngoscopy as a therapeutic tool in voice therapy (visual laryngeal biofeedback). Patients with muscle tension dysphonia including minor vocal fold lesions are randomly assigned to either a traditional treatment group ($N = 26$) or a group using visual laryngeal biofeedback ($N = 24$). The package of outcome measures includes perceptual auditory rating of voice quality, electroglottography, and a patient questionnaire. Subjects in both treatment groups demonstrate statistically significant improvement after voice therapy on all three outcome measures (Wilcoxon signed rank test and paired samples *t* test). The median total treatment time to complete voice therapy for the traditional treatment group and the biofeedback group is, respectively, 3 hours *versus* 1 hour. As the average time to complete voice therapy in the biofeedback group is about 2 hours less than in the traditional treatment group, the authors conclude that voice therapy using visual laryngeal biofeedback is more efficient than traditional voice therapy.

Other studies do not focus on one specific therapy, but use one selected evaluation instrument for evaluating general voice therapy. For example, Weichbold and Zorowka[62] and Machulla et al[63] restrict their outcome measures to quality-of-life measurements. The first study investigates the suitability of the so-called Munich List of Quality-of-life Dimensions in patients with dysphonia. Although the authors state that most patients express high satisfaction with the therapy received, it is concluded that the Munich List is not sensitive enough to detect all effects of logopedic therapy (paired *t* test). Machulla et al study therapy effects with a German version of the Voice Handicap Index in a group of 39 dysphonic patients with diverse phoniatric diagnoses. Norms for a significant difference between pre- and posttherapy measurements are based on literature describing the original American version of the inventory. A significant reduction of the summary score is achieved by 10 of 39 patients. The inventory is not regarded as a reliable measure to evaluate a voice rehabilitation program. Numerous prior treatments constitute a negative prognostic criterion for rehabilitation success. Carding et al[64] use acoustic analysis for evaluation of therapy effects in a large group of dysphonic patients. The effects of voice therapy ($N = 90$) are compared with effects of laryngeal surgery ($N = 55$). After therapy, changes in mean acoustic measures represent effect sizes that can be considered small to moderate. The effect sizes are similar for both interventions but the difference in mean scores reaches statistical significance only for voice therapy and not for surgery (*t* tests). This is most likely because of the larger sample size in case of voice therapy. In contrast to Carding et al who included a large group of subjects, Amir et al[65] restrict both the number of subjects ($N = 7$) and the diversity of evaluation measurements (acoustic and perceptual analyses). After the voice course, most acoustic measures improve significantly, whereas no significant effect is found for any of the perceptual scales (analysis of variance). However, the number of subjects is very small.

In MacKenzie et al's study,[66] an attempt is made to examine the overall effectiveness of voice therapy for dysphonia using ratings of laryngeal features, perceptual impression by one expert, self-evaluation by the patient, amplitude and pitch perturbation, and psychological distress measures. Data of 70 patients randomized to voice therapy and 63 to no treatment have been used for statistical analysis. Voice therapy is performed by one therapist. It is concluded that voice therapy is effective in improving self-rated and observer-rated measures of voice quality. However, voice therapy does not significantly affect laryngeal pathophysiology or reduce the high levels of psychological distress that characterized the patients with dysphonia. In the studies of Speyer et al,[1–4] the overall effects of voice therapy are determined in a national effect study in the Netherlands. To do so, diverse types of voice therapy, a large group of voice therapists, and patients with functional or diverse vocal fold pathologies ($N = 78$) are included. A multidimensional voice assessment has been used. The overall group effects on videolaryngostroboscopy, perceptual panel evaluations, acoustic analysis, and self-evaluations by the patient are significant, but the average improvements are small. Therapy effects for the individual patient appear to be very diverse and vary from no improvement at all to complete recovery to a normal voice.

SUMMARY AND CONCLUSIONS

Summarizing the literature on the effects of voice therapy in dysphonic patients, the overall impression is that the number of papers is small and many studies have methodological problems. For example, in case of perceptual evaluation, it is very often unclear whether the data have been offered to the listeners in randomized order and without any information on pre- or posttherapy status of the voice samples. Some studies use very subjective instruments to evaluate therapy effects without any statistical foundation. Furthermore, the lack of a good alternative for a control group receiving no therapy weakens many study designs. Usually, the results of the effect studies are based on small or restricted groups of patients and a small number of speech therapists. Often only restricted sets of assessment instruments have been used in the experiments. As a consequence, many aspects of voicing may be missed.

Although no conclusions can be drawn from the literature, some tendencies might be observed. If statistically significant positive results are reported, these are in general modest and the therapy effects in individual patients are varying. Direct voice therapies seem to be more effective than indirect therapies.[37,59] In studies of some specific voice therapies, such as manual laryngeal tension reduction[27–30] and the Accent method,[57–59] positive therapy outcomes are more frequently reported than in other studies in which the therapy is not clearly defined. Studies including a restricted population of subjects with specific diagnoses, for example mutational dysphonia[25,27,28] or vocal nodules,[41,42,44,55] report often statistically significant positive therapy changes. These tendencies in the reported results suggest that in studies on therapy effect, it is recommended to restrict the patient population and to use a well defined therapy. A remarkable point is the enormous variation in the duration of the therapies. Some studies claim significant (short-term) improvement after one single treatment session,[31] whereas others describe long series of sessions.

When trying to answer the question whether voice therapy in general is effective, one may conclude that no single answer can be given to that question, because of the diversity in phoniatric diagnoses, subject's personalities, voice therapies, as well as voice assessment instruments.

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