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RESEARCH ARTICLE

Preliminary study of Novafon local vibration voice therapy for dysphonia treatment

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ABSTRACT

Background: The objective of this study was to explore the effectiveness of a five-week Novafon local vibration voice therapy (NLVVT) program for dysphonia treatment.
Methods: Eleven dysphonic subjects participated in this specific program.
Results: Treatment effects were assessed during (i.e. weekly) and after NLVVT. Large and significant treatment effects were revealed in acoustics (i.e. spectrography), and multiparametric indices (i.e. Acoustic Voice Quality Index (AVQI), and Dysphonia Severity Index (DSI)) during and after NLVVT (all p values $< .01$). Additionally, self-evaluation (i.e. Voice Handicap Index (VHI)) showed a significant improvement after NLVVT ($p < .01$). Gender independent voice range profile parameters (i.e. acoustics) only showed significant effects after treatment ($p \leq .01$), but not during the treatment. Finally, aerodynamic measurement (i.e. phonation quotient) showed low treatment effects after NLVVT, which were not significant ($p > .05$).
Conclusions: The preliminary results showed that NLVVT might be successful in voice treatment. Large treatment effects might be expected in AVQI, DSI, spectrography and VHI after using NLVVT. Other voice characteristics showed smaller treatment effects (i.e. voice range profile parameters) or no meaningful treatment effects (i.e. phonation quotient).

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Dysphonia; local vibration therapy; Novafon; treatment effect; voice assessment; voice therapy

Introduction

The adult population will experience voice problems of almost 30% (i.e. chronic about 21.5% or acute about 78.5%) at some point in their life [1]. Voice disorders/dysphonia might reach 6% of the general population [2], in which 85% are presented in urban areas and are more frequent in females than males [3]. Next to medical treatments (i.e. pharmaceutical therapy, phonosurgery and radio/chemo therapy), voice therapy has shown statistically significant improvements in the treatment of many types of dysphonia [4–7]. There are several methods, which have shown significant improvements in dysphonia treatment, for example, semi-occluded vocal tract exercises [8–12], accent method [13,14], vocal function exercises [15–17], manual laryngeal therapy [18] and resonant voice therapy [19]. The effects of local vibration in voice therapy, however, are unknown. Local vibration therapy by, for example, Novafon® (see Figure 1) is a non-invasive solution and it is a clinically successful treatment for pain [20–22], and the effects after a stroke [23,24]. The utilization of vibration on the skin might activate fast adaptive threshold stimuli [25]. The external vibrations stimulate superficial and lower layer mechanoreceptors. Particularly, the Pacinian corpuscle, which are nerve endings in the skin, and the endings of neuromuscular spindles, which are connected with large diameter afferents, are sensitive to vibration and pressure [26]. The activation of these receptors enables a high selective nature of the involved sensors under the 'gate-control' hypothesis by Melzack and Wall [27] to treat for example symptoms of pain. Additionally, the external vibration evokes muscle contraction via stretch reflexes [28], which should increase the physical fitness by principally fast fibres or type two fibres of muscles [29]. Particularly, the percentages of type two fibres have a higher concentration for example in the thyroarytenoid muscle and cricothyroid muscle [30], which regulate the glottal closure of the vocal folds. Study results showed that the local vibration therapy reduces the muscle tension for example in cases of neurological spastics [31,32]. This might have a positive effect to reduce hypertension in voice production as well. The mechanic vibrations of a Novafon sound wave appliance penetrate six centimeters deep into the tissue [33]. The treatment with Novafon sound wave appliance is both activating and relaxing.

However, the effectiveness of the Novafon sound wave appliance has not yet been tested in the treatment of dysphonia. A new program for voice therapy has been developed combining Novafon local vibration and voice exercises, called Novafon local vibration voice therapy (NLVVT) (see supplementary material).

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Supplemental data for this article can be accessed here.

Figure 1. Novafon classic sound wave appliance.

The present preliminary study aimed to explore the newly developed NLVVT program in the treatment of dysphonia (i.e. benign vocal fold lesions, vocal fold paralysis and non-organic voice disorders). As voice is a multidimensional phenomenon, various voice characteristics had to be investigated as for example, recommended by the European Laryngological Society (ELS) [34,35]. The present study includes acoustics, aerodynamics, multiparametric indices and self-evaluation measurements to describe the treatment effects before, during and after the NLVVT program.

Table 1. List of demographic characteristics and type of voice disorders.

Variable	Results
Sex	
Male	2
Female	9
Age in years (mean ± standard deviation; range from minimum to maximum age)	53.55 ± 19.01; 22–80 years
Voice disorder	
Paralysis or paresis	6
Functional dysphonia	2
Nodules	2
Polypoid mucosa (edema)	1

Methods

Subjects

Subjects who had a diagnosed voice disorder and an otolaryngology letter of referral were recruited from German speech-language therapy practices. All subjects were at least 18 years old and had nonorganic or organic laryngeal pathologies. Subjects having prior voice therapy, laryngeal surgery or trauma, and head and neck cancer were excluded. From 17 voice-disordered subjects that were initially asked to participate, only 11 subjects completely finished the NLVVT program. Six subjects had to quit the program for various reasons (e.g. disease). Table 1 summarizes further details of the 11 subjects.

This investigation consisted of a prospective study with an interventional analysis of recordings and measurements. The requirements of the Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects were used. Additionally, every subject signed a statement of agreement and data privacy policy.

Novafon local vibration voice therapy

The voice therapy followed the hierarchy, which is listed in the supplementary material. Each participant had five individual 45-minute sessions, one session a week for five weeks. The voice therapy program mainly contained voice exercises which are supported in the literature improving the voice production (i.e. humming [19,36–39], chewing [40,41], tongue-trill [10,39], lip-trill [10,39], combination of tongue-trill and hand over mouth approach [39], and resonant voice [19]). During all exercises of the voice therapy program, the Novafon classic sound wave appliance (Novafon GmbH, Weinstadt, Germany) with 100 Hz vibration was used. The intensity of the vibration from the Novafon sound wave appliance was adjusted individually to the highest intensity level which was still comfortable in vibration pressure for the user. The placement of the Novafon sound wave appliance was applied on the thyroid lamina. During phonation, an extra buzzing sound resulting from the local vibration of the Novafon sound wave appliance has to be heard from the user. The buzzing sound ensures that the vocal folds passively vibrate, which might stimulate/support an easy and comfortable voice production. Thus, the placement on the thyroid lamina can vary (e.g. side of the lesion). Furthermore, in the case of an organic or neurological vocal fold disorder, the placement and the side of the thyroid lamina vary well (e.g. unilateral polyp on the left anterior side, and unilateral vocal fold paralysis of the right side). The vibration setting was kept on the highest intensity level (i.e. maximum level of the Novafon sound wave appliance and/or comfortable in vibration pressure) of the program. All subjects attended each session. Every week, the next step in the hierarchy of the NLVVT program was achieved. Furthermore, daily practice was obligatory for each subject. The content of the exercises for the daily practice was dependent on the number of conducted sessions with their related hierarchy level. All subjects did daily home exercises with their own Novafon classic sound wave appliance for 10 minutes practice sessions, twice per day.

Voice diagnostic measures

Gender independent voice measures were assessed by acoustic measurements, multiparametric indices, aerodynamic measurement and self-evaluation. To verify the level of environmental noise of the voice recordings post-hoc, the signal-to-noise ratio (SNR) by Deliyski et al. [42,43] was used. All voice samples were consistent with the recommended SNR norm for acceptable circumstances of acoustic recordings and analysis. Furthermore, the voice recordings were obtained in a quiet office. Acoustic measures and multiparametric indices were measured before, during and after the NLVVT program. These measurements were conducted weekly in every individual session before the voice therapy program went further in the hierarchy. The aerodynamic measurement and the self-evaluation measurement were evaluated only before and after the intervention. All measures of the present study are explained in detail in the following sections.

Acoustic measurements

First, the spectrography was used to evaluate the voice quality aspects on a three-second mid-vowel [a:]. The classification scheme for signal typing in voice was used by Sprecher et al. [44]. Recent results have confirmed that this classification scheme is meaningful for signal typing in voice using narrowband spectrograms on sustained vowels as a valid complement in the objective evaluation of the voice quality aspects of hoarseness and breathiness [45]. The interpretation of the scheme for narrowband spectrograms scores was based on the guidelines by Sprecher et al. [44]. Level A is normal and adapted to a score of 0 and all other levels (i.e. B–D) received the score 1–3.

Second, the VRP was acquired with the Voice Profiler® 5.0 (Peter Pabon, Alphatron, Rotterdam, The Netherlands). The examiner guided the subjects in how to reach the maximum boundaries of their voice. The patients were instructed to phonate the vowel [a:] for at least two seconds to measure the lowest pitch, the lowest intensity, the highest frequency and the highest intensity. For further analyses/interpretation, only intensity- and frequency range were used based on the guidelines by ELS [34,35] which concluded that the frequency range >24 semitones, and the intensity range >40 dB are normal for females and males. These two parameters of the VRP are gender independent.

Multivariate indices

First, a multivariate index of overall hoarseness severity was administered. The Acoustic Voice Quality Index (AVQI) [46,47] is a six-factor acoustic model to quantify overall voice quality in concatenated continuous speech and sustained vowel segments analyzed with the computer program Praat [48]. The AVQI analysis was applied on the first 22 syllables of the German phonetically balanced text ‘Der Nordwind und die Sonne’ [The Northwind and the Sun] at comfortable pitch and loudness and three-second mid-vowel [a:]. Furthermore, the continuous speech element for the AVQI analysis contained only voiced segments using the extraction Praat-script by Maryn et al. [46]. Although AVQI was originally developed for Dutch speakers, the AVQI has also been approved for German speakers [49]. The interpretation of the AVQI scores was based on the guidelines by Barsties and Maryn [49] which concluded that an AVQI score ≤ 2.70 is normal.

Second, another multivariate index was used to measure the status of vocal function, called Dysphonia Severity Index (DSI) [50]. The DSI is based on a weighted combination of the parameters of maximum phonation time (MPT), jitter percent on a three-second mid-vowel [a:], the highest frequency of a VRP, and the lowest intensity of a VRP. The outcome of the MPT is based on habitual pitch and loudness on the vowel [a:], which had to be sustained as long as possible after taking a deep breath. The longest MPT trial of two trials was used related to the interpretation of the displayed oscillogram and narrowband spectrogram in the program Praat [48]. The duration in seconds can be measured as precisely as possible detecting the beginning and end of phonation. The interpretation of DSI scores was based on the guidelines by Hakkesteegt et al. [51] which concluded that a DSI score ≥ 3.00 is normal.

Aerodynamic measurement

The measurement for aerodynamic was the phonation quotient (PQ in ml/s). The PQ was calculated as the ratio between vital capacity (VC) and MPT. To analyze the VC in ml, the subject is asked to exhale air as long as possible after a maximum inhalation in a spirometer method of Riester (Jungingen, Germany). This measurement was repeated twice. The interpretation of the PQ scores was based on the guidelines by ELS [34,35] which concluded that a PQ score <200 ml/s is normal.

Self-evaluation measurement

The Voice Handicap Index (VHI) was used as a standardized questionnaire to quantify functional (VHI-F), physical (VHI-P) and emotional (VHI-E) impacts of voice problems.

The original version of the VHI was introduced by Jacobson et al. [52], and it consists of 30 questions. The subjects answer on a five-point Likert-scale (from 0 = never to 4 = always). The VHI sum score (i.e. VHI total score or VHI-T) ranges from 0 to 120 points. The highest value represents the maximum level of self-experienced voice handicap. The VHI has also been approved and found reliable in German speakers [53]. The performance of the VHI was conducted with the digital version of the VHI [54]. The interpretation of the three subscales and total scores was addressed to the guidelines by Vanneste and Verbrugghe [55] which concluded that a VHI-T < 24, a VHI-F < 6, a VHI-P < 17, a VHI-E < 6 are normal.

Statistics

All statistical analyses were completed using SPSS for Windows version 23.0 (IBM Corp., Armonk, NY), except when stated otherwise. First, treatment effects in the voice characteristics were analyzed with an effect size to interpret how strong the relationship between before and after the intervention of the NLVVT was. Tendencies for the magnitude of the treatment effects by comparing differences between the outcome means of the measures were assessed to investigate the practicable significance of the treatment. Cohen's d effect size (d) was used by comparing the pre-NLVVT program scores and the post-NLVVT program scores [56,57]. This effect size was determined with the Effect Size Calculator software [58]. However, Fritz et al. [59] recommended using an unbiased calculation of d (d_{unb}) for small sample sizes because d tends to overestimate the population effect size. Interpretation guidelines for the effect size were provided by Cohen [56]. Effect sizes are defined as small at $d = 0.2$, medium at $d = 0.5$ and large at $d = 0.8$. Furthermore, the Wilcoxon signed-rank test for two related samples was used to evaluate significant differences between the various voice characteristics before and after NLVVT. The results were considered statistically significant at $p \leq .05$.

Second, a one-way repeated measure analysis of variance (ANOVA) was conducted to evaluate the changes of the various voice characteristics when measured before, during and after the NLVVT. Effects were tested based on Wilks' lambda F ratio. To compare the main effects with pairwise comparisons, the Bonferroni correction was used to counteract the problem of multiple comparisons. The Bonferroni correction compensates for that increase by testing each individual hypothesis at a significant level by dividing the desired overall alpha level with the number of hypothesis [60]. In the case of the present study, the following calculation was performed to define this specific significant level: $p = .05/5$. The results were considered statistically significant at $p \leq .01$. Effect sizes were estimated by means of the partial eta-squared statistic, which describes the proportion of total variability attributable to a factor. A partial eta-squared value between 0.01 and 0.06 indicates a small effect, a value between 0.06 and 0.14 a medium effect, and a value higher than 0.14 a large effect.

Results

Table 2 lists the outcomes of the gender independent voice characteristics before, during and after NLVVT. The outcomes of significant differences and effect size measures of the voice assessment categories will be summarized in the next paragraphs and are listed in Table 3.

Outcomes of acoustic measurements

A large and significant improvement was found in spectrography between before and after voice therapy ($d_{unb} > 0.80$; $z = -2.714$, $p = .007$). Additionally, a large effect size was revealed in spectrography over the duration of five weeks (Wilks' lambda $F = 5.160$, $p = .029$; Partial Eta Squared $= 0.824$). After the fourth week, a steady and significant improvement of the spectrography was reached (Bonferroni: $p < .006$ to $.017$). Furthermore, the signal typing in voice using narrowband spectrograms was pathological before treatment. The score decreased over the time of treatment but the results have not reached yet a normal score after NLVVT [44].

The results of the two VRP parameters (i.e. frequency range and intensity range) showed a medium to large improvement between before and after voice therapy ($d_{unb} > 0.50$ and $d_{unb} > 0.80$, respectively). Additionally, these improvements are statistical significant for both VRP parameters ($p = .010$ and $p = .003$, respectively). However, the results of the ANOVA indicated no significant time effect for frequency- and intensity range, but with a large effect size (Wilks' lambda $F = 1.415$, $p = .339$; Partial Eta Squared $= 0.541$, and Wilks' lambda $F = 1.875$, $p = .233$; Partial Eta Squared $= 0.610$, respectively). Furthermore, the frequency range and the intensity range were normal before treatment [34,35], but the scores of both parameters further increased after NLVVT.

Figure 2 shows before, during and after the NLVVT treatment, the boundaries of VRPs of the subjects. Particularly, subjects 2, 3, 5, 8, 9 and 11 expanded their VRP boundaries. The other subjects showed medium to low effects in their VRP boundaries.

Outcomes of multiparametric indices

A large and significant improvement was found in AVQI between before and after voice therapy ($d_{unb} > 0.80$; $z = -2.756$, $p = .006$). Furthermore, significant differences over the time of five weeks were revealed in AVQI with a large effect size (Wilks' lambda $F = 10.160$, $p = .006$; Partial Eta Squared $= 0.900$). Additionally, the AVQI score revealed normal after NLVVT, which was pathological before the treatment [49].

Next to AVQI, the DSI also reached a large and significant improvement between before and after voice therapy ($d_{unb} > 0.80$; $z = -2.845$, $p = .004$). The results of the ANOVA indicated a large effect size for the DSI over the treatment time (Wilks' lambda $F = 4.776$, $p = .042$; Partial Eta Squared $= 0.799$). After the third week, a steady and

Table 2. Results of the gender independent voice characteristics before, during and after NLVVT of the 11 subjects.

		Pre-NLVVT program		After week 1		After week 2		After week 3		After week 4		After week 5 (post-NLVVT program)	
Voice assessment category	Parameters	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Acoustic: voice range profile	Frequency range (in semitones)	29.64	7.03	32.09	6.81	34.00	4.38	34.73	4.38	34.09	3.65	34.64	4.59
	Intensity range (in dB)	45.23	9.30	51.87	7.90	51.45	5.64	53.28	9.32	53.40	4.52	55.67	6.92
Acoustics: Multiparametric indices	Spectrography	1.64	0.67	1.00	0.77	0.91	1.04	1.18	0.75	0.64	0.67	0.82	0.75
Multiparametric indices	Dysphonia Severity Index	1.38	1.74	3.00	1.74	3.56	1.57	4.00	1.50	3.82	1.36	4.37	1.83
	Acoustic Voice Quality Index	3.89	1.07	3.12	1.24	3.05	1.40	3.01	1.15	2.64	1.11	2.70	1.10
Self-evaluation	Voice Handicap Index – Total	36.91	15.19	–	–	–	–	–	–	–	–	12.55	7.09
	Voice Handicap Index – Functional	8.91	7.18	–	–	–	–	–	–	–	–	2.36	2.66
	Voice Handicap Index – Physical	19.73	5.53	–	–	–	–	–	–	–	–	8.91	4.66
	Voice Handicap Index – Emotional	8.73	5.18	–	–	–	–	–	–	–	–	1.27	2.00
Aerodynamic	Phonation Quotient (ml/s)	251.01	85.60	–	–	–	–	–	–	–	–	205.13	83.78

Table 3. Impact of performance condition over the time of NLVVT on various voice characteristics of the 11 subjects.

		Effect size between before and after voice therapy program			Significant differences over the time of five weeks			
			Wilcoxon's signed ranked test					
Voice assessment category	Parameters	d_{unb}	*z*-Score	*p* Value	Wilks' lambda	*F*-Value	*p* Value	Partial Eta squared
Acoustics: voice range profile	Frequency range (in semitones)	0.78[b]	−2.585	.010**	0.459	1.415	.339	0.541[d]
	Intensity range (in dB)	1.18[c]	−2.934	.003**	0.390	1.875	.233	0.610[d]
Acoustics	Spectrography	1.06[c]	−2.714	.007**	0.176	5.160	.029*	0.824[d]
Multiparametric indices	Dysphonia Severity Index	1.11[c]	−2.845	.004**	0.201	4.776	.042*	0.799[d]
	Acoustic Voice Quality Index	1.01[c]	−2.756	.006**	0.100	10.746	.006**	0.900[d]
Self-evaluation	Voice Handicap Index – Total	1.90[c]	−2.938	.003**	–	–	–	–
	Voice Handicap Index – Functional	1.12[c]	−2.675	.007**	–	–	–	–
	Voice Handicap Index – Physical	1.96[c]	−2.671	.008**	–	–	–	–
	Voice Handicap Index – Emotional	1.75[c]	−2.937	.003**	–	–	–	–
Aerodynamics	Phonation Quotient (ml/sec)	0.48[a]	−1.334	.182	–	–	–	–

[a]Small effect size ($d = 0.2$).
[b]Medium effect size ($d = 0.5$).
[c]Large effect size ($d = 0.8$).
[d]Large effect size (partial eta squared >0.14).
*Significant at the .05 level.
**Significant at the .01 level.

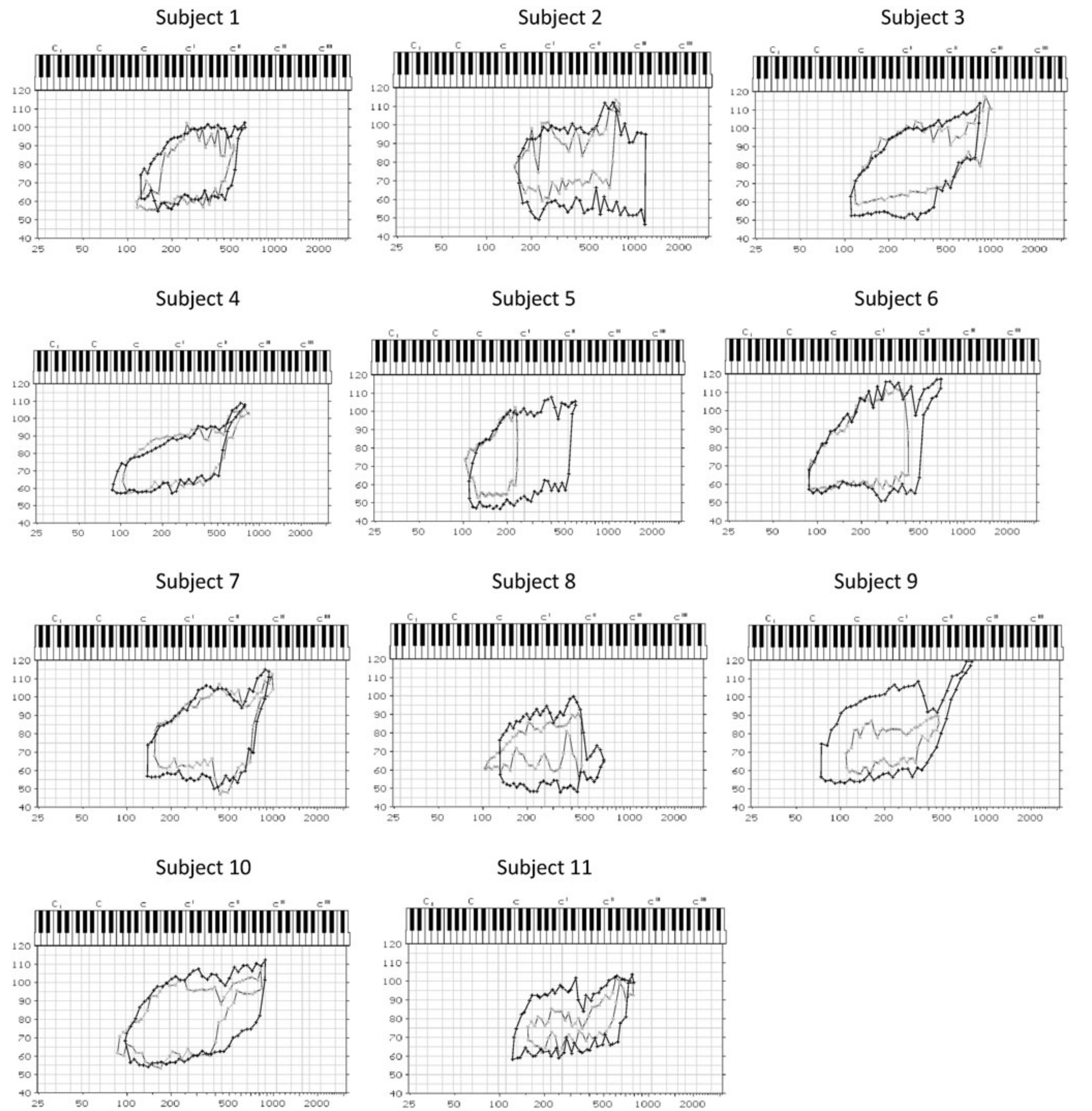

Figure 2. The two plotted voice range profiles (executed by the voice range profile contour software [61]) of the 11 subjects illustrated the process of the NLVVT: ● //–// symbols curve = pre-NLVVT program; ● +–+ symbols curve = post-NLVVT program.

significant improvement of the DSI was reached (Bonferroni: $p < .007$ to .025). Furthermore, the DSI score was pathological before treatment and after NLVVT the DSI score was normal [51].

Outcome of aerodynamic measurement

A low improvement was found in PQ after five weeks of Novafon local vibration therapy ($d_{unb} > 0.20$), in which the results are not significant ($z = -1.334$, $p = .182$). The results of the PQ slightly decreased after NLVVT but the outcome was still pathological [34,35].

Outcome of self-evaluation measurement

All VHI parameters revealed a large improvement after NLVVT (all $d_{unb} > 0.80$), which was also highly significant (all $p < .01$). Furthermore, all measures of the VHI were pathological before NLVVT and normal results in every subscale plus the total score were found after NLVVT [55].

Discussion

In this preliminary study, the NLVVT was evaluated on various voice characteristics on subjects with different degrees and types of dysphonia. The results showed significant improvements in nearly all voice characteristics with medium to large effect sizes, in which AVQI, DSI and spectrography reached significant improvements after three to five weeks. After finishing the NLVVT program, normal scores were revealed in three of five measurements (i.e. AVQI, DSI and VHI), which were pathological before treatment. The gender independent parameters of the VRP significantly improved after NLVVT, but there was still a normal score before treatment according to the ELS guideline [34,35]. However, VRP boundaries expanded meaningfully in 55% of the cases, which showed that in some cases the vocal function could be improved. By increasing the vocal functions in the VRP, the voice-disordered subjects might also benefit from a more robust voice with more voice control. The two parameters PQ and spectrography did not reach the normal score but a significant improvement in spectrography was found with a large effect size. To summarize, the voice production improves after the NLVVT program.

Benefits of local vibration in voice therapy

A potential rationale regarding potential benefits of local vibration in the voice therapy as external vibration source during phonation might depend on a stimulation of blood circulation, metabolism, and regulation of muscle tension. The Novafon sound wave appliance deeply stimulates the tissue of six centimeters [33], which might have effects on these three factors. Particularly, the regulation of the muscle tension improves the voice production as demonstrated, for example, by laryngeal manual techniques/methods in the treatment of voice disorders [62–64].

The NLVVT program implements a relatively strict hierarchy and application, that is easy to follow for the therapist and patient. However, the use of the Novafon sound wave appliance has flexibility in use (i.e. vibratory setting and placement). This flexibility allows the therapist to individualize the application on a minimum level. Thus, the Novafon sound wave appliance might reach effects on the voice production demonstrated in the present results of the preliminary study. However, further research is necessary to evaluate the effectiveness of the use of local vibration in voice therapy.

Comparison of NLVVT and other methods

The NLVVT program reached significant effects in a short period, in which 80% of the measurements showed significant improvements after NLVVT according to the guidelines mentioned above. Commonly, voice therapy lasts an average of 9.25 weeks distributed over 10.87 sessions [65]. The program of the NLVVT is geared to span five weeks by consulting a speech-language pathologist at five sessions of 45 minutes. The present results showed that significant treatment effects using NLVVT for the treatment of voice disorders could be reached after three to five weeks. These temporal aspects in voice therapy are relevant because there is an increased dropout risk with more frequent sessions and voice therapy duration. Currently, there are no standardized frames of reference to estimate the need of voice therapy in terms of duration and frequency, in comparison to medical or pharmaceutical therapy [65]. In voice therapy, there are only some specific approaches which were tested for their (optimal) therapy dosage like manual laryngeal musculoskeletal reduction technique [66], or Lee Silverman Voice Therapy [67].

Limitations

The results of the preliminary study showed initial improvements in voice characteristics of voice-disordered subjects using the NLVVT. However, the treatment effects cannot be generalized. In addition to this specific limitation, a number of additional limitations should be acknowledged. The first limitation pertains to the small number of participants. To include more subjects with a wide range of degrees and types of dysphonia from a voice clinic population, a generalization of the treatment effects might be realistic.

A second limitation is the absence of a control group to compare the treatment effects. It is essential in future studies to investigate the additional value of the Novafon sound wave appliance to traditional voice exercises relating to the first positive treatment effects with the NLVVT. A control group without the Novafon sound wave appliance ensures a comparison of the effectiveness in treatment of voice disorders to improve the voice production. A third limitation is the absence of a follow-up session after the last treatment. To assess the long-term treatment effects, follow-up investigations are sensible. A fourth limitation is the absence of laryngeal imaging and auditory-perceptual judgment, because of practicable and financial reasons. In the case of auditory-perceptual judgement, there was a lack of having an available panel of expert listeners. The absence of laryngeal imaging prevents knowing the true status/health of the vocal folds and surrounding structures. Thus, the findings would have been strengthened by additional information regarding laryngeal/vocal structure and physiology. Additionally, auditory-perceptual judgment of a representative and homogenous rater panel is useful to assess voice quality features in addition to the multiparametric indices. A fifth limitation is related to use gender dependent variables by including a comparable number of males and females. Gender dependent variables such as the MPT, extreme markers of the VRP, are useful to complete the voice assessment. A sixth limitation is the wide age range and variety of voice disorders of the selected subjects with dysphonia. Future studies should also investigate treatment effects in homogeneous groups of voice disorders and selected groups of age. By controlling these two factors, a better estimation of treatment effects might be possible. However, the present selected group of subjects represents a population in voice clinics in which significant improvements in voice production were reached after NLVVT without controlling age and variety of voice disorders.

Conclusions

The results of the present preliminary study of voice-disordered subjects using NLVVT might suggest a high treatment effect of selected measures such as AVQI, DSI, spectrography and VHI. Lower treatment effects might be expected in VRP parameters after NLVVT. No treatment effects might be presented in the PQ after NLVVT. The present preliminary results showed that local vibration therapy might be an addition to traditional voice therapy. However, to draw a firm conclusion of the evidence of local vibration as a voice therapy method and the identification of potential clinical benefits, further research is necessary.

Disclosure statement

This manuscript has no actual or potential conflict of interest.

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