## **ORIGINAL ARTICLE**



# A comparative study of stretch-and-flow voice therapy versus Smith accent method in rehabilitation of hyperfunctional dysphonia: a randomized controlled trial

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## Abstract

**Background** This work aims to compare between stretch-and-flow voice therapy and Smith accent method of voice therapy in treatment of hyperfunctional dysphonia in order to assess the benefit of using this new technique in its management. A randomized controlled trial was conducted at the Unit of Phoniatrics, Otorhinolaryngology Department, in the period from November 2020 to February 2023. A sample of 60 patients with hyperfunctional dysphonia was randomly divided into two groups; each group consisted of 30 patients: "group A" who received stretch-and-flow voice therapy (SnF) and "group B" who received Smith accent (SA) method of voice therapy. Assessment included auditory perceptual assessment (APA) using modified GRBAS scale and Arabic-voice handicap index (Arabic-VHI).

**Results** The study revealed significant improvement in grade of dysphonia, voice quality, and Arabic-VHI post-therapy for both groups. There was a significant improvement regarding voice pitch in SnF group only and in loudness of voice in SA group only.

**Conclusion** SnF can be considered as an alternative approach for treating hyperfunctional dysphonia, offering a shorter duration, and potentially being a simpler alternative for patients who struggle with the more intricate rhythms of the Smith Aaccent voice therapy method.

**Keywords** Hyperfunctional dysphonia, Primary muscle tension dysphonia, Smith accent, Stretch and flow, Auditory-perceptual assessment, Arabic-VHI

## Background

Nonorganic voice disorders as hyperfunctional dysphonia is characterized by excessive tension of the laryngeal and/or extra laryngeal muscles, resulting in poorly regulated laryngeal muscle action tension and unbalanced aerodynamic forces [1]. Some authors refer to nonorganic dysphonia as muscle tension dysphonia (MTD)

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[2, 3]. Primary MTD is used when the excessive muscle tension leads to a decompensation of the voice with the patient being dysphonic [4].

According to Payten et al. [5], 40 to 60% of patients referred for voice assessment do not have any organic "structural or neurological" pathophysiology but with a voice disorder resulting from nonorganic causes.

The distinctive features of a person's voice as reflected in the auditory-perceptual patterns of pitch, quality, intensity, and intonation all serve to differentiate one person from another, reflecting age, gender, education, intelligence, different aspects of personality, and sociocultural background [6].



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In the context of voice disorders, reductions in physical, social, and/or economic status resulting from voice disturbances are considered as indicators of diminished quality of life (QoL).

Therefore, the perspectives and expectations of patients play a crucial role in their assessment and management (vocal rehabilitation). Moreover, these patient-centered insights complement the conventional approaches of clinical voice assessment [7].

Behavioral readjustment voice therapy (BRAT) is the main line of treatment for such patients specifically Smith accent method (SA) [8].

SA is a holistic multidimensional physiological approach of voice therapy which can be applied to hyperfunctional and hypofunctional voice disorders [9]. On the other hand, stretch-and-flow voice therapy (SnF) is a specific approach which was first designed to be used for hyperfunctional dysphonia/primary MTD [10]. But over the years, it has been integrated into more common practice in voice therapy across diagnoses such as benign vocal fold lesions, vocal fold motion impairment and, in gender affirming voice rehabilitation [11].

A study done by Kaneko et al. [12] demonstrated the positive effects of SnF voice therapy on tension imbalance following unilateral vocal fold paralysis and paresis. It may be effective for supporting vocal fold tension and addressing voice use patterns due to tension imbalance following unilateral vocal fold paralysis and paresis.

SnF voice therapy aims to reduce vocal fold strain and retrain compensation of laryngeal hyperfunction to produce a strong and clear voice with the least amount of vocal effort [13, 14].

The rationale of SnF voice therapy is based on the idea of proper channeling of air stream achieved using a relaxed laryngeal position, which will eventually lead to a clear vocal quality. So, these exercises are believed to facilitate relaxation and reduce strain and tension in the extra-laryngeal musculature [15].

It is also based on an easy onset of phonation, consistent release of airflow, forward focus of resonance (transferring energy to the forward aspects of the vocal tract), and reduction of the overall physiological effort when phonating (using of minimal effort) [16].

SnF consists of a hierarchy of 5 skill levels: skill level 1 (flow), skill level 2 (stretch and flow), skill level 3 (stretch and voiced flow), skill level 4 (reduced stretch and increased flow), and skill level 5 (reduced air flow) [14].

SA method is the most widely used method of voice therapy in Egypt, with the lack of literature on alternative methods that can be used for helping Egyptian dysphonic patients. Thus, this study aims to evaluate the effectiveness of stretch-and-flow voice therapy compared to the Smith accent method for treating hyperfunctional dysphonia, in order to determine the advantages of using this new technique.

## Methods

## Aim

This work aims to compare between stretch-and-flow voice therapy and Smith accent method in treatment of hyperfunctional dysphonia in order to assess the benefit of using this new technique in management of hyperfunctional dysphonia.

#### Study design

A randomized controlled trial was conducted at the Unit of Phoniatrics, Otorhinolaryngology Department, in the period from November 2020 to February 2023. The study involved a purposive convenient sample of 60 dysphonic patients diagnosed with hyperfunctional dysphonia with both subjective and objective measures, who were selected based on specific inclusion and exclusion criteria.

#### Sample size

By extensively reviewing the literature, no previous similar studies were found (pilot study), and hence, sample size calculation was not performed but being based on expert phoniatricians' recommendations.

## Subjects

## Inclusion criteria

Patients included ranged in age from 20 to 60 years, with adequate language comprehension and intellectual abilities for receiving voice therapy techniques.

#### **Exclusion criteria**

These are patients with dysphonia caused by any other factor rather than a hyperfunctional element or with history of previous voice therapy sessions, individuals with a past history of hearing impairment, and individuals who have previously undergone micro-laryngeal surgery (MLS) for any vocal fold lesion.

They were further randomly divided into two equal groups; each group contains 30 patients through a computer randomization system called research randomizer on web.

- 1. Group "A" who received stretch-and-flow voice therapy in 60-min sessions once per week for 6 weeks
- 2. Group "B" who received Smith accent method of voice therapy in 20-min sessions twice per week for 6 weeks

In group "A," the patients' age ranged from 22 to 60 years, with a mean of  $38.70 \pm 10.96$  years, while in

group "B," the age ranged from 22 to 59 with a mean of  $37.63 \pm 10.68$ . As regard the gender, 17 females (56.7%) and 13 males (43.3%) were included in group "A," while group "B" included 14 females (46.7%) and 16 males (53.3%).

## Study procedures

Patients were first diagnosed as hyperfunctional dysphonia using the following selected assessment steps, extracted from the voice assessment protocol [17]:

- (1) Detailed personal history: Name, age, gender, education, occupation, residence, marital status, and number of children.
- (2) Complaint and analysis of symptoms: Duration, onset, and course
- (3) Phonasthenic symptoms (throat dryness, throat tenderness, frequent throat clearing, or difficulty in swallowing sticky throat mucous)
- (4) History of possible etiological factors: Smoking, excessive faulty use of voice, hardworking environmental factors, repeated upper respiratory tract infection, chronic cough, asthma, autoimmune diseases, allergies, GERD, and LPR.
- (5) Symptoms related to the larynx: Breathing and airway patency, chewing, swallowing, and hearing
- (6) Past history of any medical illness and any laryngeal or neck surgeries
- (7) Auditory perceptual assessment: Auditory perceptual assessment with tabulation of the results following modified GRBAS scale [18]: scoring of APA of all the recorded data was done by two experienced phoniatricians other than the administrator, where it takes two sessions 5 h each (with nearly similar circumstances to decrease intra-rater reliability).
- (8) Laryngeal examination using a rigid laryngeal endoscope with a 70° viewing angle or flexible nasofibrolaryngoscope looking for minor signs suggestive of hyperfunctional dysphonia as vocal fold edema, vocal fold erythema, phonatory gap, latero-medial, and anteroposterior compression of the larynx.
- (9) The Arabic-voice handicap index (Arabic-VHI) [19] which was filled by the patient him/herself: It consists of 30 items, equally distributed over three domains: functional, physical, and emotional aspects of voice disorders. Using a 5-point scale (0, never; 1, almost never; 2, sometimes; 3, almost always; 4, always), Arabic-VHI total scores range from 0 to 120. A total Arabic-VHI score from 0 to 30 denotes mild degree of handicap; generally, a score of 10 points or less is considered as being normal, a score from 31 to 60 denotes moderate degree

of handicap, and a score from 61 to 120 denotes a significant and serious degree of handicap due to voice problems.

Regarding APA and Arabic-VHI, the evaluation technique listed was used to asses both groups: the first assessment (baseline) was completed before starting any intervention and the second one applied 6 weeks after beginning voice therapy.

## The stretch-and-flow group (group A)

For 6 weeks, they received SnF voice therapy sessions once per week for 60 min. Typically, the therapeutic program needs six sessions to be completed. The patients passed through a hierarchy of five skill levels (flow, stretch and flow, stretch and voiced flow, reduced stretch with increased flow, and reduced air flow) to finally reach a perceptually appropriate conversational loudness with normal (non-breathy) air flow, normal rate, and modal (natural for that person) fundamental frequency. All skill levels were first performed by the instructor while the patient was observing, followed by imitation and finally the patient alone, while receiving auditory feedback on accuracy and techniques to enhance voice quality, including simple phonation initiation and steady airflow release. In addition to homework excercises of the current skill level being given.

The transition from one skill level to the next one occurred after ten consecutive successive trials in the previous level with breaks as much as needed in between. So, the patient went throughout the five skill levels, but if problems recur, they can return to the previous level until they reach functional performance.

Voice hygienic advice was given once to the patient at the beginning of sessions, despite of not being a part of this voice therapy technique. But it could not be neglected for its crucial complementary role in any vocal rehabilitation method.

As for the administrator's experience with the application of SnF voice therapy, he/she had attended an online MedBridge course "flow phonation" for application of flow phonation/SnF by Jackie Gartner-Schmidt, PhD, CCC-SLP, and ASHA Fellow. In addition to thorough research of literature about application of this new technique.

## Smith accent method group (group B)

Minimal initial explanation of the method was given followed by voice hygienic advice and then after learning diaphragmatic breathing went through the hierarchical steps of the SA method of voice therapy (largo, andante, and allegro) in 20-min sessions given twice weekly. The therapy program required 12 sessions for its completion. ◆ Post-therapy evaluation was done after 6 weeks of starting the first session. Both groups were subjected to reassessment using the same procedures used before receiving voice therapy sessions. Post-therapy improvement was considered as any improvement of the measured parameters after comparing it to the pre-therapy status, even if not returning to its normal status.

## **Tests of reliability**

The reliability of APA of voice was tested by inter-rater and test-retest (intra-rater) reliability methods. Testretest reliability was assessed by having the same examiner reasses the audio-recordings of the same patients on two occasions under similar circumstances. For this procedure, 10 patients were selected at random from each group to undergo retesting. Inter-rater reliability was assessed by having two different raters code all of the audio-recordings.

## Data management and analysis

The collected data was revised, coded, tabulated, and introduced to a PC using Statistical Package for Social Science (SPSS 20). Data were presented, and suitable analysis was done according to the type of data obtained for each parameter.

- i. Descriptive statistics
  - Mean ± SD (standard deviation) and range for parametric numerical data. Median and interquartile range (IQR) for nonparametric numerical data
  - Frequency/number and percentage of nonnumerical data
- ii. Analytical statistics

- Wilcoxon rank test: Was used to assess the statistical significance of the difference of a quantitative non-parametric variable between two study groups (dependent samples)
- Mann Whitney test (U-test): Was used to assess the statistical significance of the difference of a quantitative nonparametric variable between two study groups (independent samples)
- **Paired t-test:** Was used to assess the statistical significance of the difference between two quantitative parametric variables means measured twice for the same study group
- **Independent t-test:** Was used to assess the statistical significance of the difference between two quantitative parametric variables means measured for two study groups
- **Chi-square test (χ2):** Was used to examine the relationship between two qualitative variables

## Results

There was nonsignificant difference between both groups as regard age and gender distribution as shown in Table 1.

When pre- and post-therapy findings for each group were compared, there was a statistically significant improvement in the grade of dysphonia in both groups as shown in Table 2, with no statistically significant difference between the two groups as shown in Table 3. There were 9 patients (30%) in the "SnF group" who had not totally recovered from dysphonia. While in the SA method group, 5 patients (16.7%) were not entirely recovered as shown in Table 2.

Comparing pre- and post-therapy results for each group, there was a comparable high statistical significant difference in the voice quality post-therapy in both groups, with 70% of patients in group "A" achieved normal vocal quality. While 83.3% in group "B" achieved

		Group A (SnF group)	Group B (SA group)	Test value	<i>p</i> -value	Sig.
Age	Range	22-60	22-59			
	Mean	38.70	37.63			
	SD	±10.96	±10.68	0.382 <sup>b</sup>	0.704	NS
		Group A (SnF group)	Group B (SA group)	Test value <sup>a</sup>	<i>p</i> -value	Sig.
		No. = 30	No. = 30			
Gender	Female	17 (56.7%)	14 (46.7%)	0.601	0.438	NS
	Male	13 (43.3%)	16 (53.3%)			

 Table 1
 Comparison between both groups regarding age and gender distribution

P-value > 0.05, nonsignificant (NS). P-value < 0.05, significant (S). P-value < 0.01, highly significant (HS)

SnF Stretch and flow, SA Smith accent method

<sup>a</sup> Chi-square test

<sup>b</sup> Independent *t*-test

Group A (SnF group)		Pre-therapy		Post-therapy		Test value	p-value	Sig.
		No	%	No	%			
APA								
Grade of dysphonia	None	0	0.0%	21	70.0%	38.727	0.000	HS
	Mild	13	43.3%	9	30.0%			
	Moderate	9	30.0%	0	0.0%			
	Severe	8	26.7%	0	0.0%			
Group B (SA group)		Pre-therapy		Post-therapy		Test value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Grade of dysphonia	None	0	0.0%	25	83.3%	44.762	0.000	HS
	Mild	16	53.3%	5	16.7%			
	Moderate	11	36.7%	0	0.0%			
	Severe	3	10.0%	0	0.0%			

## Table 2 Comparison as regard the grade of dysphonia pre- and post-therapy within each group

 Table 3
 Comparison between both groups regarding the grade of dysphonia pre- and post-therapy

Pre-therapy			Group A (SnF group)			Group B (SA group)		Test value	<i>p</i> -value	Sig.
			No		%	No	%			
APA										
Grade of dysphonia		None	0		0.0%	0	0.0%	2.783	0.249	NS
		Mild	13		43.3%	16	53.3%			
		Moderate	9		30.0%	11	36.7%			
		Severe	8		26.7%	3	10.0%			
Post-therapy			Group A (SnF group)			Group B (SA group)		Test value	<i>p</i> -value	Sig.
			No	%		No	%			
APA										
Grade of dysphonia	None		21	70.0%		25	83.3%	1.491	0.222	NS
	Mild		9	30.0%		5	16.7%			
	Moderate		0	0.0%		0	0.0%			
	Severe		0	0.0%		0	0.0%			

Table 4 Comparison as regard the voice quality on APA both pre- and post-therapy within each group

Group A (SnF group)		Pre-therapy		Post-therapy			Test value		<i>p</i> -value	Sig.
		No	%	No		%				
APA										
Voice quality	Normal	0	0.0%	21		70.0%	32.311		0.000	HS
	Strained, leaky	23	76.7%	7		23.3%				
	Strained, leaky, & irregular	7	23.3%	2		6.7%				
Group B (SA group)		Pre-therapy		Post-therapy			Test value	<i>p</i> -value		Sig.
		No	%	No	%					
APA										
Voice quality	Normal	0	0.0%	25	83.3%		43.226	0.000		HS
	Strained, leaky	26	86.7%	5	16.7%					
	Strained, leaky, & irregular	4	13.3%	0	0.0%					

normal vocal quality as shown in Table 4, but when the results of both groups were compared, there was no statistically significant difference between them neither prenor post-therapy as shown in Table 5.

When comparing the pre- and post-therapy results within each group, a statistically significant improvement in pitch was observed in the SnF group. However, no statistical difference was found between the pre- and posttherapy results in the SA group, as indicated in Table 6. Furthermore, when comparing the results of both groups, no statistical significance difference was observed between them in terms of pre- and post-therapy values as shown in Table 7.

There was no statistical significant difference of voice loudness in SnF group post-therapy, while there was a statistical difference in SA post-therapy group as shown in Table 8, but there was no statistically significant difference between the two groups in pre-therapy and posttherapy values as shown in Table 9.

The reliability of APA of voice was tested by interrater reliability and test-retest reliability using Cohen's kappa. McHugh [20] suggested that "values of kappa  $\leq 0$  indicated no agreement, 0.01–0.20 indicated none to a slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0 l.61–0.80 substantial agreement, and 0.81–1.00 almost perfect agreement".

Regarding inter-rater reliability, pre-therapy, there was an agreement ranging from moderate (kappa=0.634) to almost perfect agreement (kappa=1) in SnF group and ranging from substantial (kappa=0.870) to almost perfect (kappa=1) agreement in SA group. Post-therapy, there was an agreement ranging from substantial (kappa=0.844) to almost perfect agreement (kappa=1) in SnF group and ranging from moderate (Kappa=0.647) to almost perfect (kappa=1) agreement in SA group as shown in Table 10.

When test re-test (intra-rater) reliability was performed, pre-therapy, there was a perfect reliability (ICC=1) in SnF group and from good (ICC=0.844) to perfect reliability in SA group. Post-therapy, it ranged from a good (ICC=0.8621) to a perfect (ICC=1) reliability in SnF group and from good (ICC=0.844) to perfect reliability (ICC=1) in SA group as shown in Table 11.

 Table 5
 Comparison between both groups regarding the voice quality on APA pre- and post- therapy

Due the survey		C		C		Testur		<b>C</b>
Pre-therapy		Group A (ShF group)		Group B (SA group)		lest value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Voice quality	Normal	0	0.0%	0	0.0%	1.002	0.317	NS
	Strained, leaky	23	76.7%	26	86.7%			
	Strained, leaky, & irregular	7	23.3%	4	13.3%			
Post-therapy		Group A (SnF group)		Group B (SA group)		Test value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Voice quality	Normal	21	70.0%	25	83.3%	1.520	0.468	NS
	Strained, leaky	7	23.3%	5	16.7%			
	Strained, leaky, & irregular	2	6.7%	0	0.0%			

**Table 6** Comparison as regard the voice pitch on APA both pre- and post-therapy within each group

	Pre-therapy			Post-therapy		Test value	<i>p</i> -value	Sia.
	No	%		No	%		F	3.9.
_OW	6	20.0%		0	0.0%	11.087	0.004	HS
Average	16	53.3%		27	90.0%			
High	8	26.7%		3	10.0%			
	Pre-therapy			Post-therapy		Test value	<i>p</i> -value	Sig.
	No		%	No	%			
_ow	6		20.0%	3	10.0%	3.510	0.173	NS
Average	22		73.3%	27	90.0%			
High	2		6.7%	0	0.0%			
	.ow Average High .ow Average High	Pre-therapy       No       Low     6       Average     16       High     8       Pre-therapy     No       Low     6       Average     22       High     2	Pre-therapy No%.ow620.0%Average1653.3%High826.7%Pre-therapy NoNo.ow6Average22High2	Pre-therapy         %           No         %           .ow         6         20.0%           Average         16         53.3%           High         8         26.7%           Pre-therapy         No         %           .ow         6         20.0%           Average         22         73.3%           High         2         6.7%	Pre-therapy NoPost-therapy NoNo%No.ow6 $20.0\%$ 0Average16 $53.3\%$ 27High8 $26.7\%$ 3Pre-therapy No%No.ow6 $20.0\%$ 3.ow6 $20.0\%$ 3Average2273.3%27High2 $6.7\%$ 0	Pre-therapy No         Post-therapy No         Post-therapy No         %           .ow         6         20.0%         0         0.0%           Average         16         53.3%         27         90.0%           High         8         26.7%         3         10.0%           Pre-therapy No         %         No         %           .ow         6         20.0%         3         10.0%           Average         22         73.3%         27         90.0%           High         2         6.7%         0         0.0%	$\begin{array}{c c c c c c c c c c c c c c c c c c c $	$\begin{array}{cccccccccccccccccccccccccccccccccccc$

Pre-therapy		Group A (SnF group)		Group B (SA group)		Test value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Voice pitch	Low	6	20.0%	6	20.0%	4.547	0.103	NS
	Average	16	53.3%	22	73.3%			
	High	8	26.7%	2	6.7%			
Post-therapy		Group A (SnF group)		Group B (SA group)		Test value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Voice pitch	Low	0	0.0%	3	10.0%	6.000	0.050	NS
	Average	27	90.0%	27	90.0%			
	High	3	10.0%	0	0.0%			

Table 7 Comparison between both groups regarding the voice pitch on APA both pre- and post-therapy

Table 8 Comparison regarding the voice loudness on APA both pre- and post-therapy within each group

Group A (SnF group)		Pre-therapy		Post-therapy		Test value	p-value	Sig.
		No	%	No	%			
APA								
Voice loudness	Decreased	2	6.7%	1	3.3%	0.351	0.554	NS
	Average	28	93.3%	29	96.7%			
Group B (SA group)		Pre-therapy		Post-therapy		Test value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Voice loudness	Decreased	4	13.3%	0	0.0%	4.286	0.038	S
	Average	26	86.7%	30	100.0%			

Table 9 Comparison between both groups regarding the voice loudness on APA pre- and post-therapy

Pre-therapy		Group A (SnF group)		Group B (SA group)		Test value	P-value	Sig.
		No	%	No	%			
APA								
Voice loudness	Decreased	2	6.7%	4	13.3%	0.741	0.389	NS
	Average	28	93.3%	26	86.7%			
Post-therapy		Group A (SnF group)		Group B (SA group)		Test value	<i>p</i> -value	Sig.
		No	%	No	%			
APA								
Voice loudness	Decreased	1	3.3%	0	0.0%	1.017	0.313	NS
	Average	29	96.7%	30	100.0%			

• 1: Perfect reliability

• $\geq$ 0.9: Excellent reliability

•  $\geq$  0.8 < 0.9: Good reliability

Comparing the results of the Arabic-VHI in both groups post-therapy, it revealed a highly significant difference (reduction) in total scores, and its three domains (functional, physical, and emotional) as shown in Table 12, but when comparing pre-therapy results of the two groups, there was no statistical significant difference between them regarding the total score, with a high statistical significant difference regarding the functional, emotional, and physical domains as shown in Table 12.

When comparing post-therapy results of the Arabic-VHI between the two groups, there was no statistical significant difference regarding the following: total scores and functional, while there was a statistical significant difference regarding physical domain. Moreover, there was a highly significant difference regarding emotional domain as shown in Table 13.

 Table 10
 Inter-rater
 agreement
 between
 first
 and
 second

 observer in SnF group and SA group pre- and post-therapy
 and post-therapy
 between
 between

	Group	A (SnF group)	Group	B (SA group)
	Карра	95% Cl	Карра	95% Cl
Pre-therapy				
A. Grade of dys- phonia	1.000	1.000 to 1.000	1.000	1.000 to 1.000
B. Voice quality	1.000	1.000 to 1.000	1.000	1.000 to 1.000
C. Voice pitch	0.952	0.859 to 1.000	1.000	1.000 to 1.000
D. Voice loudness	0.634	0.178 to 1.000	0.870	0.620 to 1.000
Post-therapy				
A. Grade of dys- phonia	0.800	0.625 to 0.975	0.647	0.378 to 0.916
B. Voice quality	0.896	0.688 to 1.000	0.793	0.522 to 1.000
C. Voice pitch	0.844	0.553 to 1.000	0.839	0.532 to 1.000
D. Voice loudness	1.000	1.000 to 1.000	1.000	1.000 to 1.000

Cl confident interval (kappa  $\leq$  0 indicated no agreement, 0.01–0.20 indicated none to a slight agreement, 0.21–0.40 fair agreement, 0.41–0.60 moderate agreement, 0 l.61–0.80 substantial agreement, and 0.81–1.00 almost perfect agreement)

 Table 11
 Intra-rater
 agreement
 between
 first
 and
 second

 reading of the first observer in SnF group and SA pre- and post-therapy
 SnF

	Group	A (SnF group)	Group	B (SA group)
	ICC	95% Cl	ICC	95% CI
Pre-therapy				
A. Grade of dys- phonia	1.000	1.000 to 1.000	1.000	1.000 to 1.000
B. Voice quality	1.000	1.000 to 1.000	1.000	1.000 to 1.000
C. Voice pitch	1.000	1.000 to 1.000	0.844	0.553 to 1.000
D. Voice loud-	1.000	1.000 to 1.000	1.000	1.000 to 1.000
ness				
Post-therapy				
A. Grade of dys- phonia	0.6968	0.4541 to 0.8432	0.8382	0.6878 to 0.9196
B. Voice quality	0.8621	0.7307 to 0.9319	0.8922	0.7862 to 0.9472
C. Voice pitch	1.000	1.000 to 1.000	1.000	1.000 to 1.000
D. Voice loud- ness	1.000	1.000 to 1.000	0.793	0.522 t o1.000

/CC intra-class correlation (1, perfect reliability;  $\geq$  0.9 excellent reliability; and  $\geq$  0.8 < 0.9, good reliability)

## Discussion

The purpose of this work was to study the effect of stretch-and-flow voice therapy (SnF) in comparison to Smith accent (SA) method of voice therapy in the rehabilitation of hyperfunctional dysphonia. The overall effectiveness of voice therapy was measured by the changes in auditory perceptual assessment (APA) and Arabic-voice handicap index (Arabic-VHI). Despite the availability of instrumental measures for precise quantification of voice problems, there is an increasing emphasis on incorporating subjective parameters in voice evaluation to better understand the impact of a vocal disorder [21]. The evaluation of quality of life is primarily conducted through questionnaires, specifically self-reported symptom-specific scales. These scales not only provide valuable information about quality-of-life issues but also shed light on functional abilities, as well as social and emotional domains [22].

In order to more accurately assess the handicap caused by a vocal disorder and its influence on an individual's quality of life, the Arabic-VHI is used [19].

Patients with hyperfunctional dysphonia were randomly assigned to one of the two study groups, including 30 patients in each arm, in a pilot randomized controlled trial (RCT).

SA is the main and most popular method among Egyptian phoniatricians as the current standard care for hyperfunctional dysphonia, served as the comparison group for stretch and flow (SnF). However, it was discovered that some patients struggled to adapt to the SA method's increasingly accentuated rhythms and melody, found it difficult to learn the abdomino-diaphragmatic breathing, or even felt dizzy and faced difficulty with generalization of the learned technique in everyday situation.

Despite the positive results associated with laryngeal hyperfunction methods of voice therapy that have been documented in the study literature, no single method was effective in every instance. This might be explained by the fact that there are many different causes and symptoms of laryngeal hyperfunction, and that more treatment choices and data-based reports are required [23].

In this clinical trial, the voice therapy was given a set of 6-week duration, after which the outcomes were assessed, whether voice therapy was continued beyond this timeframe or not, and whether or not a full resolution or acquisition of a healthy vocal practice had been achieved at that point or not.

The SnF group was supposed to be given at home exercises of the current skill level [14]. Unfortunately, in this study, the patients were unable to do it alone at home with worsening of the condition. So, these exercises were discontinued as it may require a greater number of sessions to trust the patient to do it alone at home.

The definition of effective voice therapy is heavily reliant on the evaluation methods employed to assess treatment outcomes. When treatment outcomes are monitored in a standardized manner, it leads to a clinically relevant change. So, determining effectiveness is rather simple [24].

Auditory perceptual assessment is commonly regarded as the benchmark for voice assessment procedures [15].

5 1						
Group A (SnF group)		Pre-therapy	Post-therapy	Test value	<i>p</i> -value	Sig.
Arabic-VHI						
Total score	Mean±SD	$77.10 \pm 10.30$	$17.30 \pm 5.76$	- 35.427	0.000	HS
	Range	59-92	8–25			
Functional domain	Mean±SD	$30.00 \pm 5.72$	$8.87 \pm 2.86$	- 18.259	0.000	HS
	Range	20-39	4–13			
Physical domain	Mean±SD	27.67±5.29	$3.27 \pm 1.60$	-23.189	0.000	HS
	Range	18–36	1–6			
Emotional domain	Median (IQR)	19.5 (16–23)	6 (4–9)	-4.786	0.000	HS
	Range	13–26	2-10			
Group B (SA group)		Pre-therapy	Post-therapy	Test value	<i>p</i> -value	Sig.
Arabic-VHI						
Total score	Mean ± SD	74.77±10.18	$15.20 \pm 5.09$	- 34.907	0.000	HS
	Range	57–90	6–22			
Functional domain	$Mean \pm SD$	$26.03 \pm 5.32$	$8.33 \pm 2.09$	- 16.233	0.000	HS
	Range	18–34	5-11			
Physical domain	Mean ± SD	$22.63 \pm 5.35$	4.33±2.41	- 17.528	0.000	HS
	Range	15-30	1–8			
Emotional domain	Median (IQR)	22 (19–26)	2 (1-2)	-4.790	0.000	HS
	Range	18–29	0-3			

 Table 12
 Comparison regarding the Arabic-VHI (total score, functional, physical and emotional domains) both pre- and post-therapy within each group

 Table 13
 Comparison between the Arabic-VHI in the two groups both pre- and post-therapy

Pre-therapy		Group A (SnF group)	Group B (SA group)	Test value	<i>p</i> -value	Sig.
Arabic-VHI						
Total score	$Mean \pm SD$	$77.10 \pm 10.30$	74.77±10.18	0.882	0.381	NS
	Range	59–92	57–90			
Functional domain	Mean±SD	$30.00 \pm 5.72$	$26.03 \pm 5.32$	2.780	0.007	HS
	Range	20–39	18–34			
Physical domain	Mean±SD	27.67±5.29	22.63±5.35	3.664	0.001	HS
	Range	18–36	15–30			
Emotional domain	Median (IQR)	19.5 (16–23)	22 (19–26)	-2.642	0.008	HS
	Range	13–26	18–29			
Post-therapy		Group A (SnF group)	Group B (SA group)	Test value	<i>p</i> -value	Sig.
Arabic-VHI						
Total score	Mean±SD	$17.30 \pm 5.76$	$15.20 \pm 5.09$	1.496	0.140	NS
	Range	8–25	6–22			
Functional domain	Mean±SD	8.87±2.86	$8.33 \pm 2.09$	0.824	0.413	NS
	Range	4–13	5–11			
Physical domain	$Mean \pm SD$	$3.27 \pm 1.60$	4.33±2.41	-2.020	0.048	S
	Range	1–6	1–8			
Emotional domain	Median (IQR)	6 (4–9)	2 (1–2)	- 5.788	0.000	HS
	Range	2–10	0-3			

The primary objective of voice therapy is to restore the patient's voice to a functional level that allows them to meet their daily voice and/or speech communication requirements [25]. In this study, we define improvement

of dysphonia as either the complete resolution of dysphonia and restoration of a normal voice or a reduction in the severity of dysphonia. In this study, there was significant improvement of grade of dysphonia in both groups. Dysphonia completely recovered within 6-week period of therapy in most of the patients (70% in SnF group and 83.3% in SA group). The remaining 30% and 16.7% respectively experienced an improvement as well, though not complete; their post-therapy dysphonia grade was less compared to their pre-therapy grade.

Moreover, there was a significant improvement of voice quality post-therapy in both groups. A total of 86.7% of the SnF group and 83.3% of the SA group reached normal voice quality. So, both voice therapy techniques were able to improve grade of dysphonia and voice quality comparably.

The results of our study are in accordance with Fex et al. [26] who studied the effects of SA method of voice therapy in treatment of ten patients with functional voice disorder and bilateral vocal nodules. According to the perceptual evaluation of voice, all patients had better voice quality post-therapy.

Another study by Kotby et al. [27] showed a decrease in patient's vocal complaints with improvement in auditory perceptual assessment of voice in 28 individuals with functional voice disorders, vocal nodules, and vocal fold paralysis.

In addition, a randomized controlled trial was conducted by McCullough et al. [23] involving six participants who displayed muscle tension dysphonia (MTD). These individuals underwent five sessions and were assessed before and after each session. The Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) was used to rate their voice quality at the start and conclusion of the treatment. The results showed a significant decrease in the mean overall severity scores based on the CAPE-V, with values decreasing from 43.00 to 10.33 after therapy.

Contradictory results were reported in a study by Watts et al. [28] where participants with primary MTD were randomly assigned to either the stretch-and -flow therapy or resonant voice therapy. Their results revealed no significant improvement of voice for both techniques.

In our study, there was significant improvement in pitch in the SnF group post-therapy, while there was no significant difference between the outcomes in the SA group. This might be attributed to the small number of patients with pitch abnormalities in the latter group rather than to the superiority of one therapy over the other. Moreover, there was significant improvement in loudness post-therapy in the SA group, but in the SnF group, no significant improvement was detected.

These findings can be ascribed to the fact that pitch and loudness are not equally represented in both groups in our situations with randomization, and so post-values cannot be securely compared to draw conclusions of superiority of one therapy over the other.

In our study, the nonsignificant difference pre-therapy between the two groups in the total scores of Arabic-VHI with significant difference in its three domains may be explained by the fact that Arabic-VHI is a subjective selfassessment tool that may vary within the same patient from day to day in the severity of symptoms in its different domains.

When comparing post-therapy results of the Arabic-VHI within each group, there was a high significant difference in total score, functional domain, and emotional and physical domain.

Emphasizing that physiologic voice therapy as SnF and SA seems to be effective in improving self-perceived voice in patients with hyperfunctional dysphonia. Also, the reciprocal interaction during the session in both therapy methods might have contributed to the improvement noticed especially in the emotional domain of VHI.

Also, describing the patient's voice problem or how the therapy program is intended to correct faulty vocal behaviors while the clinician and patient alternate productions in a turn taking manner, as the patient imitates the clinician's model [16].

Rangarathnam et al. [16] reported similar findings, indicating an improvement in voice-related quality-oflife measures (VHI ratings) for both groups with hyperfunctional dysphonia. The first group received SnF therapy and individualized vocal hygiene education for 12 sessions over a 6-week period, while the second group received vocal hygiene education only for 3 weeks (six sessions), followed by an additional 3 weeks (six sessions) of both vocal hygiene instruction and flow phonation therapy.

Similarly, Watts et al. [14] found a significant improvement in VHI results among participants with hyperfunctional dysphonia who received stretch-and-flow voice therapy sessions once weekly for 6 weeks.

Othman et al. [8] conducted a similar trial in which the first 25 patients received resonance tube method of voice therapy, and the second 25 patients received SA method of voice therapy. Although there were differences in the post-therapy outcomes of the two groups, but this improvement was with no statistically significant difference. In the highlight of some of the limitations seen in this study, some future recommendations have been suggested as follows:

- Larger controlled clinical trials with longer duration
   of follow-up
- Further studies with modifications to the frequency and duration of SnF voice therapy sessions could be done for better compliance as minimizing the dura-

tion of the 60-min session which was noticed to be long time to be tolerated by the patients. So, 30-min sessions twice per week could be tried instead.

- Further randomized control trials on the effect of SnF on other nonorganic (functional) voice disorders as phonasthenia or benign vocal fold lesions are recommended.
- Further studies investigating other objective tools as acoustic analysis of voice and aerodynamic measures
- Studying other variables that may affect the outcomes as the type of patient, gender, occupations, education, and duration of dysphonia and severity of symptoms

## Conclusion

SnF can be considered as an alternative approach for treating hyperfunctional dysphonia, offering a shorter duration, and potentially being a simpler alternative for patients who struggle with the more intricate rhythms of the Smith accent voice therapy method.

#### Abbreviations

Auditory perceptual assessment		
Arabic-voice handicap index		
W		
n dysphonia		
djustment therapy		
ditory-Perceptual Evaluation of Voice		

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#### Authors' contributions

RMS made the design of the work. YHE made the analysis and interpretation of the study. DMM collected and tabulated the data. HME wrote the manuscript and shared in analyzing the results. All authors read, revised, and approved the final manuscript.

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#### Availability of data and materials

The data used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

#### Ethics approval and consent to participate

An informed consent has been obtained from the participants recruited in the current research. The confidentiality, as well as the privacy of participants, was guaranteed. During the study design process, deceptive methods were excluded. The subjects had the option not to complete the research at any time. The Ain Shams Institute's Ethical Committee of Human Research (reference number: FWA000017585) approved this research; the approval number is FMASU M D 539/2020.

#### **Consent of publication**

Not applicable.

#### **Competing interests**

The authors declare that they have no competing interests.

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