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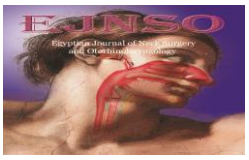

Management of Dysphonia in Children with Minimal Associated Pathological Lesions (Surgical Treatment versus Voice Therapy)

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Abstract:

Objectives: The prevalence of childhood dysphonia has varied from 6–9% in some reports to 38% in others. Dysphonia, especially the chronic type, harmed children's quality of life, many treatment modalities for benign vocal fold lesions have been present, including surgical management and voice therapy as well as medical treatment according to the condition, the study aimed to compare the outcome of voice therapy versus surgical therapy of VFs (vocal folds) nodules and cysts among children.

Patients and methods: A prospective cohort study was conducted, containing two groups, a voice therapy group (40 patients) and a surgical group (20 patients), auditory perceptual assessment (APA), stroboscopy, and acoustic analysis were done at baseline and post-treatment assessments.

Results: Vocal fold nodule is the underlying pathology in two-thirds of included patients followed by vocal fold cysts (33.3%). In the baseline assessment, both studied groups had matched findings with non-significant differences, also, both groups showed a large glottal gap in the baseline assessment. Meanwhile, in post-treatment assessment, reduced glottal gab was noted similarly in both groups, but APA measures had better results in the voice therapy group, also it is more aperiodic. While the acoustic analysis was non-significant between both groups post-treatment, both groups recorded a post-treatment improvement in all measures. Still, unfortunately, the surgical group recorded 4 complicated cases (20%) including synechiae.

Conclusions: vocal folds nodules and cysts are common among children, and both voice therapy and surgical treatment are effective with some superiority for voice therapy. Avoidance of surgical complications is another advantage.

Keywords: Vocal folds lesions, Egyptian children, Voice therapy, Surgical treatment

Introduction

The voice is considered a finger print that shares in formulation of our identity and provides uniqueness. Also, the voice is the primary communication tool for humans. [1, 2]

Benign vocal fold lesions (BVFL) frequently affect the general population and cause significant hoarseness by interfering with daily communication. [3]

Voice disorders affect around 5-million children around the world, of which at least 35-78% of children have vocal nodules or suffer from dysphonia, with a higher incidence in males. It is noteworthy that pediatric cases who suffer from vocal disorders often find it difficult to express themselves adequately. It often leads to

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underdeveloped communication skills and psychosocial disabilities that are often associated with low self-esteem. [4]

Studies also show children with unresolved voice disorders usually affect the child quality of life, relations and communications, and also interfere with his potential dreams related to voice, furthermore, it can require additional ongoing treatment into adulthood, placing a substantial burden on child, his family and the medical system in the form increasing health cost. [5]

Egyptian studies reported different values for the rate of dysphonia among children, one of them revealed that, prevalence of school aged children dysphonia was 12.4% [6] , but another one reported 2.4% voice disorders among children. [7]

Organic laryngeal diseases are common in adults and children, Vocal fold nodules (VN) represent the most frequent cause of dysphonia in childhood, and diagnosed by laryngostroboscopy. [8]

Benign Vocal folds lesions can be treated by surgical removal but ,in many occasions,non-surgical voice therapy interventions could be used (e.g., voice re-training, rest or hygiene advice) or medical/pharmacological therapy of underlying causes (infections, allergy or gastroesophageal reflux).

Voice therapy is the established treatment for vocal fold nodules and is traditionally listed as a first-line therapy for benign vocal fold lesions, with surgical excision reserved for treatment failure [9] but treatment modalities are ranging from indirect or direct voice therapy to surgical treatment. [10]

There is significant controversy over the effectiveness of surgery in the management of vocal folds nodules. Surgical excision of nodule was the standard method of management, but with better understanding of vocal function, more conservative non-surgical treatment modalities have been developed and are now considered the primary treatment of choice. Rates of surgical intervention in pediatric cases vary widely and the exact criteria for selection of surgical intervention are not clearly defined. [11] In Egypt, children with benign vocal fold lesions, surgical treatment is still considered primarily in many cases. [12-13]

This necessitates comparing the results of both treatment protocols (voice hygiene & voice therapy) versus surgical excision, using both subjective and objective measures for pre & post management assessment.

This study aimed to compare voice therapy approach with surgical treatment of dysphonia among children with some benign vocal fold lesions.

Patients and methods:

A follow up observational study was conducted in Phoniatric unit, Otorhinolaryngology Department, Menoufia university hospital for selection of voice therapy group and surgical group respectively, during the period from the first of July 2022 to the end of December 2022

Ethical approval: the study was approved by research ethics committee, faculty of medicine, Menoufia University. An informed consent was taken from each patient's guardian.

Inclusion criteria: all patients with unilateral or bilateral vocal fold cyst or nodules, having normal hearing and language skills were included in this study.

Exclusion criteria: Patients with vocal fold lesions other than cysts and nodules; suffering from acute or chronic respiratory tract infections, Bronchial asthma, COPD, nasal allergy and hypothyroidism were excluded from the study.

Allocation of patients: voice therapy group was selected as follows.

All patients who met inclusion and exclusion criteria of the study were asked to be study participants and started the voice therapy either indirect or direct method:

Direct voice therapy comprises vocal function exercises, resonance therapy, and semi-occlusion of the vocal tract.

Indirect voice therapy is more focused on altering the psychology and behavior of the patient and their surrounding environment. It mainly involves educating and counseling the patients regarding maintaining a healthy and hygienic vocal system and its advantages.

Surgical group: surgical cases were chosen when vocal folds nodules had features which indicate surgical intervention like fibrotic nodules or loss of stroboscopic waves or asymmetrical nodules, deeply whitish, absent mucosal wave, base >2mm and high >0.9mm, also some parents when didn't notice fast obvious improvement on voice therapy, they seek for surgical therapy.

A total number of 60 children with chronic dysphonia related to nodule or cyst were selected and allocated as follows (figure 1):

Methodology

The study methodology was performed in 3 stages

Stage 1: initial assessment

Clinical examination: personal and clinical history was taken.

Laryngoscopic examination: fiberoptic laryngoscopy was performed to evaluate vocal fold anatomy and appearance to diagnose the lesion.

Auditory perceptual assessment (APA): By careful listening to the child's voice using modified GRBAS scale [(G) Overall Grade, (R) Rough, (B)Breathy, (A) Athenic and (S) Strained] with 4 grades from 0 (normal) to 3 (severe dysphonia) for determining grade and character of dysphonia. [14]

Examination with a stroboscope: it provides additional information about the vibratory and closure patterns of the vocal folds and helps excluding other vocal fold pathology. Stroboscopy is considered a necessary preoperative examination. Vocal fold imaging by video laryngoscopic examination using rigid 90° laryngoscope along with stroboscopy to appreciate the mucosal waves. [15]

Acoustic analysis: it assesses fundamental frequency disturbance indices that included Jitter percent (Jitt), Shimmer (shim), amplitude perturbation quotient (APQ), Pich perturbation quotient (PPQ) and Harmonic to Noise Ratio (HNR). Acoustic and aerodynamic criteria alone cannot be used for diagnosis, although improvements in certain parameters, with return towards normal values, can be taken as a sign of response to intervention. [16] As many patients did not have surgery, a clinical diagnosis may not have been confirmed by histological examination.

Stage 2: intervention stage

Voice therapy group: either direct or indirect

Indirect voice therapy: it is used for children less than 5 years; this approach focuses on eliminating behaviors that are potentially harmful to the vocal mechanisms including voice rest and reduction of voice abuse.

Direct voice therapy: it is used for children age ranged from 5 – 16 years. Smith accent method, breathing & relaxing exercise, that were modeled as 2 sessions a weak for 2 – 3 months.

Surgical group

Laryngeal phono-microsurgery was done under general anesthesia. The surgeon introduced the laryngoscope for laryngeal exposure while the neck flexed and head extended. Then the

larynx was suspended with upward and anterior pressure to allow for optimal visualization of the larynx. The micro flap was the used surgical approach.

The incision is typically made using a sickle knife placed immediately lateral to, or directly over, the area of pathology, a fine micro-scissor may be used to enter the submucosal plane. Following the incision, a blunt curved elevator can be used to dissect between the epithelium and the location of the subepithelial pathology. Contents of the lesion (nodule or cyst) are removed using blunt and sharp dissection. The mucosal flap is draped back down and excess epithelium is trimmed with an upward curved micro scissor.

Stage 3: Assessment of the outcome

Post-treatment assessment was done by repetition of pre- treatment assessment after 3 months.

Statistical analysis

Data were transferred to a personal computer, classified, and analyzed using SPSS (version 20, SPSS Inc., Illinois, and Chicago, USA).

The quantitative data was described as mean, standard deviation and range while qualitative data was described as number and percentage. t-test and Mann Whitney U test were used to compare quantitative data of two independent groups that was normally distributed and not normally distributed respectively.

Paired t test and Wilcoxon signed rank test were used to compare pretest and posttest measures for normally distributed and not normally distributed respectively. Chi square test was the test of qualitative data comparison. P-value <0.05 was considered statistically significant

Results

This study was conducted during the period from the first of July 2022 to the end of December 2022, the cases were selected from attendants of phoniatric unite (voice therapy group) that included 40 patients, and (Surgical group) was selected from pediatric patients were admitted in ENT department for surgical excision of vocal folds nodule; it included 20 cases. The age of the studied groups had average age 7.47±2.06& 11.86±3.41 for voice therapy and surgical groups respectively with significantly higher age in surgical group, there was non-significant difference between both groups regarding sex distribution and definitive diagnosis, also in voice therapy group, 4 cases (10%) were treated by indirect voice therapy, those cases represented the younger age group ranged from 3.9 – 4.6 years (table 1).

Glottal gab was observed in patients of both groups and reduced significantly in both treatment modalities with non-significant difference between both groups either in pre or post treatment assessment (table 2).

All APA measures were non-significant in pretreatment values between both voice therapy group and surgical group, while voice therapy showed better results than surgical group in all APA in post treatment measures, in each study group, there was significant improvement in post treatment measures (table 3).

In pretest assessment in voice therapy and surgical groups, all cases had incomplete glottic closure, asymmetrical motion, absent mucosal wave, reduced amplitude, and aperiodicity. Post treatment measures were significantly better in voice therapy group regarding periodicity. All stroboscopic measures improved in post treatment measures in both studied groups (table 4).

Table 5 showed acoustic analysis among both studied groups, there were non-significant difference between both voice therapy and surgical groups in pretest and posttest measurements regarding Jitter percent, PPQ, Shimmer percent, APQ and NHR, while, all measurements showed significantly lower values in post treatment than in pretest results in both studied groups.

Complications was noted in surgical group in 4 cases (20%), 2 cases (10%) showed post operative synechiae (fig, 2) and 2 cases (10%) were complicated by scar.

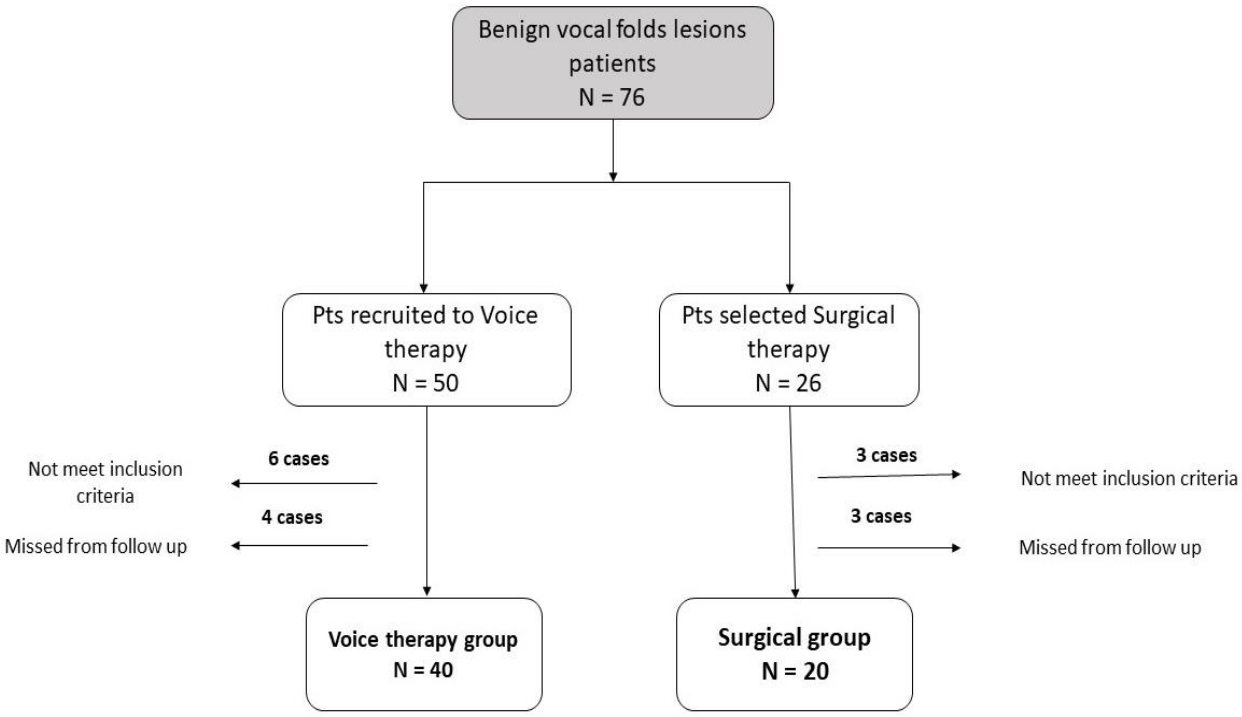

Fig 1: Flow chart demonstrating patients' recruitment in the study

Table 1: Personal and clinical data among the studied groups

	Voice therapy N = 40	**Surgical N = 20**	Total	Test	P value
Age (years)				t-test	
Mean ±SD	7.47±2.06	11.86±3.41	8.93±3.30	6.20	<0.001
Range	3.9 – 13	7.1 – 17.3	3.9 – 17.3		
Sex [n (%)]				χ^2	
Male	22 (55.0)	12 (60.0)	34 (56.7)	0.14	0.71
Female	18 (45.0)	8 (40.0)	26 (43.3)		
Diagnosis				χ^2	
Right VF cyst	1 (2.5)	0 (0.0)	1 (1.7)	5.31	0.26
Left VF cyst	5 (12.5)	2 (10.0)	7 (11.7)		
VF cyst with reaction	4 (10.0)	4 (20.0)	8 (13.3)		
Bilateral VFs cyst	1 (2.5)	3 (15.0)	4 (6.7)		
Bilateral VFs nodule	29 (72.5)	11 (55.0)	40 (66.7)		
Type of therapy				χ^2	
Indirect therapy	4 (10.0)	0 (0.0)	4 (6.7)	60.0	<0.001
Direct therapy	36 (90.0)	0 (0.0)	36 (60.0)		
Surgical	0 (0.0)	20 (100)	20 (33.3)		

SD = standard deviation, χ^2 = chi square test,

Table 2: glottal gab among the studied groups in pre and post treatment assessment

	Voice therapy		**Surgical**		Test	P value
	Pre	**Post**	**Pre**	**Post**	t-test	
Glottal gap					0.75a	0.25[1]
Mean ±SD	0.88±0.11	0.46±0.14	0.90±0.11	0.43±0.09	0.24a	0.81[2]
Range	0.7 – 1	0.3 – 0.7	0.7 – 1	0.3 – 0.6	14.92c	<0.001[3]
					14.79c	<0.001[4]

a= student-t test, b= Mann Whitney U test, c= paired t test, d = Wilcoxon signed rank
1 = comparing pre-test in voice therapy and surgical groups
2 = comparing post-test in voice therapy and surgical groups
3= comparing pre-test and post-test in voice group
4= comparing pre-test and post-test in surgical group

Table 3: Auditory perceptual assessment (APA) among the studied groups in pre and post treatment assessment

APA	Voice therapy		Surgical		Test	P value
	Pre	Post	Pre	Post	X^2	
Grade					2.81	0.09[1]
1	0 (0.0)	27 (67.5)	0 (0.0)	9 (45.0)	9.15	0.01[2]
2	27 (67.5)	13 (32.5)	9 (45.0)	7 (35.0)	44.9	<0.001[3]
3	13 (32.5)	0 (0.0)	11 (55.0)	4 (20.0)	12.52	0.002[4]
Breathiness					----	----[1]
0	40 (100)	40 (100)	20 (100)	20 (100)	-----	-----[2]
					-----	-----[3]
					-----	-----[4]
Roughness					2.81	0.09[1]
1	0 (0.0)	27 (67.5)	0 (0.0)	9 (45.0)	9.15	0.01[2]
2	27 (67.5)	13 (32.5)	9 (45.0)	7 (35.0)	44.9	<0.001[3]
3	13 (32.5)	0 (0.0)	11 (55.0)	4 (20.0)	12.52	0.002[4]
Leakiness					2.81	0.09[1]
1	0 (0.0)	27 (67.5)	0 (0.0)	9 (45.0)	9.15	0.01[2]
2	27 (67.5)	13 (32.5)	9 (45.0)	7 (35.0)	44.9	<0.001[3]
3	13 (32.5)	0 (0.0)	11 (55.0)	4 (20.0)	12.52	0.002[4]
Straining					2.81	0.09[1]
1	0 (0.0)	27 (67.5)	0 (0.0)	9 (45.0)	9.15	0.01[2]
2	27 (67.5)	13 (32.5)	9 (45.0)	7 (35.0)	44.9	<0.001[3]
3	13 (32.5)	0 (0.0)	11 (55.0)	4 (20.0)	12.52	0.002[4]
Pitch					2.81	0.09[1]
1	0 (0.0)	27 (67.5)	0 (0.0)	9 (45.0)	9.15	0.01[2]
2	27 (67.5)	13 (32.5)	9 (45.0)	7 (35.0)	44.9	<0.001[3]
3	13 (32.5)	0 (0.0)	11 (55.0)	4 (20.0)	12.52	0.002[4]
Loudness					2.81	0.09[1]
1	0 (0.0)	27 (67.5)	0 (0.0)	9 (45.0)	9.15	0.01[2]
2	27 (67.5)	13 (32.5)	9 (45.0)	7 (35.0)	44.9	<0.001[3]
3	13 (32.5)	0 (0.0)	11 (55.0)	4 (20.0)	12.52	0.002[4]

a= student-t test, b= Mann Whitney U test, c= paired t test, d = Wilcoxon signed rank
1 = comparing pre-test in voice therapy and surgical groups
2 = comparing post-test in voice therapy and surgical groups
3= comparing pre-test and post-test in voice group
4= comparing pre-test and post-test in surgical group

Table 4: Stroboscopic assessment among the studied groups in pre and post treatment assessment

Stroboscopic assessment	**Voice therapy**		**Surgical**		Test	P value
	Pre	**Post**	**Pre**	**Post**	X^2	
Glottic closure					2.03	0.15[1]
Complete	0 (0.0)	27 (67.5)	1 (5.0)	11 (55.0)	0.90	0.34[2]
Incomplete	40 (100)	13 (32.5)	19 (95.0)	9 (45.0)	40.75	<.001[3]
					11.9	0.001[4]
Symmetrical motion					----	-----[1]
Symmetrical	0 (0.0)	29 (72.5)	0 (0.0)	13 (65.0)	0.36	0.55[2]
Asymmetrical	40 (100)	11 (27.5)	20 (100)	7 (35.0)	45.5	<0.001[3]
					19.26	<0.001[4]
Mucosal wave					----	-----[1]
Present	0 (0.0)	27 (67.5)	0 (0.0)	11 (55.0)	0.90	0.34[2]
Absent	40 (100)	13 (32.5)	20 (100)	9 (45.0)	40.75	<0.001[3]
					15.17	<0.001[4]
Amplitude					----	-----[1]
Normal	0 (0.0)	25 (62.5)	0 (0.0)	11 (55.0)	0.17	0.68[2]
Decreased	40 (100)	15 (37.5)	20 (100)	9 (45.0)	36.36	<0.001[3]
					15.17	<0.001[4]
Periodicity					----	-----[1]
Periodic	0 (0.0)	27 (67.5)	0 (0.0)	8 (40.0)	4.15	0.04[2]
Aperiodic	40 (100)	13 (32.5)	20 (100)	12 (60.0)	40.75	<0.001[3]
					10.0	0.002[4]

1 = comparing pre-test in voice therapy and surgical groups
2 = comparing post-test in voice therapy and surgical groups
3= comparing pre-test and post-test in voice group

4= comparing pre-test and post-test in surgical group

Table 5: Acoustic analysis among the studied groups in pre and post treatment assessment

Acoustic analysis	Voice therapy		Surgical		Test	P value
	Pre	Post	Pre	Post		
Jitter percent (Jitt)					0.02b	0.99[1]
Mean ±SD	1.90±0.71	0.91±0.18	1.85±0.65	1.18±0.69	0.48b	0.63[2]
Range	1.11 – 3.72	0.44 – 1.22	1.11 – 3.7	0.56 – 3.2	5.51d	<0.001[3]
					3.85d	0.001[4]
Pich perturbation quotient					0.25b	0.80[1]
(PPQ)	1.48±0.53	0.54±0.22	1.48±0.63	0.84±0.69	0.71b	0.48[2]
Mean ±SD	0.67 – 2.54	0.26 – 1.13	0.73 – 2.54	0.26 – 2.17	5.51d	<0.001[3]
Range					3.64d	<0.001[4]
Shimmer percent (Shim)					1.46a	0.15[1]
Mean ±SD	3.81±0.69	2.70±0.17	3.53±0.75	2.78±0.58	0.56a	0.58[2]
Range	2.89 – 5.55	2.22 – 2.91	2.68 – 4.77	2 – 4.55	11.14c	<0.001[3]
					4.63c	<0.001[4]
Amplitude perturbation					1.63a	0.11[1]
quotient (APQ)	2.84±0.54	1.82±0.17	3.08±0.50	1.92±0.39	1.46a	0.15[2]
Mean ±SD	2 – 4.01	1.4 – 1.98	2.28 – 3.75	1.4 – 3.16	11.29c	<0.001[3]
Range					7.69c	<0.001[4]
Harmonic to Noise Ratio					1.07a	0.30[1]
(NHR)	0.14±0.006	0.12±0.005	0.15±0.06	0.12±0.008	0.36b	0.72[2]
Mean ±SD	0.13 – 0.15	0.11 – 0.14	0.13 – 0.39	0.11 – 0.14	17.99c	<0.001[3]
Range					3.95d	<0.001[4]

a= student-t test, b= Mann Whitney U test, c= paired t test, d = Wilcoxon signed rank

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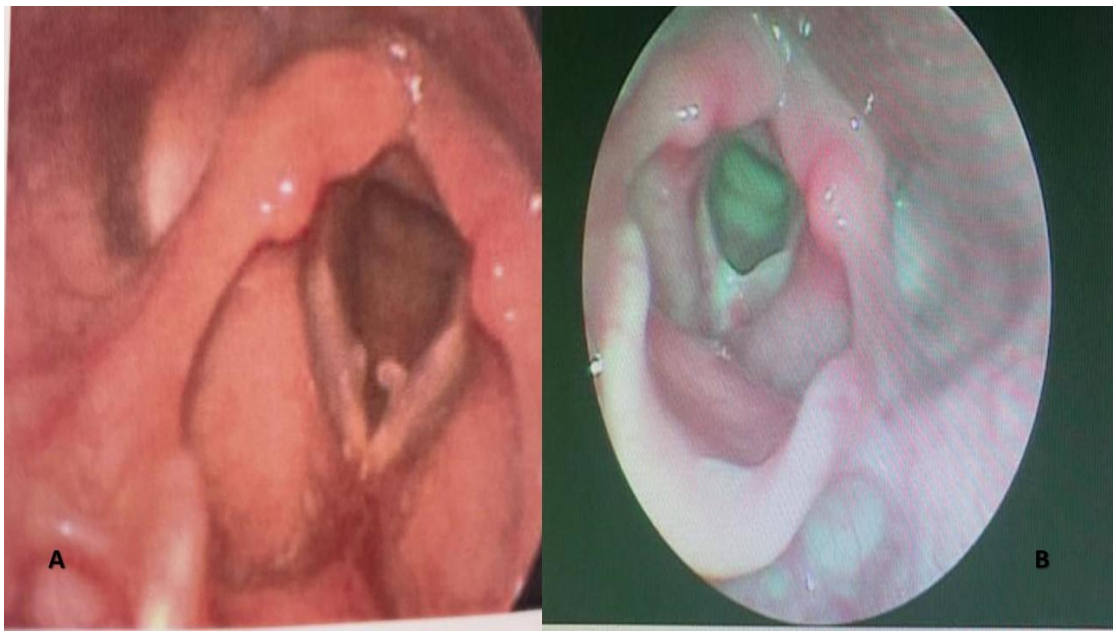

Figure 2: A: preoperative: bilateral vocal folds nodules that later on, subjected to surgical excision**.** B: post-operative: on laryngeal telescopic examination, there was synechiae between anterior thirds of both vocal folds. Ten-year male child 10. He had bilateral vocal folds nodules that subjected to surgical excision and on laryngeal telescopic examination post-operatively, there was noted synechiae between anterior thirds of both vocal folds.

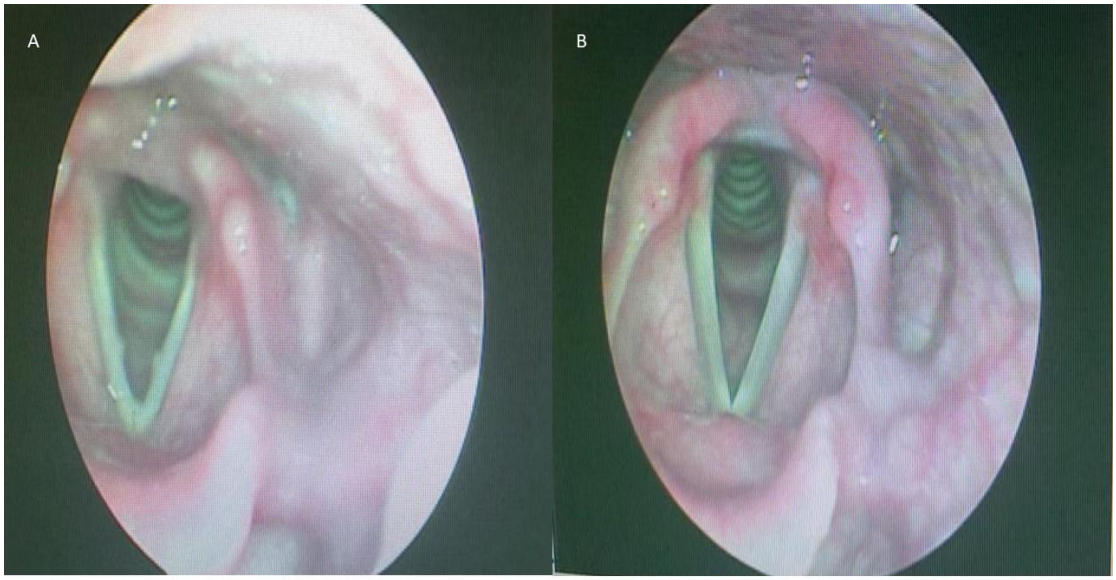

Figure 3 Seven-year male child had chronic childhood dysphonia with bilateral VFs nodules that subjected to surgical excision with excellent result and significant improvement of the voice quality

Discussion:

Benign vocal fold lesions among children are common disabling disorder that affects functional and social aspects of child's life. [17]

The best method for management of such lesions among children is still controversial as almost all studies that evaluate different treatment modalities reported post treatment improvement. [18, 19]

But some meta-analysis concluded that there is a need for well-designed research, especially randomized controlled trials to clarify the superiority of a treatment modality, if any. [13, 20]

The results of this work revealed improvement after both treatment modalities (voice therapy and surgical excision). Similar results were found in several studies, **Murry &Woodson, 1992**[18] reported satisfactory improvements after voice therapy, surgical treatment and combined surgical and voice therapy and they gave superiority for voice therapy method to avoid potential complications of surgery and, also reported that the removal of vocal fold nodules is indicated only after other approaches fail to produce the desired results. Also, **Palash et al, 2022** [21] encountered a significant improvement after treatment in surgical and non-surgical groups. but **Agarwal et al, 2019** [22] explored that, patients experienced greater short-term improvement through surgery employed alone or in combination with voice therapy (mean improvement 12.5 and 12.3, respectively) than with voice therapy alone (mean improvement 2.84), this may be attributed to that the study was performed on vocal fold polyps which weren't included in our study.

Glottal gap area is located at the most closed point of vibration, it was assessed by laryngoscopy, in the current work, in addition to the minimal organic lesions that was detected, also, enlarged sized glottal gab was observed, coincident results were reported by **Patel at al.,** 2016 [23], this reflects probable functional impact of minimal VFs lesions that

produce abnormal cyclic movement and incomplete closure during glottal cycle.

APA assessment

In voice therapy group, there was a significant post therapy improvement in all APA measures. These results run in line with **Şenkal & Çiyiltepe, 2013** who evaluated the effect of voice therapy on school age children with dysphonia and found a significant post-operative improvement using (GRBAS) scale. [4] Another study documented an improvement in items of GRBAS scale (the grade, roughness, breathiness, asthenia& strain) [24], as well as, **Braden et al 2020** [25] found a statistically significant difference in perceptual ratings of voice quality.

Post therapy improvement also noted in surgical group regarding all perceptual rating measures, this also was noted in most studies included in meta-analysis on outcome of surgical treatment of benign VF lesions [26], but a controversial outcome with 90% post-operative subjective improvement was reported by **Landa et al, 2017** [27].

APA measuresshowed better results in voice therapy group than in surgical group in post-treatmentassessment regarding (grade, roughness, leakness, straining, pitch and loudness).

Stroboscopic examination demonstrated an improvement in its measures in both studied groups, similar results were noted by multiple studies. [4, 26]

On comparing voice therapy group with surgical group, there was a better periodicity in voice therapy group with no difference in other stroboscopic measures - Periodicity refers to the regularity of successive vocal vibratory cycles. Normal vibratory activity is regular and periodic [28] - this may indicate probable post-operative affection of vocal fold vibratory movement.

Acoustic analysis

Acoustic analysis showed post therapy improvement in both studied groups, with non-significant difference between voice therapy group and surgical group**. Saltürk et al 2019** [24] found that Shimmer and Jitter measurement showed an improvement after 6 and 8 weeks of voice therapy.

In surgical group, short term complications were reported in 20% of cases with 10% synechiae and 10% scar formation, one of synechiae cases was bilateral vocal fold nodule and underwent bilateral surgical excision of the nodules in the same session; this predisposed to synechiae formation. **Landa et al, 2017** [27] encountered, no complicated cases after surgical removal of lesion. The vocal fold mucosa in children was documented as less well developed, so it is more prone for undesired surgical sequalae. [29]

Conclusion:

Benign vocal fold lesions are common among children that had disabling functional and social effects, the most common treatment modalities are voice therapy either direct and indirect and surgical treatment. Despite the preference of voice therapy by guidelines specially in childhood lesions, but still surgical treatment is present as a primary treatment option in Egypt. Both studied treatment modalities recoded significant improvement in voice quality parameters but voice therapy is beneficiary among children to avoid the potential risk of post-surgical complications.

Limitations

- The size of the study is small in terms of the number of cases included. A larger study may give more validity to the conclusions.

- Compliance of patients for voice therapy and suggested lifestyle modifications was variable. This had an impact on the results of the study.
- Long follow up is not available to trace recurrence rate in both groups.

Funding support: Our study did not receive any funding support.

Conflicts of interest: No

Reference:

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