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Research Article

Diathermy versus surgical technique methods of adenotonsillectomy and its effect on voice in children

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Abstract
Background: The vocal tract, which starts from the glottis and extends to the lips is considered as a resonator for speech production. Enlarged palatine tonsils may cause hypernasal speech, oral breathing, or muffled voice. Adenotonsillectomy is the most common surgery performed by otolaryngologists, especially in children. To assess different possible surgical factors of adenotonsillectomy that can affect speech and voice of children with hypertrophy palatine tonsils and nasopharyngeal adenoid. **Methods:** This is a prospective study that was done on 100 children selected randomly, ranging in age between 3-13 years, all the cases were suffering from recurrent attacks of pharyngitis, fever, nasal obstruction, and mouth breathing indicated for adenotonsillectomy in the department of otorhinolaryngology El-Minia University hospital. **Results:** Children were undergone adenotonsillectomy operation either by diathermy or surgical techniques show no significantly different effect on their voice postoperatively. **Conclusion:** Regardless of different techniques of adenotonsillectomy as diathermy or surgical technique could cause differences in the voice and speech postoperatively in children.

Key Words: Adenotonsillectomy, hypernasality voice

Introduction
The vocal tract, which starts from the glottis and extends to the lips is considered as resonator for speech production. Enlarged palatine tonsils may cause hypernasal speech, oral breathing or muffled voice [(1,2).]

The voice is basically a product of three physiological processes: 1) constant expiratory airflow controlled by chest muscles. 2) production of glottal sound through vibration of the vocal folds. 3) change in this sound with amplification and muffling of sound frequencies resulting from the action of pharyngeal, oral and nasal resonant structures (vocal tract) [(3,4).]
Adenotonsillectomy is the most common surgery performed by otolaryngologists especially in children. Among the most frequently voiced concerns regarding this procedure are questions about changes in vocal patterns after surgery and whether they are temporary or permanent. It is also reported that adenoid and tonsil hypertrophy cause obstruction of the nasopharyngeal region and a decreased mobility of velopharyngeal muscles (i.e. soft palate).

Although it is the most studied, nasality is not the only form of voice alteration that can occur after adenotonsillectomy. With vocal tract modification, there can be changes in voice quality due to phonation instability as a consequence of changes in the vibration pattern of the vocal folds [(3)].

There are number of techniques of tonsillectomy and can be grouped as cold and hot. Cold methods (No heat is used) include dissection, guillotine, partial tonsilectomy with microdebrider, harmonic scalpel, plasma mediated ablation and cryosurgery. Hot methods include electro-cautery, laser, coblation and radio-frequency [(5,6)].

Common risks reported with these operations include but are not limited to bleeding, infection, and velopharyngeal insufficiency (VPI). VPI is defined as

improper closure of the velopharyngeal sphincter during speech such that the soft palate is unable to reach the posterior and lateral aspects of the pharynx. Improper nasopharyngeal closure leads to hypernasal speech due to abnormal nasal air emission (NAE) and in some cases nasal regurgitation of food and beverages [7,8,9].

Methods

Subjects and Study Design

The present study was done to evaluate surgical factors affecting speech and voice outcomes after adenotonsillectomy in pediatric patients the study sample is composed of 100 children those were divided in two groups

Group 1 who composed of 50 child, they were operated by surgical cold dissection technique.

Group 2 who composed of 50 child, they were operated by bipolar diathermy

The study sample composed of 100 children all of them had adenotonsillar hypertrophy, group 1 were operated with surgical dissection 20 male (39.20%), 30 female (60.8%) and group 2 were operated with bipolar diathermy 27 male (57.4%), 23 female (42.6%) ranging in age (2-13).

Assessment method

All patients were subjected to

I- Preliminary Diagnostic Procedures

1) Full E.N.T. history

Taking Recurrent attacks of tonsillitis at least seven episodes in the previous year, at least five episodes in each of the previous two years, or at least three episodes in each of the previous three years. Choronic tonsillitis causing persistent enlarged juglo-diagastric lymph nodes, persistent hallitosis not responsive to medical treatment, septic focus, rheumatic fever or glomerul-onephritis.

Nasal obstruction causing snoring and sleep apnea.

Adenoid facies

2) Full E.N.T. examination.

3) Subjective auditory perceptual assess-ment "APA" of both speech and voice. (preoperative and post-operative 1 month and post-operative 3 month)

II- Clinical Diagnostic Aids:

1) Acoustic analysis:

This study aims to find out the results of measurement of fundamental frequency, jitter, shimmer and harmonic to noise ratio in children to make accurate measurements of the proper voice in children for use in the diagnosis and follow-up the patient's voices before and after one month of surgery.

Data collection was carried out in a sound treated room during the morning and before 12 pm to avoid errors due to sound fatigue. Using Multidimensional voice program software, at Phoniatrics Unit at Minia University Hospital. The microphone used was kept at a fixed distance of 10 cm in front of the subject's mouth. We used the sustained vowels /a/e/u in a comfortable and habitual way, after deep inhaling.

The multi-dimensional voice profile, MVDP, provides a comprehensive analysis of continuous vowel sounds. In order to analyze the samples, we used the time of 3-6 seconds, and irregularities in both the beginning and end of the vowel uttering were eliminated. These vowels were analyzed as to their acoustic parameters: fundamental frequency (Hz), jitter (%), shimmer (dB) and noise-harmony ratio (NHR) (dB).

2) flexible fibro optic nasopharynx-goscopy

Results

The present study was done to evaluate surgical factors affecting speech and voice outcomes after adenotonsillectomy in pediatric patients. the study sample is composed of 100 children those were divided in two groups

Group 1 who composed of 50 child, they were operated by surgical cold dissection technique. Group 2 who composed of 50 child, they were operated by bipolar diathermy.

1) Descriptive:

Table (1): Distribution of age and sex of cases.

	Surgical dissection N=50	Diathermy N=50	p value
Sex			
Male	20(39.2%)	27(57.4%)	0.136
Female	30(60.8%)	23(42.6%)	
Age			
Mean ± SD	7.3 ± 2.6	7.2 ± 2.3	0.97
median	7	7	

The study sample composed of 100 children all of them had adenotonsillar hypertrophy, group 1 were operated with surgical dissection 20 male (39.20%), 30 female (60.8%) and group 2 were operated with bipolar diathermy 27 male (57.4%), 23 female (42.6%) ranging in age (2-13) with Mean ± SD 7.3 ± 2.6 for group 1 and Mean ± SD 7.2 ± 2.3 as shown in table (1).

2) Comparative study

Auditory perceptual assessment(APA) of voice :

Table (2): Distribution of the APA of voice

	Surgical dissection (50)	Diathermy (50)	p value*
APA Of Voice preoperative:			
No dysphonia	**36 (70.6%)**	**35 (70%)**	**0.999**
G1	**9(19.6%)**	**10 (20%)**	
G2	**5 ((9.8%)**	**5 (10%)**	
APA Of Voice 1 month post operative:			
No dysphonia	39 (76.5%)	37 (74%)	0.956
G1	9 (19.6%)	11 (22%)	
G2	2 (3.9%)	2 (4%)	
APA Of Voice 3 months post operative:			
No dysphonia	40 (78.4%)	38 (76%)	0.829
G1	9(19.6%)	10 (20%)	
G2	1 (2%)	2 (4%)	

Statistical comparison between pre-operative, postoperative 1month and postoperative month 3 as regards auditory perceptual assessment of voice (APA of voice) insignificant differences were obtained between two groups as regard APA of voice as

Preoperatively: there were 36 patients (70.6%) with no dysphonia, 9 patients (19.6%) with dysphonia grade 1, 5 patients (9.8%) with dysphonia grade 2 were operated by surgical dissection as in group 1.
There were 35 patients (70%) with no dysphonia, 10 patients (20%) with dysphonia grade 1, 5 patients (10%) with dysphonia grade 2 were operated by bipolar diathermy as in group 2.
There was insignificant difference were obtained between 2 groups as (p value 0.136)

Postoperatively 1 month: there were 39 patients (76.5%) with no dysphonia,9 patients with dysphonia grade 1, 2 patients (3.9%) with dysphonia grade 2 were operated by surgical dissection as in group 1.
There were 37 patients (74%) with no dysphonia, 11 patients (22%) with dysphonia

grade 1, 2 patients (2%) with dysphonia grade 2 were operated by diathermy as in group 2.
There was insignificant difference were obtained between 2 groups as (p value 0.999).
Postoperatively 3 months: there were 40 patients (78.4%) with no dysphonia, 9 patients (19.6%) with dysphonia grade 1, 2 patients (2%) with dysphonia grade 2 were operated by surgical dissection as in group 1.
There were 38 patients (76%) with no dysphonia, 10 patients (20%) with dysphonia grade 1, 2 patients (4%) with dysphonia grade 2 were operated by diathermy as in group 2.
There was insignificant difference were obtained between 2 groups as (p value 0.829).

Table (3): Statistical comparison between pre-operative, postoperative 1month and postoperative month 3 as regards auditory perceptual assessment of voice (APA of voice)

Pairs		**N=100 (%)**	**p value**
Pair 1	APA Of Voice preoperative: No dysphonia G1 G2	 71 (70.3%) 20 (19.8%) 10 (9.9%)	**0.001***
	APA Of Voice 1 month post operative: No dysphonia G1 G2	 76 (75.2%) 21 (20.8%) 4 (4%)	
Pair 2	APA Of Voice preoperative: No dysphonia G1 G2	 71 (70.3%) 20 (19.8%) 10 (9.9%)	**0.0001***
	APA Of Voice 3 months post operative: No dysphonia G1 G2	 78 (77.2%) 20 (19.8%) 3 (3%)	
Pair 3	APA Of Voice 1 month post operative: No dysphonia G1 G2	 76 (75.2%) 21 (20.8%) 4 (4%)	0.083
	APA Of Voice 3 months post operative: No dysphonia G1 G2	 78 (77.2%) 20 (19.8%) 3 (3%)	

As shown in table (3) and figure (1):

There is highly Statistically significant difference between preoperative and postoperative 1 month as regard APA of voice (**p=0.001**). There is highly Statistically significant difference between preoperative and postoperative 3 month as regard APA of voice (p<0.0001). There is Statistical insignificant difference between postoperative 1 month and postoperative 3 month as regard APA of voice (p=0.083)

<u>Auditory perceptual assessment (APA) of speech</u>

1) resonance

Table (4): Distribution of resonance

	Surgical dissection (50)	Diathermy (50)	p value*
Resonance preoperative:			
Mild hypo nasality	4 (7.8%)	5 (10%)	0.928
Moderate hypo nasality	30 (60.8%)	30 (60%)	
Severe hypo nasality	16 (31.4%)	15 (30%)	
Resonance 1-month post-operative:			
Normal nasality	4 (7.8%)	4 (8%)	0.8
Mild hypo nasality	30 (60.8%)	33 (66%)	
Moderate hypo nasality	15 (29.4%)	11 (22%)	
Slight hyper nasality	1 (2%)	2 (4%)	
Resonance 3 months post-operative:			
Normal nasality	45 (90.2%)	46 (92%)	0.75
Mild hypo nasality	5 (9.8%)	4 (8%)	

Statistical comparison between pre-operative, postoperative 1month and postoperative month 3 as regards resonance.

Preoperatively, there were 4 patients (7.8%) with mild hyponasality,30 patients (6 0.8%) with moderate hypo nasality, 16 patients (31.4%) with severe hypo nasality were operated by surgical dissection as in group 1. There were 5 patients (10%) with mild hyponasality,30 patients (60%) with moderate hypo nasality, 15 patients (30%) with severe hypo nasality by bipolar diathermy as in group 2. There was insignificant difference were obtained between 2 groups as (p value 0.928)

Postoperatively 1 month, there were 4 patients (8%) with normal nasality,33 patients (66%) with mild hypo nasality, 11patients (22%) with severe hypo nasality,1 patient (4%) slight hyper nasality were operated by surgical dissection as in group 1. There were 45 patients (90.2%) with normal nasality, 5 patients (60.8%) with mild hypo nasality, 15 patients (29.4%) with severe hypo nasality,1 patient (2%) slight hyper nasality were operated by bipolar diathermy as in group 2. There was insignificant difference were obtained between 2 groups as (p value 0.8)

Postoperatively 3 month, there were 45patients (8%) with normal nasality,5 patients (9.8%) with mild hypo nasality were operated by surgical dissection as in group 1. There were 46 patients (92%) with normal nasality,4 patients (9.8%) with mild hypo nasality were operated by bipolar diathermy as in group 2. There was insignificant difference were obtained between 2 groups as (p value 0.75)

Table (5)

Pairs		N (%)	p value
Pair 1	**Resonanse preoperative:**		**0.001***
	Mild hyponasality	9 (8.9%)	
	Moderate hyponasality	61 (60.4%)	
	Sever hyponasality	31 (30.7%)	
	Resonanse 1 month post operative:		
	Normal	8 (7.9%)	
	Mild hyponasality	64 (63.4%)	
	Moderate hyponasality	26 (25.7%)	
	Slight hypernasality	3 (3%)	
Pair 2	**Resonance preoperative:**		**0.0006***
	Mild hyponasality	9 (8.9%)	
	Moderate hyponasality	61 (60.4%)	
	Severe hyponasality	31 (30.7%)	
	Resonance 3 months post operative:		
	Normal	92 (91.1%)	
	Mild hyponasality	16 (15.8%)	
Pair 3	**Resonance 1 month post operative:**		**0.0001***
	Normal	8 (7.9%)	
	Mild hyponasality	64 (63.4%)	
	Moderate hyponasality	26 (25.7%)	
	Slight hypernasality	3 (3%)	
	Resonance 3 months post operative:		
	Normal	92 (91.1%)	
	Mild hyponasality	16 (15.8%)	

Statistical comparison between pre-operative, postoperative 1month and post-operative month 3 as regards resonance.

As regard resonance regardless the techniques. As shown in table (5), there is highly statistically significant difference between preoperative and postoperative 1 month as regard resonance (**p<0.001).**

There is highly statistically significant difference between preoperative and post-operative 3 month as regard resonance (**p<0.0006)**. There is highly statistically significant difference between preoperative and postoperative 3 month as regard resonance (**p<0.0001**).

Acoustic analysis of voice

Statistical comparisons between pre-operative (pre), post-operative 1month (po1), post-operative 3 month (po2) as regards fundamental frequency (FO), jitter 1st, shimmer db, harmonic noise ratio (HNR) is shown in table (10) between two groups.

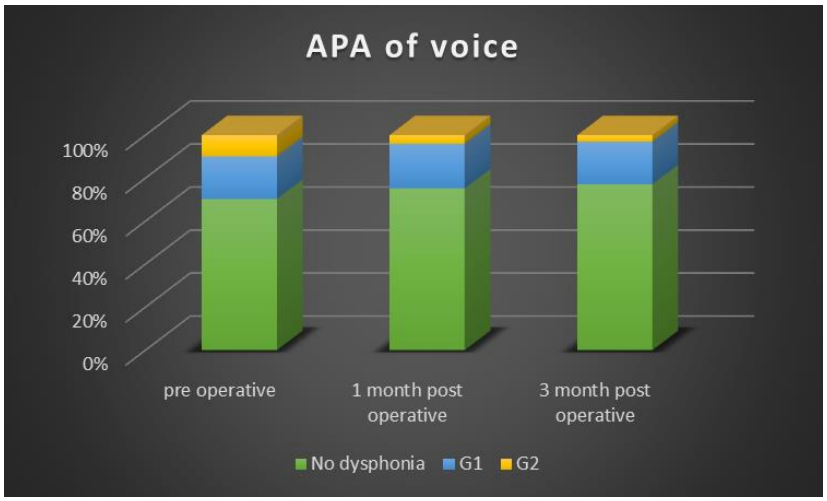

Figure 1 As regard APA of voice:regardless the types of techniques

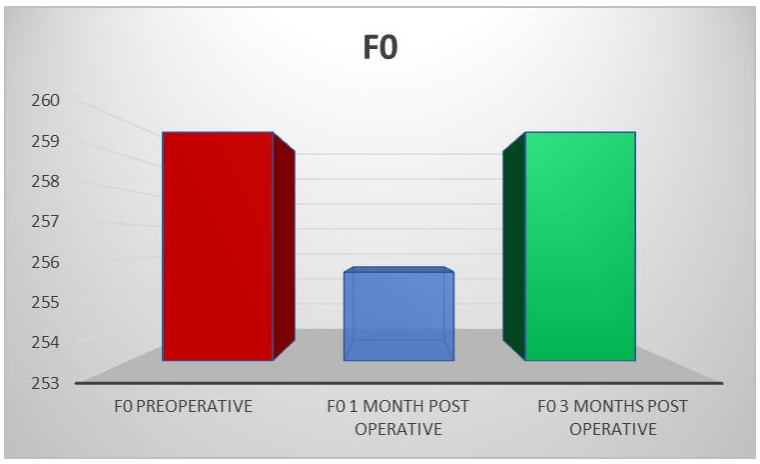

Figure 2 Comparison between preoperative and postoperative in FO. There were insignificant difference were obtained between 2 groups.

Table (6): Distribution of acoustic analysis of voice

	Surgical dissection (50) **Mean ± SD** **Median**	**Diathermy (50)** **Mean ± SD** **Median**	**p value***
F0 preoperative	**249 ± 86.3** **259.7**	**253.1 ± 77.8** **260.2**	**0.935**
Jetter preoperative	42.4 ± 32.7 24	40.1 ± 32.2 21.7	0.702
Shimmer preoperative	2.16 ± 2.1 1.5	1.9 ± 1.8 1.33	0.87
HNR preoperative	7.3 ± 6.6 5.5	07.1 ± 6.1 6.37	0.916
F0 1-month post-operative	247.9 ± 86.5 255.6	252.8 ± 75 261.1	0.975
Jetter 1-month post-operative	40.7 ± 32.3 23	38.6 ± 31.3 19.9	0.587
Shimmer 1-month post-operative	2.24 ± 2.2 1.5	1.7 ± 1.6 1.22	0.273
HNR 1-month post-operative	7.2 ± 6.5 5.5	6.1 ± 5.4 5.2	0.419
F0 3 months post-operative	249 ± 86.3 259.7	253.1 ± 77.8 260.2	0.935
Jetter 3 months post-operative	42.4 ± 32.7 24	40.1 ± 32.2 21.7	0.702
Shimmer 3 months post-operative	2.2 ± 2.1 1.5	1.9 ± 1.8 1.3	0.87
HNR 3 months post-operative	7.3 ± 6.6 5.5	7.1 ± 6.1 6.4	0.916

Statistical comparisons between pre-operative, post-operative 1month, post-operative 3 month as regard fundamental frequency (FO), jitter 1st, shimmer db, harmonic noise ratio (HNR) between two groups.

Mann Whitney test for non- parametric quantitative data between the two groups

[a]: p value > 0.05, [b]: p value <0.01, [c]: p value <0.001

The preoperative FO Mean ± SD is 249±86.3 while the median is 259.7 while post operative1 Mean ± SD is 247.9t±86.5 the median is 255.6 while post operative2 Mean ± SD is 249±86.3 and the median is 259.7

Table (7):

Pairs		**Mean ± SD**	**p value**
Pair 1	F0 preoperative	251 ± 81.8	**0.0001***
	F0 1 month post operative	250.3 ± 80.8	
Pair 2	Jetter preoperative	41.2 ± 32.3	**0.0001***
	Jetter 1 month post operative	39.6 ± 31.7	
Pair 3	Shimmer preoperative	2.1 ± 1.9	**0.0001***
	Shimmer 1 month post operative	2 ± 1.9	
Pair 4	HNR preoperative	7.2 ± 6.3	**0.0001***
	HNR 1 month post operative	6.6 ± 6	

Statistical comparisons between pre-operative, post-operative 1month as regard fundamental frequency (FO), jitter 1st, shimmer db, harmonic noise ratio (HNR) between two groups.

Mann Whitney test for non- parametric quantitative data between the two groups

[a]: p value > 0.05, [b]: p value <0.01, [c]: p value <0.001

As table shown regardless type of techniques, there is highly statistically significant difference between preoperative and postoperative 1 month as regard F0 (p value <0.0001). There is highly statistical significant difference between preoperative and postoperative 1 month as regard jetter (p value <0.0001). There is highly statistically significant difference between preoperative and postoperative 1 month as regard shimmer (p value <0.0001). There is highly statistically significant difference between preoperative and postoperative 1 month as regard harmonic noise ratio (HNR) (p value <0.0001).

Discussion

Palatine tonsils are located at the vocal tract, between the palatoglossal and palato-pharyngeal arches. They are immune-logically active lymphoid tissue that are part of the lymphoid system[10,11]. Thus, there are several quantitative studies on the effects of tonsillectomy on voice and speech reported in the literature. These studies mainly concentrate on the funda-mental frequency and the first two to four formant frequencies of the vowels [12,13,14]. Tonsils, however, decrease oropharyngeal airspace and may push the tongue forward. For this reason, the effects of the tonsils' motion and their interaction within the vocal tract may also influence consonants. Large tonsils could cause hypernasal speech, oral breathing, or muffled voice. When individuals produce some sounds, the soft palate moves to touch the back of the throat which seals off the nasal cavity above from the oral cavity below. Large tonsils may prevent the soft palate from touching the back of the throat. For this reason, air escapes from the nasal cavity and causes hypernasal speech. The preoperative findings are not in agreement with The study by [1,15]. Who related that the presence of hypertrophic tonsils reduces the oropharyngeal space, project the tongue forward and cause hypernasality, mouth breathing and muffled voice. In the present study, there was a statistically significant improvement in APA of voice (dysphonia) and APA of speech (hypo-nasality) at 1 and 3 months after adenotonsillectomy.

Our study revealed that for APA of voice Postoperatively 1 month there were 39 patients (76.5%) with no dysphonia,9 patients with dysphonia grade 1,2 patients (3.9%) with dysphonia grade 2 were operated by surgical dissection as in group 1. There were 37 patients (74%) with no dysphonia,11 patients (22%) with dysphonia grade 1 ,2 patients (2%) with dysphonia grade 2 were operated by diathermy as in group 2. There was insignificant difference were obtained between 2 groups as (p value 0.999). This could be explained as tonsillectomy and adenoidectomy do not directly affect the larynx and therefore should not influence the rate at which vocal folds open and close during sustained phonation. Which is agree with the study[13] believed that this observation is not surprising because tonsillectomy and adenoidectomy do not directly affect the larynx and therefore should not influence the rate at which vocal folds open and close during sustained phonation. These results indicate improvement of voice and speech of the patients by perceptual assessment of the voice and speech after adenotonsillectomy which in agreement with the study by [16] who indicated that Velopharyngeal insufficiency can exist without overt clefts of the hard or soft palate. The suspected causes are congenital short soft palate large nasopharynx, or both but in many cases neither can be anatomically established and the Velopharyngeal insufficiency must be considered idiopathic. These conditions often remain undetected until adenoidectomy deprives the patient of tissue mass in the nasopharnx and veloadenoidal closure. the study by [17,18] show adenoidectomy may affect voice resonance and nasalance, changing the shape and size of nasopharynx and upper respiratory tract, without any significant change in the voice quality. The earlier study by [19] reported that the most common observation in pathological conditions is a strong tendency for frequent and rapid changes in the regularity of the vibratory pattern, which are reflected acoustically as disturbances of F0.[20]

Conclusion

Regardless of different techniques of adenotonsillectomy as diathermy or surgical technique could cause no different changes affected the voice and speech postoperatively in children.

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