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Original Article

Voice Handicap Index and Acoustic Parameters in Thyroidectomized Patients with and without Voice Problems

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ABSTRACT

Background and Objective: Vocal changes are one of the most common consequences of thyroid surgery. These changes can be due to neurological or other factors. With respect to vocal changes after surgery, and the need for determination of details of the vocal problems and related consequences in the patients' life after thyroidectomy, the aim of this study was determination of some acoustic parameters of their voice after thyroidectomy and the status of subscales of Voice Handicap Index (VHI).

Methods: This study is a cross-sectional descriptive analytic and non-interventional. One voice of 32 thyroidectomized patients (23 women and 9 men) with 20-60 years of age analyzed acoustically and they completed VHI questionnaire.

Results: Statistical comparison of mean scores of VHI in two groups of patients with and without vocal problem showed that mean score and standard deviation of total scores of VHI, and the scores of functional, emotional, and physical subscales in patients with voice problems are more than the other group, and the differences were significant (P=0.000). Comparison of acoustic parameters in the two groups of patients showed that F0, jitter, shimmer, and HNR were different, but the differences were not significant. According to our results, amplitude perturbations and harmonic to noise ratio was high in both groups of thyroidectomized patients.

Conclusion: According to the findings of this research, we can conclude that F0, jitter, shimmer, and HNR of voice may be not enough for determination of voice problems, but other acoustic measures, self-perceptual, or self-reported evaluation tools such as VHI maybe more efficient in determination of thyroidectomized patients' voice problems.

Keywords: Thyroidectomized patients, Acoustic parameters, Voice Handicap Index, Voice problems

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Introduction

With respect to the high incidence of thyroid related disorders, thyroid surgery is a routine treatment for some of thyroid related disorders (Aryal, Gyawali, Rajbhandari, Aryal, & Pandeya, 2010; Chun et al., 2012; DeRuiter, 2002; Peker et al., 2014; Pinto & Glick, 2002; Wallace & Stone, 2003). Thyroidectomy is a safe (conservative) surgery, but may have some side effects such as other surgeries. Some of these side effects are: damage of vague nerve, damage to external branch of superior laryngeal nerve, hypoparathyroidism, airway obstruction, and ulcer infection (Jatzko, Lisborg, Mül-

ler, & Wette, 1994; Lahey & Hoover, 1938).

One of the most important and most common side effects of thyroid surgery is damage of recurrent laryngeal nerve (Chandrasekhar et al., 2013; Chiang, Wang, Huang, Lee, & Kuo, 2005; Jatzko et al., 1994; Safioleas et al., 2006; Soylu, Ozbas, Uslu, & Kocak, 2007), which is the well-known cause of vocal problems after thyroidectomy (Chun et al., 2012), and also in professional voice users (Bora, Narwani, Agarwal, & Bapna, 2005; Calò et al., 2014; de Pedro Netto et al., 2006). Vocal changes are common side effects of thyroid surgery (Bora et al., 2005; Debruyne, Ostyn, Delaere, & Wellens, 1997), which its occurrence is between 41 till 84 percent. Other causes of vocal changes maybe dysfunction of cricothyroid muscle, mucosal congestion due to intubation, local pain in neck area, and psychological reactions after thyroidectomy (Bora et al., 2005). Trauma to arytenoid cartilages during intubation is other cause of vocal changes after thyroidectomy (de Pedro Netto et al., 2006).

Studies showed that 25 till 90 percent of patients reported vocal abnormalities in some weeks after surgery, and 11 till 15 percent of them reported permanent vocal changes 3 till 6 months after surgery (Debruyne et al., 1997). In the cases with damage of recurrent laryngeal nerve, more than 50 percent of patients shows abnormal symptoms in videolaryngostroboscopy, but have normal voice (de Pedro Netto et al., 2006; Debruyne et al., 1997; Mcivor, Flint, Gillibrand, & Morton, 2000). Most common symptoms are harshness, changing of the mass of vocal fold, and vocal fatigue, which may have important effect on social life, and his/her functional voice (Henry et al., 2010).

Soylu et al, studied 48 thyroidectomized patients by acoustic measures and videolaryngostroboscopy, prior surgery, two days, and three months after surgery. Findings showed that 37.5 percent of patients during first period after surgery, and 14.6 percent of them three months later had vocal complaints. Means of F0, jitter, shimmer, and HNR were significantly different before surgery and in primary period after surgery, but fundamental frequency is the only variable which was significantly different till third months after surgery (Soylu et al., 2007).

Henry et al. in a study evaluated functional voice outcomes after thyroidectomy. They studied Dysphonia Severity Index (DSI), acoustic parameters, perceptual assessment of voice (CAPE-V), and indirect videolaryngostroboscopy of 62 patients before and 6 months after surgery. Their study showed that 8 person (13% of the subjects) had voice problems till six months after surgery (Henry et al., 2010).

Neri et al., studied dysphonia in two groups of thyroidectomized patients with and without damage to superior laryngeal nerve. Videolaryngostroboscopic, acoustic, and self-reported perceptual (VHI) assessment was used for 15 patients (7 with and 8 without damage to superior laryngeal nerve). Results showed that the patients had voice problem till one year after surgery even when they had not damage to superior laryngeal nerve. The majority of the studied patients of both of the groups had complaints of deterioration of the quality of voice and the long period of voice problem (Neri et al., 2011).

Therefore, results of different studies showed that the majority of patients had vocal disorders or complaints after surgery. From other hand, access to objective assessment instrumentations is a priority, but in the cases that there is not any access to such instrumentations, speech language pathologist can rely on patients' complaint as an important factor in diagnosis. With this description, and with respect to the high incidence of voice problems in thyroidectomized patients, the simultaneous study of self-perceptual and acoustic assessment of voice problem seems necessary, and may help to better selection of assessment tools which are in access.

With respect to vocal changes as one of the most common consequences of thyroid surgery which can be evaluated by acoustic analysis, and perceptual or sel-perceptual tools, and the need for determination of the vocal problems of these patients, and related consequences in their life after thyroidectomy, the aim of this study was determination of some acoustic parameters of their voice after thyroidectomy and the status of subscales of Voice Handicap Index (VHI).

Materials and Methods

This study is a cross-sectional, descriptive, and analytic study. The committee of ethics in Iran University of Medical Sciences (IUMS) has approved the research, and dedicated the ethical code IR.IUMS.REC 1395.9311360007 to it. The sample was selected from 232 thyroidectomized patients who were referred from different ENT clinics. All of them were Farsi speakers and had one of different Iranian dialects and were literate and could complete the VHI questionnaire. They had age range of 20-60 years. They were not smoker, had not any history of neurological disorders such as Parkinson's disease and multiple sclerosis, had not any history of another surgery in head and neck area, and had not any history of voice problems before different types of thyroid surgery (Figure 1). After consideration of inclusion criteria, 32 patients (23 female & 9 male) agreed to sign consent form for participation in this study. After signature of consent form, they completed a questionnaire including demographic data. One of the questions of this questionnaire was about having a voice problem or not, at the present time. According to the answer of this question, they divided in two groups with and without voice problem.

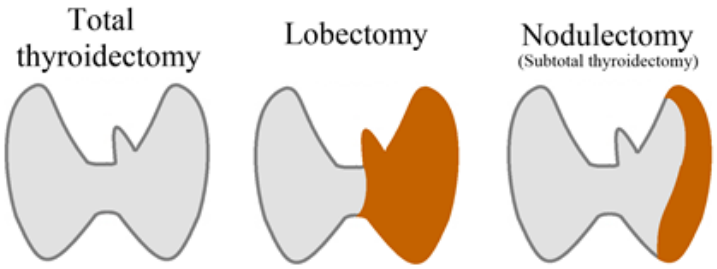

Figure 1. Different types of thyroid surgery.

Each of the patients completed the Voice Handicap Index (VHI) questionnaire. Voice Handicap Index (VHI) is developed first by Jacobson et al. (1997) (Jacobson et al., 1997). Persian version of this questionnaire is a standard questionnaire (Moradi et al., 2012). The instructions were explained for the questionnaire, and then they completed the questionnaire in a quiet room. The VHI questionnaire has 30 questions. The questionnaire has three parts: physical, emotional, and functional parts. Each part has 10 questions. Patients must select a score of 0-4 for each of the questions (0 = never, 1=almost never, 2= sometimes, 3 = almost always, 4 = always).

For assessment of acoustic parameters (jitter, shimmer, fundamental frequency, and harmonic to noise ratio), patients were asked to produce the vowel /a/ three times in the comfortable level of loudness and pitch, and sustain it for 5 seconds. Sustained vowel recorded by cardioid Rode NT1 Kit Condenser Microphone attached to AVID Fast-Track Solo external soundcard and Asus laptop. Jet-Audio software was used with sample rate of 44.1 kHz. The distance of microphone from mouth was nearly 10 centimeters. Noise level was lesser than 40db. PRAAT software was used, and middle seconds of any recording was considered for determination of acoustic parameters.

SPSS 21 (SPSS Inc., Chicago, Ill., USA) was used for performing of data analysis at a significant level of lesser than 0.05. Descriptive statistics were used for calculation of means, standard deviations, and standard errors of variables. T-test is used for comparison of mean values of different variables in two groups with and without voice problems.

Results

This study aimed to determine the acoustic and self-rated VHI variables in thyroidectomized patients and compare them between two groups with and without voice problems.

Participants of this study were 23 women and 9 men. Voice Handicap Index was administered and acoustic parameters were determined (Table 1).

Descriptive statistic values of VHI subscales and acoustic parameters are presented in Table 2. The data shows that mean score and standard deviation of all of VHI subscales and total VHI score in patients with

voice problems are more than the other group. It is interesting that the difference is very high, and in the group without voice problem, it's so that it seems these data decline to zero. The other notion is that the scores of physical and emotional subscales of VHI were respectively the most and the least scores in both of the groups with and without voice problems.

According to the results, all of acoustic parameters unless shimmer, were more in the group with voice problem, but about shimmer, it's slightly more in the group without voice problem. According to the Table 2, all of acoustic parameters unless shimmer, and F0 in females, were more in the group with voice problem.

Table 1. Distribution of studied persons according to gender, age, type of surgery, presence or absence of voice problem, and the cause of surgery respectively.

Demographic findings		Frequency	Percent
Gender	Female	23	71.9
	Male	9	28.1
Age	Under 30 till 39 years	16	50
	40 till 50 years and more	16	50
Type of surgery	Total thyroidectomy	23	71.9
	Lobectomy	3	9.4
	Nodulectomy	6	18.8
Voice problem	No	17	53.1
	Yes	15	46.9
The cause of surgery	Benign tumor	5	15.6
	Cancer	2	6.3
	Cyst and nodule	2	6.3
	Goiter	6	18.8
	Hyperthyroidism	3	9.4
	Hypothyroidism	1	3.1
	Thyroid nodule	13	40.6

Table 2. Descriptive statistic values of VHI and its subscales and acoustic parameters in patients with and without voice problems

	Voice problem	Mean	SD
VHI-total	With (n=15)	42.73	25.731
	Without (n=17)	1.47	3.642
VHI Functional	With (n=15)	13.73	10.074
	Without (n=17)	.35	.862
VHI-emotional	With (n=15)	11.93	8.948
	Without (n=17)	.12	.485

Voice problem			Mean	SD
VHI-physical	With (n=15)		16.93	8.013
	Without (n=17)		1.00	2.598
Shimmer	With (n=15)		5.47	4.333
	Without (n=17)		6.94	5.486
F_0	With (n=15)	male (n=1)	136.65	-
		female(n=14)	189.17 ()	43.65
	Without (n=17)	male (n=8)	116.08 ()	22.37
		female (n=9)	213.28 ()	45.7
HNR	With (n=15)		18.36 ()	6.872
	Without (n=17)		18.00 ()	5.104
Jitter	With (n=15)		.42 ()	.163
	Without (n=17)		.41 ()	.215

The content of Table 3 presents the results of statistical comparison of two groups by using of t-test. These results denote that total VHI scores and the scores of three subscales are significantly different in two groups with and without voice problems, but the difference between the means of two groups was not significant in the four acoustic parameters.

Table 3. The results of statistical comparison of VHI subscales and acoustic parameters between two groups with and without voice problems

		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
VHI-total	Equal variances assumed	36.651	.000	6.552	30	.000	41.263
	Equal variances not assumed			6.157	14.495	.000	41.263
VHI-func	Equal variances assumed	30.902	.000	5.465	30	.000	13.380
	Equal variances not assumed			5.127	14.181	.000	13.380
VHI-emo	Equal variances assumed	54.419	.000	5.447	30	.000	11.816
	Equal variances not assumed			5.108	14.073	.000	11.816
VHI-phys	Equal variances assumed	16.575	.000	7.764	30	.000	15.933
	Equal variances not assumed			7.367	16.593	.000	15.933
Shimmer	Equal variances assumed	1.186	.285	-.833	30	.411	-1.471
	Equal variances not assumed			-.846	29.671	.404	-1.471

		Levene's Test for Equality of Variances		T-test for Equality of Means			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
F_0 males	Equal variances assumed	0	.0	-0.867	7	.415	-20.57
	Equal variances not assumed			.0	0	0	-20.57
F_0 females	Equal variances assumed	0.130	.722	-1.277	21	.216	24.11
	Equal variances not assumed			1.267	16.796	.222	24.11
HNR	Equal variances assumed	.492	.489	.172	30	.865	.365
	Equal variances not assumed			.169	25.634	.867	.365
Jitter	Equal variances assumed	.679	.417	.157	30	.877	.011
	Equal variances not assumed			.159	29.419	.875	.011

Discussion

Normal range of acoustic parameters can help for determination of normalcy of acoustic results of any client, which our reference for these norms was based on Casper & Leonard (Casper & Leonard, 2006). Shimmer of normal speakers is small (smaller than 0.81 for males and 0.56 for females for /ah/ vowel). Average F0 of normal male speakers is between 100 and 150 Hz, and is between 180 and 250 Hz for females. HNR of normal speakers is much greater than 1. Frequency perturbation of normal speakers has a small amount, i.e. a little more or less than 1 Hz (Casper & Leonard, 2006). With respect to the confirmed norms mentioned above, mean of shimmer of both of groups was not in normal range, and mean of three other acoustic parameters of two groups were different in some extent, but were in normal range. It may be due to some probable factors such as these: first that thyroid surgery may lead to different amounts of deficiency in movements of vocal folds (Li et al., 2013; Neri et al., 2011), which can produce some amounts of acoustic differences, which may be significant (Neri et al., 2011), or non-significant(Stojadinovic et al., 2002); second that thyroid surgery may have some inevitable effects on the patients' shimmer, but the nature of the difference maybe so that they may be not so sensitive to their own voice; third that men in the group without voice problem were more, and this can be due to that men in comparison with women may show more sensitivity to their voice problems after thyroid surgery and referring for treatment; it maybe so that women may be more sensitive, but don't show their sensitivity, which need more research. Mean of jitter in the group with voice problem was a little more than the other group, but the means of jitter in both of the groups were in the norm limits (Casper & Leonard, 2006), which may shows minor effects of thyroid surgery on frequency, at least in the studied sample.

Findings of this study showed that there wasn't significant difference between mean of four acoustic parameters of two groups; and there was significant difference between total score of VHI of two groups, and also there was significant difference between scores of two groups in functional, emotional, and physical subscales. According to the findings, it can be concluded that the studied acoustic parameters are not enough for determination of voice problems, and there may be a need to use of some other acoustic parameters such as Dysphonia Severity Index (DSI) (Awan, Helou, Stojadinovic, & Solomon, 2011; Henry et al., 2010; Vicente

et al., 2014; Wuyts et al., 2000), or other indices such as perceptual evaluations (Karnell et al., 2007; Nemr et al., 2012; Solomon, Helou, & Stojadinovic, 2011) which need more research.

With respect to the findings of this research, it can be conclude that having a voice problem or complaint even when the patient has feeling of handicap confirmed with Voice Handicap Index (VHI) (Jacobson et al., 1997), cannot be conclude to find an evident acoustic difference between two groups with and without voice problems. This shows a very important clinical and theoretical notion that relying on only acoustic parameters maybe not enough, and it may be only part of assessment data, but the important assessment data can be gathered by emerging questionnaires such as VHI, VFI, and other questionnaires which are valid and reliable (Jacobson et al., 1997; Nanjundeswaran, Jacobson, Gartner-Schmidt, & Abbott, 2015).

Perceptual evaluation is used in different studies of thyroidectomy (Anand, Skowronski, Shrivastav, & Eddins, 2018; Chandrasekhar et al., 2013; Ortega, Cassinello, Dorcaratto, & Leopaldi, 2009; Santosh & Rajashekhar, 2011); and even in decision making (Chun et al., 2015). It can be predictable that valid and reliable questionnaires may have wider applications in researches and clinical settings. These applications may be about feeling of handicap (Jacobson et al., 1997; Paolillo & Pantaleo, 2015), vocal fatigue (Nanjundeswaran et al., 2015), perceptual assessment by clinicians (Karnell et al., 2007; Nemr et al., 2012), and some other issues.

Conclusion

The findings of this study indicate that subscales of vocal handicap index can be different in two groups of patients with and without voice problem; only shimmers of both of the studied groups can be different from normal limits in both of the groups; and acoustic parameters may be not different in persons with and without voice problem. It can be conclude that relying on acoustic parameters may be not enough for assessment of voice disorders after thyroid surgery and using of valid and reliable perceptual questionnaires can be very useful adjacent to acoustic parameters.

Limitations to the Study

The research studied only 32 thyroidectomized patients including 9 males and 23 females. Our limitation in having a larger sample with different groups of laryngeal pathologies or different vocal symptoms can be mentioned.

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Conflict of Interest

The authors declared no conflict of interest regarding publication of this paper.

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مقالهٔ پژوهشی

شاخص معلولیت صوتی و پارامترهای صوتی در بیماران تیروئیدکتومی شده با و بدون مشکلات صوتی

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چکیده

زمینه و هدف: تغییرات صوتی، یکی از رایج‌ترین پیامدهای جراحی تایروئید است. این تغییرات می‌تواند به خاطر عوامل نورولوژیکی یا عوامل دیگر باشد. با توجه به تغییرات صوتی بعد از جراحی و نیاز برای تبیین جزئیات مشکلات صوتی و پیامدهای مربوطه در زندگی بیمار بعد از تایروئیدکتومی، هدف این مطالعه تبیین برخی پارامترهای آکوستیکی صوت این بیماران متعاقب تایروئیدکتومی و وضعیت زیرآزمون‌های VHI بود.

روش کار: این مطالعه یک مطالعه غیرمداخله‌ای توصیفی-تحلیلی از نوع مقطعی است. صوت ۳۲ بیمار تایروئیدکتومی‌شده (۲۳ زن و ۹ مرد) با میانگین سنی ۶۰-۲۰ سال از نظر آکوستیکی تحلیل شد و آنها پرسشنامه VHI را نیز پر کردند.

یافته‌ها: مقایسهٔ آماری میانگین نمرات VHI در دو گروه از بیماران با و بدون مشکل صوتی نشان داد که میانگین و انحراف معیار نمرات کل VHI، و نمرات زیرآزمون‌های عملکردی، عاطفی و جسمی در بیماران مبتلا به اختلالات صوت بیشتر از گرون بدون مشکل بود و این تفاوت‌ها معنی‌دار بودند (P=۰/۰۰۰). مقایسهٔ پارامترهای آکوستیکی در دو گروه مورد مطالعه نشان داد که فرکانس پایه، جیتر، شیمر و HNR متفاوت بود، اما این تفاوت‌ها معنی‌دار نبود. بر اساس نتایج به‌دست آمده، آشفتگی دامنه و نسبت هارمونیک به نویز در هر دو گروه از بیماران تایروئیدکتومی‌شده بالا بوده است.

نتیجه‌گیری: براساس یافته‌های این پژوهش، می‌توان نتیجه گرفت که ممکن است فرکانس پایه، جیتر، شیمر و HNR جهت تبیین مشکلات صوت کافی نباشد، اما اندازه‌گیری‌های آکوستیکی دیگر، ابزارهای ارزیابی خودادراکی مانند VHI می‌توانند در تبیین مشکلات صوتی بیماران تایروئیدکتومی‌شده مؤثرتر واقع شوند.

واژه‌های کلیدی: بیماران تایروئیدکتومی‌شده، پارامترهای آکوستیکی، شاخص معلولیت صوتی، مشکلات صوتی