



## Analysis of Voice Changes after Thyroid Surgery and Their Impact on Quality of Life

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### Abstract

**Background:** The aim of this study was to analyze the voice changes after thyroid surgery with intact recurrent laryngeal nerve injury and to study the impact of this on voice related quality of life versus overall quality of life.

**Study Design:** It was a prospective cohort study in which 50 patients aged between 20 to 60 years who underwent thyroidectomy were included.

**Methods:** Voice changes were assessed using Voice Handicap Index (VHI), Consensus Auditory Perceptual Evaluation of Voice (CAPE-V), Multidimensional Voice Program (MDVP) in preoperative period and at 2 weeks, at 6 weeks, at 16 weeks and at 24 weeks in postoperative period. Voice related quality of life questionnaire and WHOQOL-BREF questionnaire were done in preoperative period and at 24 weeks in postoperative period.

**Results:** There were statistically significant changes seen in VHI as p value <0.0005 while not in CAPE-V (p value >0.005). There were significant changes seen in fundamental frequency, mean fundamental frequency, jitter and noise to harmonic ratio during 6 months of follow up period on MDVP. There was significant difference in mean value of VRQOL life questionnaire post-surgery while overall quality of life improved in terms of physical, social, environmental domains as p value >0.0005.

**Conclusion:** There were mild transient voices changes present during the initial 6 weeks after that subsequently return to normal or near normal during follow up.

### Introduction

Thousands of thyroid procedures are performed every year [1]. Thyroid cancer is the only non-cutaneous head and neck malignant tumour that continues to increase in incidence with a mean 5% increase per year in the United States. Its incidence has been tripled between 1978 and 2007 from 3.6 cases per 100000 to 11.9 cases per 100000 [2]. The leading cause of this abrupt increase is papillary carcinoma of thyroid and the primary treatment for this is total thyroidectomy. Papillary carcinoma of thyroid is associated with low mortality rate, therefore postoperative QOL is considered to be as important as disease control [3].

The human voice is produced by a complex instrument composed of intricate laryngeal structure which is further innervated by branches of the RLN aided by branches of SLN which lies in close proximity to thyroid gland and are vulnerable to injury during thyroidectomy [1-5]. The surgical manipulation of these nerves is associated with 46% of unilateral vocal fold paralysis and 56% of bilateral vocal fold paralysis during thyroid surgery. It can be associated with dysphonia, dysphagia and dyspnea. The effect on the voice changer after RLN injury is recognized and documented easily [1,3]. Dysphonia is considered the main symptoms of unilateral vocal fold paralysis but it has more significant physiological (dysphagia, dyspnea), psychosocial and economic consequences [6,7]. Paralysis of both RLN is associated with potential fatal airway obstruction [8]. Voice changes in the absence of nerve palsy are also noticed [9-11]. Despite surgeon attention to laryngeal nerve preservation, a subgroup of thyroidectomy patient is left with insufficient dysfunctional voices that can impact their livelihood and QOL [11]. There are large number of patients complaining of similar voice symptoms after thyroid procedure including easy vocal fatigue, roughness, difficulty with high pitch & singing voices, vague voice changes in the absence of laryngeal nerve injury and vocal cord paralysis [12,13]. The possible causes may be injury to pre-thyroid strap muscles or cricothyroid muscles or impairment of laryngeotracheal movement due to wound contracture

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after surgical trauma to soft tissue [11]. Voice changes that occur after thyroidectomy in the absence of overt vocal fold paralysis is known as post-thyroidectomy dysphonia. It ranges from 14% to 90% [2]. These changes may be temporary or permanent and can have a serious impact on patient's QOL, mainly in professional voice users [14]. The most common voice changes are lowering of the habitual pitch, decreased vocal performance with reduced frequency and intensity range, and increased perturbation parameters such as shimmer, jitter, noise to harmonic ratio, and voice turbulence index. The most common change is seen in lowering of pitch on objective and subjective evaluation [15]. This post-thyroidectomy syndrome can decrease the patient QOL [16]. There should be preoperative voice assessment and laryngeal examination before thyroidectomy to rule out other laryngeal pathology [17]. There is increasing evidence that voice impairment occurs and can even persist beyond 6 months after thyroidectomy in a substantial percentage (up to 25%) of patients who do not have objective evidence of vocal fold paresis or paralysis. These can be sufficient to decrease the QOL [18]. The primary objective of the present study is thus to evaluate the parameters of voice changes and to assess the quality of life in post thyroidectomy patient with voice changes. Our main aim is to study the voice changes in those patients who underwent thyroidectomy and having intact RLN post-surgery. We also want to study the voice related quality of life and overall quality of life in these patients.

## Aim & Objectives

### Aim

To analyze the voice changes after thyroidectomy and their impact on quality of life.

### Objectives

**Primary objective:** To evaluate the voice changes after thyroid surgery without vocal cord paralysis and study the quality of life of post thyroidectomy patients related to voice changes. To compare the voice changes in hemi thyroidectomy and total thyroidectomy patients.

**Secondary objective:** To study the overall quality of life of post thyroidectomy patients.

## Materials and Methods

A total of 50 patients was included in our study who were diagnosed with a thyroid swelling that required thyroidectomy in the Department of Otolaryngology, Head & Neck surgery, Post Graduate Institute of Medical Education and Research, Chandigarh from July 2018 to June 2019. Last patient was recruited till June 2019 as follow up period was 6 months in our study. It was a prospective cohort study. All these patients underwent a detailed clinical history and examination, complete Ear, Nose, and Throat examination including 90 degree endoscopy and a radiological examination preoperative voice analysis. Fibro-optic laryngoscopy was done under local anesthesia in those patients who had difficult 90 degree laryngoscopy examination. Radiological investigations were done using ultrasound neck; contrast enhanced computerized tomography, chest X-ray posteroanterior view for study the extent and characteristics of the thyroid swelling. An ethical clearance was obtained from institutional ethical committee. An informed and written consent was obtained in all cases.

### Study design

A total of 50 patients were included with thyroid swelling in

our study. They underwent preoperatively detailed history, clinical examination, blood examination, 90 degree endoscopy, voice assessment using established voice tools. The voice was assessed by speech pathologist using a professional speech and voice analysis system. All the patients were admitted before surgery and hemi thyroidectomy/total thyroidectomy were done under general anesthesia using the standard operating protocol. Patients were hospitalized for 3 to 5 days post-surgery and were discharged thereafter. Neck wound suture was removed on 7<sup>th</sup> postoperative day. Patients who underwent hemi thyroidectomy were arranged to Group A, & those who underwent total thyroidectomy arranged to Group B. The voice test was carried out at each follow up visits at 2 weeks, 6 weeks, 16 weeks, 6 months after surgical procedure following voice tools was used for voice analysis in the Audiology and Speech Language Pathology section of the department;

- **Multidimensional Voice Program (MDVP):** It is a computer program that is used to evaluate the various aspect of voice. It is used in vocal cord dysfunction. It is a non-invasive procedure.

- **Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V) (Annexure-1):** It is a tool developed for clinical auditory-perceptual assessment of voice. The main purpose of this tool is to describe the severity of auditory-perceptual attributes of a voice problem, in a way that can be communicated among clinician. It indicates salient perceptual vocal attributes. These attributes are 1) overall severity 2) roughness 3) breathiness 4) strain 5) Pitch 6) Loudness.

- **Voice Handicap Index (VHI) (Annexure-2):** It is a self-report questionnaire divided into three subscales (functional, organic, and emotional) each with 10 questions. It is used for evaluation of patient- perceived vocal incapacity.

- **Voice Related Quality of Life Questionnaire (VRQOL):** It is also self-report questionnaire which include total of 10 questions and is use to assess the voice related quality of life after thyroid surgery.

- QOL will be assessed in all patients at 6 months post-thyroidectomy by using WHO QOL BREF scale (Annexure-3). WHOQOL-BREF instrument comprises 26 items, which measure the following broad domains; physical health, psychological health, social relationships, and environment. The WHOQOL-BREF is a shorter version of the original instrument that is easier.

### Inclusion criteria

- All cases clinically diagnosed as thyroid lesion and planned for hemi thyroidectomy or total thyroidectomy.
- Age 20 to 60 years.
- Both male and female patient.

### Exclusion criteria

- Previous head and neck surgery including thyroid surgery.
- Performance of modified radical neck dissection to eradicate cervical lymphatic metastasis.
- Performance of partial laryngeal or tracheal resection to treat tumour invasion.
- Use of robotic or endoscopic approach for thyroid swelling.
- Failure to complete all pre & postoperative voice work up over the 3 postoperative months.

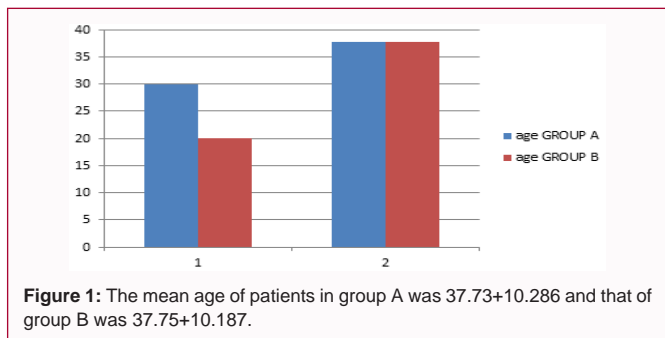


Figure 1: The mean age of patients in group A was 37.73+10.286 and that of group B was 37.75+10.187.

- External radiation and radioactive iodine therapy.

**Follow-up**

The follow-up period planned for the cohort study was 2 weeks, 6 weeks, 4 months, and 6 months in postoperative period. In the immediate postoperative period, patients were assessed for voice changes. In the postoperative day 1, antiseptic dressing was done. The 90 degree endoscopy was done and vocal cord mobility confirmed. In case of patient having vocal cord palsy noticed were excluded from the study. Neck drain was removed after 48 h. Patients were admitted in ward for 3 to 5 days and sutures were removed on 7 postoperative days. All patients who underwent surgery, follow up was done at 2 weeks, 6 weeks, 4 months, 6 months, in postoperative period. VHI, CAPE-V, MDVP were assessed at all postoperative visits. Thyroid function tests repeated at 4 months and overall quality of life was evaluated at 6 months.

**Statistical analysis**

**Sample size:** 50 patients, cohort study classified in two groups' hemi and total. The data was entered in a predesigned proforma. A comparative analysis was done using SPSS for windows 21.0 statistical software.

**Results**

During the study periods of 18 months, 50 patients who fulfilled the inclusion criteria were included in the study. All patients underwent preoperative 90 degree endoscopy, TFTs, objective and subjective evaluation of voice using MDVP, CAPE-V and VHI respectively and were instructed to answer QOL WHOQOL-BREF scale questionnaire. They were divided in to two groups Hemithyroidectomy Group A and Total Thyroidectomy Group B. Repeat 90 degree endoscopy was done at 2 weeks after surgery. TFTs were repeated at 3 months. MDVP and CAPE-V were performed at 2 weeks, 6 weeks, 4 months, and 6 months. VHI questionnaire were repeated at 2 weeks, 6 weeks, 4 months, 6 months and WHOQOL-BREF questionnaire at 6 months.

		Count	Group		Total
			Hemi	Total	
sex	f	Count	21	17	38
		% within sex	55.3%	44.7%	100.0%
	% within Group	70.0%	85.0%	76.0%	
	m	Count	9	3	12
% within sex		75.0%	25.0%	100.0%	
% within Group	30.0%	15.0%	24.0%		
Total		Count	30	20	50
		% within sex	60.0%	40.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

Figure 2: Out of 50 patients, 38 were females and 12 patients were males. In group A, 21 patients were females and 9 patients were males. In group B, 17 females and 3 patients were males.

state		Count	Group		Total
			Hemi	Total	
HP	Count	14	12	26	
	% within state	53.8%	46.2%	100.0%	
	% within Group	46.7%	60.0%	52.0%	
HR	Count	1	0	1	
	% within state	100.0%	0.0%	100.0%	
	% within Group	3.3%	0.0%	2.0%	
JK	Count	1	0	1	
	% within state	100.0%	0.0%	100.0%	
	% within Group	3.3%	0.0%	2.0%	
PB	Count	12	8	20	
	% within state	60.0%	40.0%	100.0%	
	% within Group	40.0%	40.0%	40.0%	
UP	Count	2	0	2	
	% within state	100.0%	0.0%	100.0%	
	% within Group	6.7%	0.0%	4.0%	
Total		Count	30	20	50
		% within state	60.0%	40.0%	100.0%
		% within Group	100.0%	100.0%	100.0%

Figure 3: Regional distribution of patients according to geographical location.

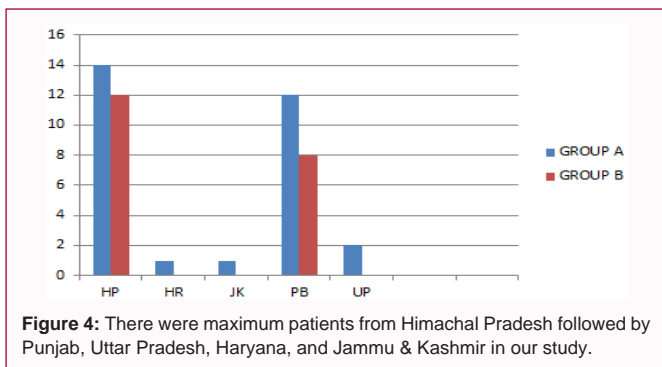


Figure 4: There were maximum patients from Himachal Pradesh followed by Punjab, Uttar Pradesh, Haryana, and Jammu & Kashmir in our study.

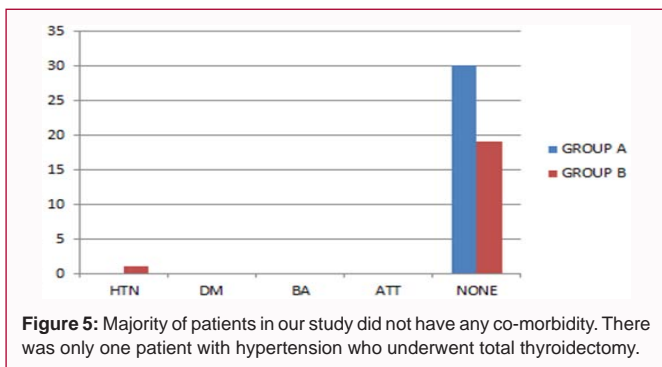


Figure 5: Majority of patients in our study did not have any co-morbidity. There was only one patient with hypertension who underwent total thyroidectomy.

**Variables**

**Age:** The mean age of patients in group A was 37.73+10.286 and that of group B was 37.75+10.187. There was no statistically significant difference between two groups (Figure 1).

**Sex:** Out of 50 patients, 38 were females and 12 patients were males. In group A, 21 patients were females and 9 patients were males. In group B, 17 females and 3 patients were males (Figure 2).

**Regional distribution of patients according to geographical location:** There were maximum patients from Himachal Pradesh followed by Punjab, Uttar Pradesh, Haryana, Jammu & Kashmir in our study (Figure 3, 4).

**Comorbidities**

Majority of patients in our study did not have any co-morbidity. There was only one patient with hypertension who underwent total thyroidectomy. There was no patient with diabetes mellitus, bronchial asthma, and tuberculosis history.

**Preoperative FNAC report**

In our study majority of patients who underwent surgery had preoperative FNAC report showing colloid goiter followed by

**Table 1:** The preoperative FNAC report.

	Group A	Group B
Colloid goitre	10	8
Papillary carcinoma	5	7
Follicular neoplasm	10	3
Hurthle cell neoplasm	4	1
Lymphocytic thyroiditis	1	1

**Table 2:** There were total 50 patients in our study out of which 30 patients underwent hemithyroidectomy and 20 patients underwent total thyroidectomy.

Group A	Group B
Hemithyroidectomy	Total Thyroidectomy
N-30	N-20

papillary carcinoma of thyroid, follicular neoplasm, hurthle cell neoplasm, and least common was lymphocytic thyroiditis (Figure 5 and Table 1).

**Surgical procedure done**

There were total 50 patients in our study out of which 30 patients underwent hemithyroidectomy and 20 patients underwent total thyroidectomy and were kept in Group A & Group B respectively (Table 2).

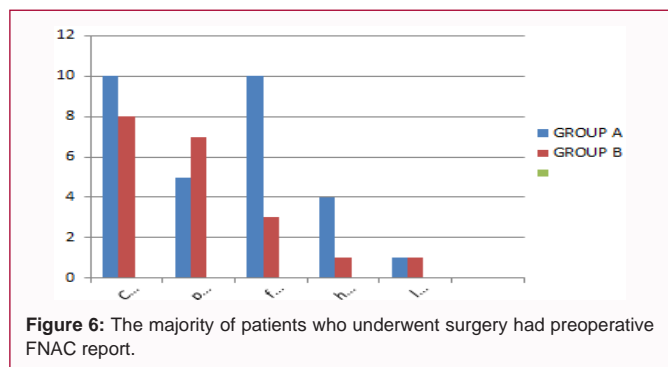
**Multidimensional voice program (MDVP)**

There were multiple parameters in our study that can be studied using software. But we had studied only fundamental frequency; mean fundamental frequency, average pitch period, standard deviation of fundamental frequency, jitter, shimmer, noise harmonic ratio, only.

**Fundamental frequency (F0):** It was found that the p value was less than 0.005, when mean of fundamental frequency were compared among two groups (Figure 6 and Table 3).

**Mean fundamental frequency (MF0):** Mean fundamental frequency was seen on higher side preoperatively in Group A as compared to Group B and p value was <0.005 (Table 4).

**Average pitch period (T0) in milliseconds:** There was no statistically significant difference seen between Group A & Group B



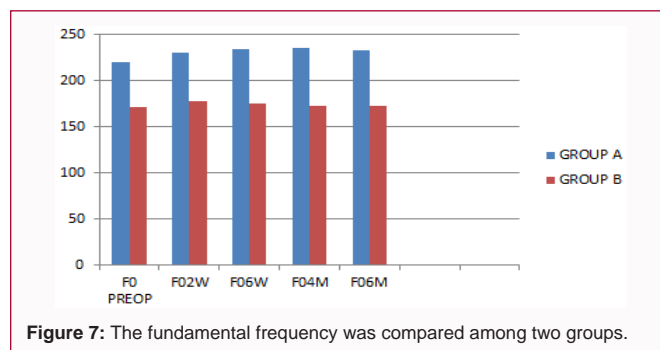
**Figure 6:** The majority of patients who underwent surgery had preoperative FNAC report.

**Table 3:** The fundamental frequency was compared among two groups.

F0	Group A (Mean Value)	Group B (Mean Value)
F0 PREOP	220	171
F0 2W	230	178
F0 6W	234	175
F0 4M	235	173
F0 6M	233	172

**Table 4:** The mean fundamental frequency values.

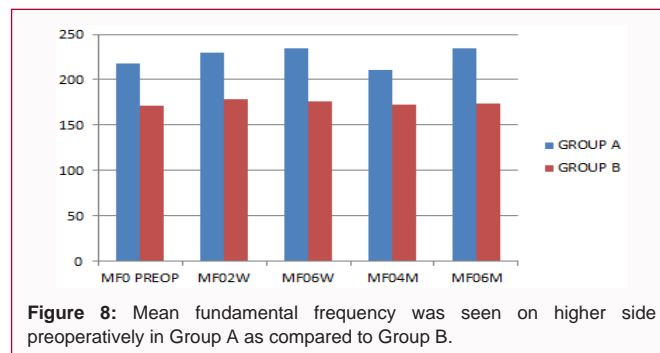
MF0	Group A	Group B
MF0 PREOP	218	171
MF0 2W	230	178
MF0 6W	234	176
MF0 4M	211	173
MF0 6M	235	174



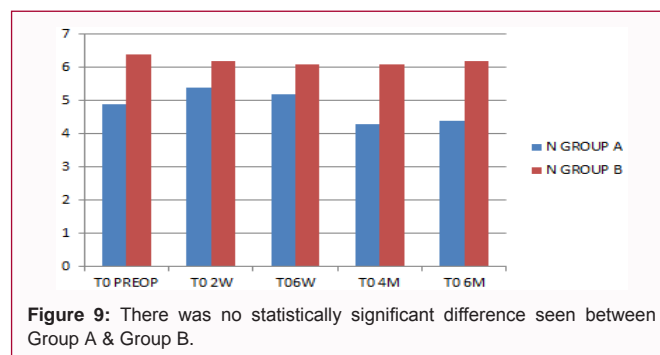
**Figure 7:** The fundamental frequency was compared among two groups.

**Table 5:** The Average Pitch Period (T0) in milliseconds values.

T0	Group A	Group B
T0 PREOP	4.9	6.4
T0 2W	5.4	6.2
T0 4W	5.2	6.1
T0 4M	4.3	6.1
T0 6M	4.4	6.2



**Figure 8:** Mean fundamental frequency was seen on higher side preoperatively in Group A as compared to Group B.



**Figure 9:** There was no statistically significant difference seen between Group A & Group B.

as the p value was >0.005 (Figure 7 and Table 5).

**Standard deviation of fundamental frequency (STD):** As p value is more than 0.005, there was no statistically difference seen among hemithyroidectomy and total thyroidectomy patients (Figure

**Table 6:** The Standard Deviation of Fundamental Frequency (STD).

STD	Group A (Mean Value)	Group B (Mean Value)
STD PREOP	2.3	1.68
STD 2W	2.5	1.7
STD 6W	2.2	1.5
STD 4M	2.3	1.3
STD 6M	2.2	1.2

**Table 7:** The Absolute Jitter (JITA) in micro seconds values.

JITA	Group A ( Mean Value)	Group B (Mean Value)
JITA PREOP	21.52	22.34
JITA 2W	30	27.37
JITA 6W	21.13	21.78
JITA 4M	26.72	21.81
JITA 6M	26.72	21.58

8 and Table 6).

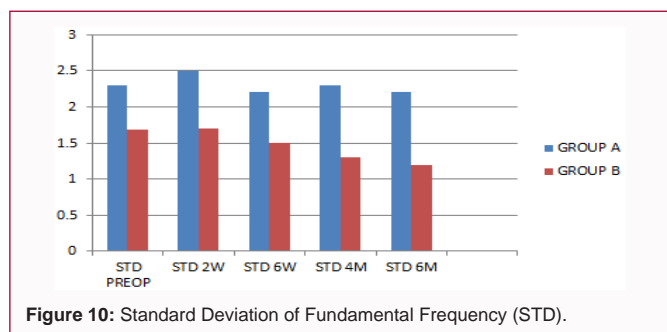
**Absolute jitter (JITA) in microseconds:** The p value was 0.002. We had seen significant changes in jitter on comparing two groups (Figure 9 and Table 7).

**Shimmer (Shdb) in decibel:** We had compared the mean value of shimmer among two groups and we found the p value was more than 0.005 (Figure 10 and Table 8).

**Noise harmonic ratio (NHR):** We had compared the mean value of NHR among two groups. The p value was 0.001 (Figure 11 and Table 9).

**Multidimensional voice program (MDVP):** We had studied fundamental frequency and when compared p value of significance among two groups following are the result as shown below. We had found that significant changes were seen in fundamental frequency, mean fundamental frequency, jitter, and noise harmonic ratio as p value was <0.005 while there were mild variations found in average pitch period, standard deviation of fundamental frequency, shimmer and but these variations were not statistical significant (Table 10).

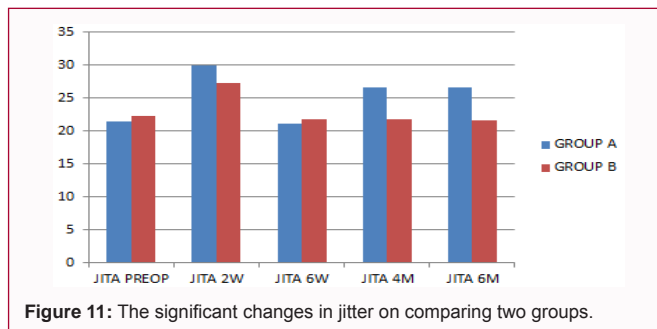
**Voice handicap index (VHI):** We had also compared the mean



**Figure 10:** Standard Deviation of Fundamental Frequency (STD).

**Table 8:** The Shimmer (Shdb) in decibel mean values.

Shdb	Group A (Mean Value)	Group B (Mean Value)
Shdb PREOP	0.27	0.32
Shdb 2W	0.34	0.34
Shdb 6W	0.34	0.35
Shdb 4M	0.35	0.36
Shdb 6M	0.33	0.41



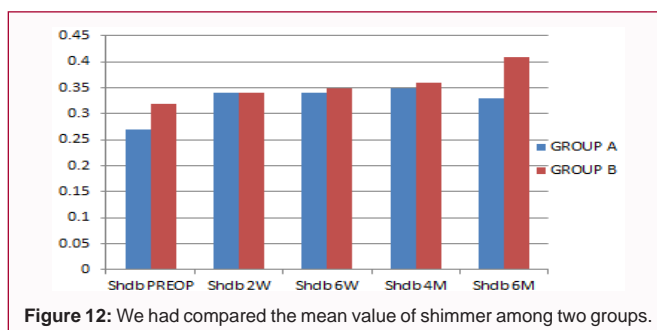
**Figure 11:** The significant changes in jitter on comparing two groups.

**Table 9:** The Noise Harmonic Ratio (NHR).

NHR	Group A	Group B
NHR PREOP	0.18	0.22
NHR 2W	0.19	0.21
NHR 6W	0.18	0.22
NHR 4M	0.18	0.23
NHR 6M	0.18	0.23

**Table 10:** The Multidimensional voice program.

Voice Parameters	P Value of Significance (<0.005)
F0	0
MFO	0
T0	0.085
STD	0.175
JITA	0.002
Shdb	0.226
NHR	0.001



**Figure 12:** We had compared the mean value of shimmer among two groups.

**Table 11:** The Voice Handicap Index (VHI).

VHI	Group A	Group B
VHI PREOP	0	0
VHI 2W	1.3	1.14
VHI 6W	0.2	0.12
VHI 4M	0.2	0.12
VHI 6M	0	0.12

value of VHI at every follow up. It was found that the p value was less than the 0.005 (Figure 12 and Table 11).

**Overall quality of life after thyroid surgery**

Overall quality of life after thyroid surgery, which was assessed using WHO QOL-BREF Scale questionnaire twice during a study period of 6 months one in preoperative period and another at the end of 6 months postoperatively. We studied overall quality of life

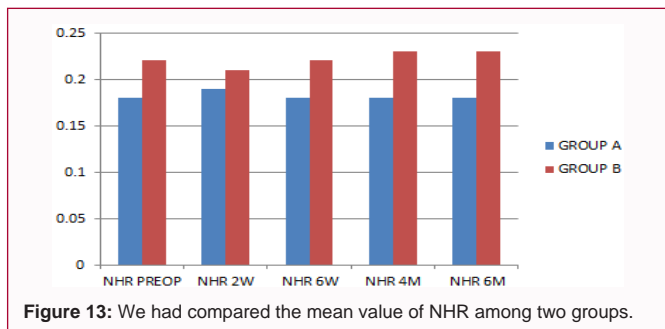


Figure 13: We had compared the mean value of NHR among two groups.

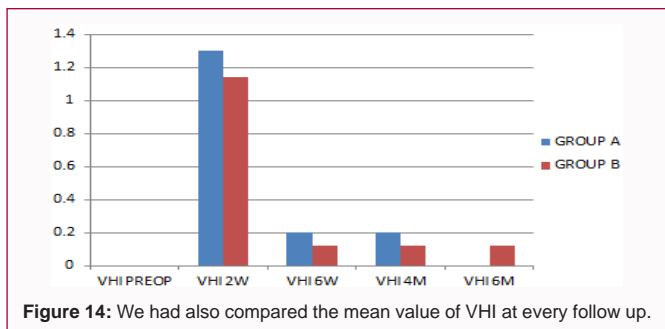


Figure 14: We had also compared the mean value of VHI at every follow up.

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	QQL1	23.62	50	3.257	.461
	QQLPOST1	25.52	50	1.776	.251
Pair 2	QQL2	18.00	50	2.365	.334
	QQLPOST2	22.66	50	1.780	.252
Pair 3	QQL3	10.00	50	1.629	.230
	QQLPOST3	10.90	50	1.035	.146
Pair 4	QQL4	24.10	50	3.228	.456
	QQLPOST4	26.34	50	2.144	.303

Figure 15: Overall quality of life after thyroid surgery, which was assessed using WHO QOL-BREF SCALE questionnaire twice during a study period of 6 months one in preoperative period and another at the end of 6 months postoperatively.

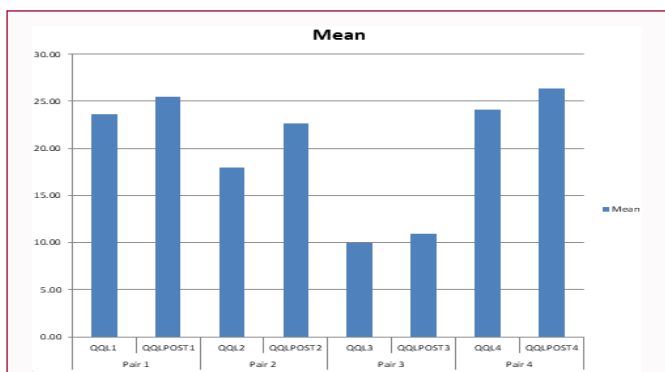


Figure 16: CAPE-V was performed by a dedicated speech pathologist. We studied that the Group A (mean = 0) and Group B (mean = 0.20).

in terms of four domains. These were physical psychological, social, environmental domains. We had compared the mean of preoperative and postoperative physical domain as pair 1 (mean =24.50 & mean =25.40), psychological (mean =18.10 & mean =22.35) pair 2, social (mean =10.40 & mean =11.20) pair 3, and environmental (mean =23.50 & mean =25.90) pair 4 respectively. There was statistically significant improvement seen in physical (p value =0.001) environmental (p value =0.005) social (p value =0.000) domain however improvement

Table 12: The Consensus Auditory-Perceptual Evaluation of Voice (CAPE-V).

CAPE-V	Group A	Group B
CAPE-V PREOP	0	0
CAPE-V 2W	0	0.2
CAPE-V 6W	0	0.2
CAPE-V 4M	0	0.2
CAPE-V 6M	0	0.2

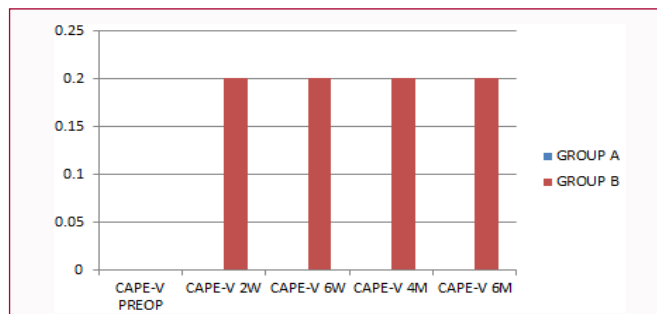


Figure 17: CAPE-V was performed by a dedicated speech pathologist. We studied that the GROUP A (mean = 0) and GROUP B (mean = 0.20).

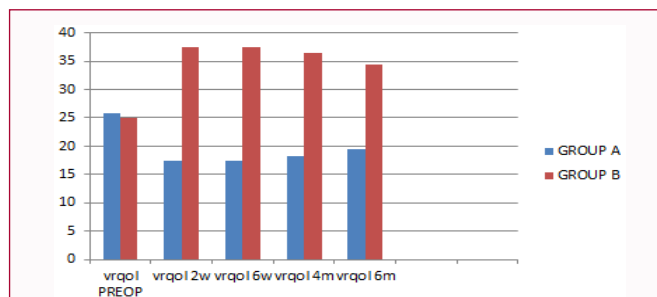


Figure 18: Voice related quality of life questionnaire showed that there was significant difference in mean value of voice related quality of life questionnaire post-surgery.

Table 13: Voice Related Quality of Life Questionnaire (VRQOL).

Vrqol	Group A (Mean Value)	Group B (Mean Value)	p value (<0.005)
Vrqol PREOP	25.83	25	0.414
Vrqol 2W	17.5	37.53	0
Vrqol 6W	17.5	37.5	0
Vrqol 4M	18.2	36.45	0
Vrqol 6M	19.53	34.45	0

in psychological domain (p value =0.164) was also seen but this was not statistically significant (Figure 13, 14).

**Consensus auditory-perceptual evaluation of voice (CAPE-V):** CAPE-V was performed by a dedicated speech pathologist. We studied that the Group A (mean =0) and Group B (mean =0.20). When we compared the mean value among two groups, even then p value is not significant (p value >0.005) (Figure 15, 16 and Table 12).

**Voice related quality of life questionnaire (VRQOL):** Voice related quality of life questionnaire showed that there was significant difference in mean value of voice related quality of life questionnaire post-surgery which was statistically significant as shown in (Figure 17, 18 and Table 13).

## Discussion

The main aim of our study was to determine the effect of thyroid

surgery whether hemi thyroidectomy or total thyroidectomy with intact recurrent laryngeal nerve injury on the subjective and objective voice quality using multipara-meter approach. In addition we had also assessed the voice related quality of life and overall quality of life in relation to physical, psychological, environmental and social domains of life. In our study, 50 patients presented with swelling in thyroid gland. Preoperative fine needle aspiration was done. Most of the patients were diagnosed with colloid goiter followed by papillary carcinoma of thyroid, follicular neoplasm, hurtle cell neoplasm and least common lymphocytic thyroiditis. All these patients underwent thyroidectomy. We divided these patients into two groups. Patients who underwent hemi thyroidectomy were kept in Group A (n=30) and total thyroidectomy in Group B (n=20). In our study all operations were performed by experienced surgeons under the same circumstances. Moreover, we did the voice assessment preoperatively and postoperatively in the similar situations by the same speech pathologist using the same voice assessment methods.

The two groups were homogenous in term of age. The mean age of patients was almost equal. Gender distribution was comparable among the two groups. Women outnumbered the men in both the groups. There was only one patient with hypertension who underwent total thyroidectomy. There was no other comorbidity found among both the groups. Majority of patients belonged to Himachal Pradesh followed by Punjab, Uttar Pradesh, Jammu & Kashmir, and Haryana.

When we compared preoperative and four postoperative values of the VHI, CAPE-V, VRQOL, we found that there were mild changes noticed in VHI which were maximum at 2 weeks followed by 6 weeks after that it returned to the normal in hemi thyroidectomy patients and near normal in total thyroidectomy patients over a period of 6 months. Kletzien H et al. [2] found that voice handicap index had maximum abnormal value at 2 weeks after that on serial examination it returned to normal preoperative value. We had concluded the same result in hemi thyroidectomy patients but the VHI returned to near normal in total thyroidectomy patients but never returned to the normal. Netto et al. [12] also found in their study that about 28 percent patients, who underwent total thyroidectomy, had shown higher VHI than presurgical value.

In our study we found that for CAPE-V score, there were no changes in hemi thyroidectomy patients while mild changes were noticed in total thyroidectomy patients who were persisted till 6 months but these were not statistically significant. There were no changes observed on 90 degree endoscopy on serial examination of vocal cord anatomy as well as mobility [19]. We had taken several surgical efforts to minimize the post-operative voice changes such as adequate hemostasis, careful dissection of the laryngeal nerves, and preservation of specific muscles important for normal voice production (i.e. sternothyroid, omohyoid necessary for lowering the larynx and sternohyoid necessary for lowering hyoid bone) [20-26].

We had done objective assessment of voice parameters using MDVP software. This software can study more than 20 acoustic parameters but we had evaluated only 7 parameters in our study. These parameters were fundamental frequency; mean fundamental frequency, average pitch period, standard deviation of fundamental frequency, jitter, shimmer, noise harmonic ratio. In our study, we concluded that preoperative value of fundamental frequency and mean fundamental frequency were lower in total thyroidectomy patients when compared to the hemi thyroidectomy patients. Overall we also found statistically significant changes in the fundamental

frequency, mean fundamental frequency, jitter and noise harmonic ratio. Sinagra et al. [20] found that 40 patients in their study had voice changes since the thyroid surgery, common changes were change in voice while speaking loudly, change in voice pitch, voice disorder while singing. He found statistically significant changes in Fundamental Frequencies (F0) which were comparable to our study. There were no statistically significant changes noticed in STD, shimmer, and average pitch period. Wong et al. [8] found significant changes in fundamental frequency and shimmer in early postoperative period while in our study we found significant changes in the fundamental frequency not in shimmer.

Chun et al. [27] did acoustic analysis and found no statistically significant changes in fundamental frequency, shimmer, jitter, noise harmonic ratio. In our study we found mixed results when compared with Chun et al. [21] as there were significant changes in fundamental frequency jitter and noise harmonic ratio but not in shimmer.

We had studied voice related quality of life as well as overall quality of life in all patients who underwent thyroid surgery. We concluded that voice related quality of life worsened more in total thyroidectomy patients till 6 weeks after that it reached the plateau while there was no worsening seen in hemi thyroidectomy patients.

Overall quality of life improved after thyroid surgery in our study. We had compared preoperative quality of life from postoperative quality of life at 6<sup>th</sup> postoperative months. We found that overall quality of life improved in terms of all physical psychological, environmental and social domains in both hemi thyroidectomy and total thyroidectomy patients. Our study showed statistically significant improvement in physical, environmental and social domains. However James et al. [19] conducted a survey to assess the quality of life in patients who underwent thyroidectomy and concluded that quality of life worsened after that.

We had done both subjective and objective evaluation of voice along with their impact on voice related quality of life and overall quality of life while most of the study done only subjective evaluation of voice or objective evaluation of voice or both. But they had not studied the voice related quality of life and overall quality of life together in a single study. In our study we had applied both VHI & VRQOL questionnaire and concluded almost similar results. Therefore VRQOL questionnaire is better than VHI because it includes only 10 questions when compared to VHI which have 30 questions and less time consuming. After this study, we found that voice changes may occur after thyroid surgery which are transients more during the initials 6 weeks of surgery after that these will return to normal or near normal and will not affect the voice related quality of life and overall quality of life. So it will be more helpful in preoperative counseling of patients who are planned for thyroidectomy.

## Limitations

- There was no control group in our study. We had compared the postoperative acoustic parameters with the preoperative values among our study groups and not with control groups.
- We had done study for 6 months only due to time constraints which was a relatively shorter duration to see the long term effects of thyroidectomy on the voice changes.
- We could not evaluate the role of intraoperative neuromonitoring because of omission at the time of study planning. It could have been more informative if we would have used it in our

study.

## Conclusion

- We had found that voice changes after thyroid surgery were mild, transient and more occurred till the first 6 weeks after thyroidectomy after that these returned to normal or near to normal.
- VHI and CAPE-V did not show the statistically significant difference between hemi thyroidectomy and total thyroidectomy patients. However both groups of patients showed more changes during the first 6 weeks in the postoperative follow up after that these returned to the normal.
- On analyzing the acoustic parameters on MDVP, F0, and MF0 were found to be on lower side and T0 which was found on higher side in total thyroidectomy patients but there was no significant difference seen when compared with hemi thyroidectomy patients. There were statistically significant variations seen in F0, MF0, JITA, and NHR among two groups but not in T0, STD, and Shdb.
- VRQOL was more affected in patients who underwent total thyroidectomy when compared with the hemi thyroidectomy patients.
- Overall QOL improved in terms of physical, psychological, social, environmental aspects in all the patients who underwent thyroidectomy either hemi thyroidectomy or total thyroidectomy.

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