

The Effectiveness of Pre and Post Operative study of Laryngeal Lesion on Aerodynamic and Acoustic Measurements

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INTRODUCTION

One of the important function of the Larynx is phonation. Voice is produced by the vibration of the Vocal Cords. Hoarseness or reduction in the voice is one of the symptoms of variety of laryngeal lesions affecting true Vocal cords. Thanks to the invention of Telendoscopes and Operating microscope in the field of diagnosis/surgery of laryngeal lesions, The use of these sophisticated instruments in disorders of vocal cord is unquestionable. The ability to assess initially the type and degree of impairment by subjecting the patient to various Aerodynamic Measurements pre-operatively and monitor the subjects progress post-operatively by using the same tests forms the basis of this study.

"With regard to Phonation, various methods have been proposed and used by many clinicians and researchers all over the world. Unfortunately, none of these methods appear to be standardized on an international basis. But majority of investigators seems to be in agreement in its significance of these tests and the interpretation of data obtained" (Hirato, 1981).

Michel and Wendhal (1971) consider Voice as a multidimensional series of measurable events and suggest twelve parameters for

assessing the Voice and Voice Disorders.

Imaizumi et al., (1980) and Kim et al., (1982) have used acoustic parameters to study the voice disorders. Some of the parameters suggested by Michel and Wendhal (1971), Imaizumi et al (1980) and Kim et al (1982) have been considered in the present study to assess the voice and its disorders.

The purpose of this study is to draw a conclusion regarding the usefulness of aerodynamic and acoustic measurements in cases of Laryngeal Lesions.

It has been found from this study that both tests are useful not only in diagnosis but also in monitoring the cases post-operatively. The following are the parameters used:

- 1 Aerodynamic Parameters
 2. Acoustic Parameters
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 - i. Vital Capacity
 - ii. Mean Air Flow Rate
 - iii. Phonation Quotient
 - iv. Vocal Velocity Index
 2. Acoustic Parameters
 1. Fundamental Frequency
 2. Phonation Duration

The following are the definitions of these parameters used in this study.

Aerodynamic Parameters:

i. Vital Capacity: Vital Capacity has been defined as the amount of air that an individual can expire after a deep inspiration.

The following instructions were given to the subjects-

Patient was made to stand and asked to take a deep breath and blow the air into the mouth piece as much as he/she can. Precaution was taken to see that no air escapes from the mouth piece.

Demonstration was given wherever necessary. The vital capacity was directly read from the vertical trace of the pointer on the graph. Three readings were taken with a rest of 2-3 minutes in between each trial. The maximum out of the three readings was considered as the Vital Capacity of the subject.

ii. Mean Air Flow Rate: It has been defined as the amount of air collected in one second during phonation at a given frequency and intensity.

The Test was conducted as follows:-

Patient was asked to sit comfortably on the chair and ask him to take deep breath and say /a/ into the mouth piece as long as he/she can, care was taken that no variation occurs in voice while saying /a/ and also care was taken that no air escapes either from nose or from the mouth piece.

An expirograph and a stop watch was used. The test was demonstrated by the tester.

The duration of the phonation was measured using the stop watch and the volume of air that it collected during phonation was directly read from the expirograph.

$$\text{Mean Air Flow Rate} = \frac{\text{Total volume of Air Collected During Phonation (in CC)}}{\text{Total Duration of Phonation (in Sec)}}$$

The Mean Air Flow rate was determined as follows:

The test was repeated thrice for each subject and with a rest of 2-3 minutes between each trial. The mean of the three readings was taken as the mean air flow rate for the individual.

iii. Phonation Quotient: It is defined as the Value obtained by dividing the Vital Capacity by the maximum phonation time-

$$\text{Phonation Quotient} = \frac{\text{Vital Capacity (in CC)}}{\text{Maximum Phonation Duration (in Sec)}}$$

Acoustic Parameters:

The Fundamental frequency (FO) and the fundamental period (P) are related as:

$$F.O. = \frac{1}{P}$$

For the measurement of fundamental frequency, a pitch analyzer (PM 100 Voice analyser) was used. The instrument is capable of analyzing phonation/speech from 1-18 KHz and it provides the mean fundamental frequency of Voice/Speech.

The Vowel /a/ recorded on the tape recorder was fed to the pitch analyzer using line feed. The mean fundamental frequency for vowel /a/ was obtained. Three recordings were taken. The average of the three fundamental frequency in Phonation for Vowel /a/ was taken for the study.

Phonation Duration: Defined as the duration of Phonation that means to say how long one can sustain phonation.

Test was carried out in sound treated room. The test was conducted as follows:

Following deep inspiration, the subject was asked to say /a/ as long as possible. Using a stop watch the duration of phonation for /a/ was noted. The whole test was repeated thrice with 2-3 minutes gap between the trials. The longest of the three

readings, was considered as the maximum phonation duration.

METHODOLOGY:

The present study consists of 30 cases of Laryngeal Lesions who were subjected for Microlaryngeal Surgery for the relief of Voice abnormalities.

All the cases were registered at All India Institute of Speech and Hearing, Mysore

Out of 30 cases investigations were complete in all respects in only 12 cases, Post-Operative aerodynamic and acoustic measurements were not done in twelve cases. Six cases did not turn-up for follow-up. Ultimately only 12 cases were included in this study.

Total No. of cases	12
Male	10
Female	2
Age Range	21-56 years

The main symptoms was alteration in Voice. Duration of Symptoms varied from 15 days to 3 years.

The cases were examined by an ENT Specialist using Hopkins Telescopes as a special instrument to study the Laryngeal lesions. Later they were subjected to Aerodynamic and acoustic measurements both pre and post-operatively by qualified Speech Pathologists at our Institute.

The following were the Laryngeal Lesions encountered pre-operatively and later confirmed by histopathology:

- i. Vocal Polyp
- ii. Vocal Nodule
- iii. Laryngeal Papilloma
- iv. Laryngeal Web.

All of them underwent microlaryngeal surgery under G.A. with endotracheal intubation. Induction was with pentothal and short acting muscle relaxant, maintained by

ga., Oxygen and halothar.

Apparatus used was Zeiss opening microscope with 10 fold magnification and appropriate microlaryngeal instruments was used to the cases,

Post Operatively absolute voice rest was observed for a week, later, allowed whispering for a week, then gradual use of the voice was allowed, along with metrical line of treatment.

Subjects were subjected Post-operative tests after 3-6 weeks time, and short period of voice therapy was give

The vital Capacity is very much reduced in Lung Pathology. The range is between 2500 - 4000 eu an/sq meter of surface area in Normals (Nataraja 1986) Pre-operatively in our study - It was 2079 cc with a standard deviation of 378 cc and Post-operatively, it was 2241 cc with a standard deviation of 403.

Shigemuri (1977) was of the opinion that phonation quotient is useful in monitoring the Surgical treatment in selected cases of Vocal Cord Lesions. The Phonation Quotient in Normals varies from 93 - 236 (Nataraja 1986). In our study group it was 274 with a standard deviation of 63 Pre-operatively and 217 with a standard deviation of 33, when we applied 'T' test there was no significant difference between pre and post-operative results. Our observation differ with the observation of Shigemuri, (1977). The fundamental frequency in normal varies from 96-164 Hz (Nataraja 1986). In our study group it was 151 Hz with a standard deviation of 54 Hz pre-operatively and post operatively it was 164 Hz with a standard deviation of 44.8 Hz when we applied 'T' Test - there was significant differences between the two results. Thus it helps in monitoring the cases where surgical intervention is needed.

DISCUSSION AND RESULTS

Table 1: T test results on various acoustic parameters

		Fundamental Frequency in Hz	Phonation duration in Sec	Vital Capacity in cc	Mean air flow Rate	Phonation Quotient	Vocal Velocity Index
Pre-	Mean	151	7.86	2079	228	274	0.111
Operative	S.D	54	1.94	378	64	63	0.002
Post	Mean	146	10.83	2241	140	217	0.006
Operative	S.D	44.8	2.44	403	40	33	0.001
'T Tests Results	.. +	+	-	+	-	+	

Table 2: Details of study results which were compared to other author Study Group

Comparative results		Pre-operative Study Present	NP. Nataraja's Study	Post Operative Study	NP. Nataraja's Study (normals range)	T ¹ Test Results.
Fundamental Frequency	Mean S.D.	151 Hz 54 Hz		164 Hz 44.8 Hz	96-164 -	+
Phonation- Duration	Mean SD	7.86 Sec 1.96 Sec	- 10.43	10.83Sec 2.44Sec	- -	+
Vital- Capacity	Mean SD	2079 cc 378 cc	- 2250-3250	2241 cc 403 cc	2500-4000 cc -	+
Mean Air Flow Rate	Mean S.D.	278 cc 64 cc	267.90 -	40 cc 40 cc	77-154 cc -	-
Phonation Quotient	Mean S.D	274 63	- 378.54	217 33	93-236 -	
Vocal Velocity Index	Mean S.D	0.111 0.002	- 8.87	0.006 -	0/02-0.05 -	

The Phonation duration in normals is 11.30 Sec (Nataraja 1986). In our study group it was 7.86 Sec with a standard deviation of 1.94 Sec. pre-operatively and post-operatively- it was 10.03 Sec with a

standard deviation of 2.44 Sec. When 'T' Test was applied there was significant differences between the two results. Once again this test is also useful in monitoring the cases post-operatively.

Shigemuri (1977) was of the opinion that in case of Laryngeal Nodules, Polyps and Polypoid growths over the Vocal Cords, the Phonation duration is valuable test for monitoring the effect of surgical treatment while dealing with the above lesions.

Mean air flow rate in normals was 77-154cc/sec (Nataraja 1986), in our study group it was 228 cc/sec with a standard deviation of 64 cc/sec Pre-operatively and Post-operatively - It was 140/sec with a standard deviation of 40cc/sec 'T' test showed significant differences in both results. Hence it is also one of the useful test in monitoring the cases post-operatively.

In pathological lesions, Mean Air Flow Rate exceeds normal. Shigemuri (1977) reported a positive relationship between mean air flow rate and the size of the lesions 1975, Hirano, Saito (1977), Shigemuri, (1977).

Vocal Velocity Index in normals was 0.02 - 0.05 (Nataraja, 1986). In our study it was 0.111 with a standard deviation of 0.002 pre-operatively and post-operatively - It was 0.006 and standard deviation of 0.001, when T Test was applied. There was significant differences between the two results. Thus Vocal Velocity Index is useful in Laryngeal pathology both at pre and post surgical levels.

In conclusion out of 6 parameters we used in our studies, the Vital Capacity and Phonation Quotient did not show any significant differences between pre and post operative results when 'T¹' test was applied.

Other four parameters like fundamental frequency, phonation duration, mean air flow rate vocal velocity index showed significant differences when 'T¹' test was applied to pre-operative and post-operative results which was in cuncurrent opinion with many authors (Shigemuri, (1977), Hirano (1975), Saito (1977).

Phonation Quotient did not turn-up as a useful test in our study group unlike that of Shigemuri (1977) who was of the opinion that it helps in monitoring the surgically handled cases of Laryngeal Lesions.

CONCLUSIONS:

1. Six Parameters were used to study the Laryngeal Lesions on the Vocal Cords.
2. The same six parameters were used Post-operatively of the same lesions.
3. The data was compared between pre-operative and Post-operative findings.
4. The Post-operative results were compared to normal data studied by other author.
5. Pre-operative data was compared to dysphonic group of other author's study cases.
6. 'T' Test results showed that significant differences in fundamental frequency, phonation duration, Mean Air Flow Rate and Vocal Velocity Index, between pre and post-operative measurements, i.e. out of six Parameters used, four parameters showed significant differences in the results.

The role of team approach is once again stressed.

LIMITATIONS:

1. It is a small group study
2. Only limited parameters were used
3. Limited types of lesions were sub jected for study
4. Age range of the subjects were limited to 21-56 years.

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