



AN OBJECTIVE LOOK INTO CHANGES IN VOICE POST THYROIDECTOMY DUE TO EXTERNAL BRANCH OF SUPERIOR LARYNGEAL NERVE INJURY - A CLINICAL STUDY

ENT

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ABSTRACT

Voice dysfunction after thyroidectomy is known to be a major concern for the surgeons. Prevalence of injury to EBSLN (External branch of superior laryngeal nerve) has been reported to be 58%, leading to enumerable voice changes clinically. Identification of Injury to EBSLN is often challenging. We used pitch, jitter, shimmer as basic acoustic measures and to analyze and describe acoustics. Using 'PRAAT' standardized software we assessed the outcome of EBSLN after 6 weeks of surgery. **Aims:** To determine subjective and objective changes in measures of voice function caused due to EBSLN injury during thyroidectomy. **Methodology:** This Cross-sectional descriptive study evaluated 50 patients presenting with thyroid swelling to the ENT OPD in a tertiary hospital in Karnataka, who underwent thyroid surgery. Subjective interview and Voice analysis was done using PRAAT Software pre- and post-surgery. **Results:** Of 50 patients evaluated, 2 patients had easy voice fatigue and decreased pitch after surgery. Perceptual postoperative analysis showed 22%, 48% and 14% had hoarse, harsh and breathy voice respectively. Objective postoperative analysis shows 42% ($p = 0.001$) had increased Jitter and Shimmer parameters. The overall incidence of EBSLN injury was found to be 84% ($p = 0.001$). **Conclusion:** The Subjective and Objective voice measures show statistically significant changes in the acoustic voice parameters with no subjective perception of voice change in majority of patients post-surgery. Along with multi- dimensional Voice analysis this protocol can serve as a useful adjuvant to evaluate and correlate long-term outcomes of EBSLN injury.

KEYWORDS

Thyroidectomy, PRAAT Program, EBSLN Injury, Voice changes.

INTRODUCTION

Injury to Laryngeal nerves is one of the most common complications of thyroid surgery. RLN (Recurrent laryngeal nerve) injury is well recognized as attributed to easy identification clinically whereas SLN injury is less researched. Injury to SLN can occur in various fashions like injury to Internal branch, external branch or trunk of SLN. Identification of Isolated injury to EBSLN is challenging due to subtle signs and symptoms.[1]

Symptoms of EBSLN (External branch of superior laryngeal nerve) injury is non- specific and clinical signs like bowing of vocal cord, inferior displacement of affected cord and ipsilateral rotation of posterior glottis are subtle findings that may be easily missed on indirect laryngoscopy which renders difficulty in identifying and become often overlooked resulting in voice changes, impacting patient's quality of life.[2]

EBSLN is at potential risk due to its close proximity and highly variable anatomical relationship with the superior thyroid pole, superior thyroid vessels.[3] Its damage may negatively affect the patient's quality of life posing significant complication not only for voice professionals but for all patients leading to deterioration in voice quality by causing a decrease in volume, difficulty in changing the pitch range, and clinical signs of vocal fatigue. Recent studies have shown that awareness of the consequences of EBSLN injuries is gradually increasing.[4]

PRAAT Program is a flexible tool used in analyzing the several acoustic parameters by providing non- invasive objective measures of vocal function at an affordable cost.[5] Therefore, the study gains significance in determining the EBSLN injury causing changes in both subjective and objective acoustic voice parameters with successful monitoring changes in voice quality.

The aims of this study are:

- 1) To determine the Incidence of EBSLN.
- 2) To determine probable subjective and objective changes in measures of voice function caused due to EBSLN injury post thyroidectomy

METHODOLOGY

Source of Data:

Patients of either sex in age group of 18-75 years attending ENT OPDs are selected at Bapuji Hospital, and Chigateri District Hospital, teaching hospitals attached to J.J.M Medical College, Davanagere.

Study of Design: Cross sectional descriptive study.

Study Duration: August 2022 – July 2024

Sample Size: 50 patients attending OPD with symptomatic thyroid swelling who fulfilled all inclusion and exclusion criteria.

Inclusion Criteria

- Patients of either sex
- Age group 18-75 years.
- Symptomatic patients with single or multiple thyroid swelling
- Patient with biochemically proven euthyroid state. Fine needle aspiration proved benign lesions.

Exclusion Criteria:

- Patients below 18 years and above 75 years
- Patients with other co-morbid condition
- Patients with biochemically proven abnormal thyroid profile.
- Patients with Fine needle aspiration proved malignancy.
- Patients with intubation or extubation injuries.
- Patients not willing to take part in the study.

Data Collection

Those patients attending ENT OPD with symptomatic thyroid swelling who fulfilled all inclusion criteria and exclusion criteria and are willing to participate in this study will be selected, informed and written consent taken from all patients.

During the study, 50 patients with symptomatic thyroid swelling presenting to OPD with biochemically proven euthyroid state after ultrasound neck and fine needle aspiration cytology proved benign lesions are selected.

Statistical Analysis

- Statistical analyses were performed using IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp.
- Results on continuous measurements were presented on Mean $\pm$ SD & categorical as Frequency (Percentage).
- Comparison of categorical pre- and post-values was done using the Chi-square, Fisher exact test, and continuous was done using a Paired t-test.
- A p value of <0.05 was considered statistically significant.

The patient diagnosed with a thyroid swelling after a detailed history, clinical examination and answering the VHI10 Questionnaire [6]. All 50 patients operated underwent Preoperative voice analysis and at 6 weeks postoperatively (for the edema or the intubation injuries, if any, to subside). While recording the PRAAT software was set to mono

sound and frequency was set to a standard of 44100Hz. Both Perceptual and Objective analysis were done by a professional Audiologist and Speech therapist.

Voice analysis protocol: Recordings were done in a soundproof room, patient was provided with a microphone, keeping mouth-to-microphone distance at least 30cm.

Voice analysis technique: The starting point of the method of voice analysis was the recording of an initial voice pattern. We used Kannada vowels “/a/”, “/i/”, “/u/” was recorded taking into account the following conditions: the microphone was set at a distance of 30 cm from the oral cavity for at least for 2-3seconds to avoid distortions or modifications in the recording; and the emission lasted for 2 seconds because a longer emission is considered singing voice.

Voice/speech material: An example of protocol for standard recording: – /a:/ at (spontaneous) comfortable pitch/loudness, recorded three times to evaluate variability of quality – /a:/ slightly louder, to evaluate the possible change in quality.

A pre-requisite- recording a voice sample: Audio recording is the most valuable basic tool for voice assessment. It is essential that all recordings of voice patients are filed as an archive, where it is easy to retrieve an earlier voice sample. A sampling frequency of at least 20,000 Hz is recommended. The recordings should be made ideally in a sound-treated room, but a quiet room with ambient noise < 50 dB is acceptable. The mouth-to-microphone distance needs to be held constant at 10 cm. A (miniature) head-mounted microphone offers a clear advantage, but a harmonica holder is also effective. Off axis positioning (45–90° from the mouth axis) reduces aerodynamic noise from the mouth in speech.

Perceptual assessment: Analysis was performed using a standard grading system as follows, GRBAS VOICE RATING BY KENT R.D. Each component is rated on a 4-point rating scale [7]

0 - Normal

1 - Mild deficit

2 - Moderate deficit

3 - Extreme deficit

G (Grade) Degree of abnormality of voice

R (Rough) Irregularity of vibration (Jitter and shimmer)

B (Breathy) Degree of air leakage

A (Asthenic) Weakness or lack of power

S (Strained) Acoustic impression of hyperfunction

Objective acoustic analysis

PITCH: MALE 80 - 120 Hz

FEMALE 180 - 240 Hz

JITTER: <0.3%

SHIMMER: 5%

Objective parameters were reported according to the given standardized ranges. The data collected from evaluating the 50 patients was compiled and analyzed.

Voice recording of patient during preop assessment while the patient says //a//, duration of 1second is selected from the graph to generate a voice report. Pitch, Jitter and Shimmer parametric measures are taken in consideration in our study.

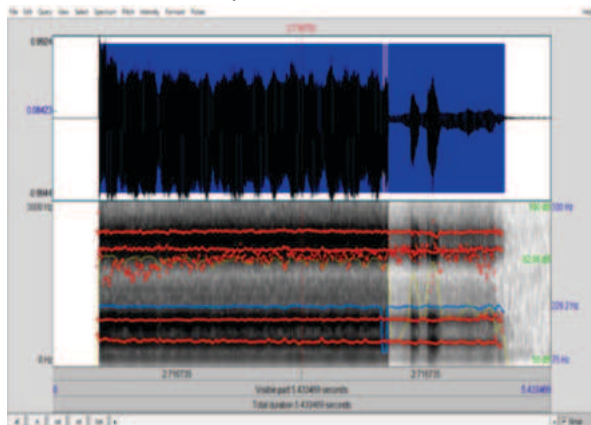
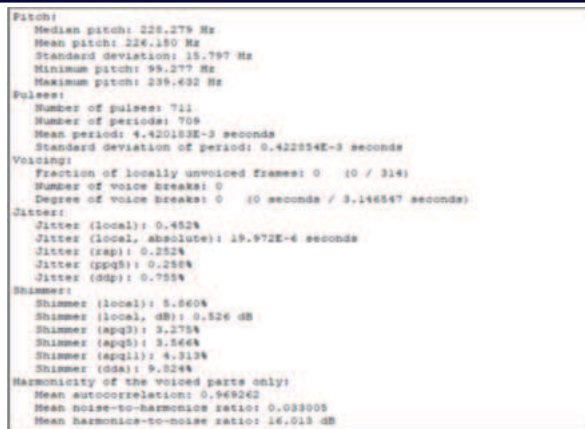


Fig 1: Voice Assessment Graph



impairing the quality of life.

Recent findings reveal multiple roles of EBSLN in voice and speech, its injury can pose variety of voice problems including serious threat of handicap. Therefore, isolation of this nerve during thyroid surgeries becomes important.

This cross-sectional descriptive study was conducted to evaluate EBSLN injury incidence and its outcome using the PRAAT Program. Patient's voice was recorded while they say the vowels; “/a/”, “/i/” and “/u/” both preop and postop (6 weeks after the surgery). PRAAT analyzed variation in pitch, jitter and shimmer basic acoustic measures.

The voice recordings of these patients were analyzed with perceptual and objective parameters to look for EBSLN injury. Perceptual postoperative voice analysis shows that 22%, 48% and 14% had hoarse, harsh and breathy voice respectively. Whereas in Objective postoperative analysis 42% ($p = 0.001$) had increased jitter and shimmer parameters. With these results, the overall incidence of EBSLN injury was found to be 84% ($p = 0.001$).

Menon RR et al [8] proposed that injury to the EBSLN in thyroidectomy is up to 58%. A study by Andre S et al [9] states that the aerodynamic measures have shown increased subglottic pressures and decreased airflow when the Cricothyroid muscle is paralytic, as well as increased jitter. The EBSLN is often an overlooked and less researched nerve as the symptoms of its injury in the postoperative period are very less. The recognition of EBSLN injury is challenging.

Mild changes to the speaking voice have been described, as the singing voice is more severely affected. Symptomatic patients complained of voice that is weak, breathy, monotonous and characterized by compression on the pitch range with inability to achieve high pitch tasks. Some patients also complained of weakness, tightness, and increased effort to speak.

In a study by Uludag M et al [10], the superior thyroid vasculature was individually ligated on the thyroid capsule and no further dissection in search of the EBSLN was undertaken when it could not be readily identified in order to avoid injury to the nerve. The incidence of EBSLN injury in this study (2%) on the basis of this surgical technique compares favorably with other modern published series (0–14%). The relationship of the EBSLN to the vasculature and its course to the inferior constrictor muscle was variable, and it could not be identified in 66% of patients.

There are several technical approaches to preserving the integrity of the EBSLN, including isolation and individual ligation of the superior pole vessels adjacent to the thyroid capsule, identification of the EBSLN prior to securing the vasculature in the same manner, and neuromonitoring of the EBSLN during thyroidectomy.

A study by Aygun N et al [4] shows that the external branch of superior laryngeal nerve is in close proximity with large goitre which is classified as type 2b according to Cernea classification; used to assess the risk of external branch of superior laryngeal nerve injury during thyroid surgery.

A comparative study by Neri et al [11] between 15 patients who underwent thyroidectomy out of which were identified with SLN (superior laryngeal nerve) lesion and in 8 patients the nerve was identified and preserved. At the end of 12 months of post-surgery period, videolaryngostroboscopy and voice acoustic features through spectrographic analysis were carried out in both the groups, and the reports stated that compared to patients without SLN injury, the patients with SLN lesion had an alteration of F0, show a lower energy level with modified spectrographic quality.

A prospective single-arm study by Stojadinovic et al [12], patients who were selected for thyroid surgery underwent voice assessment using a standardized voice grading scale and a battery of other voice assessments before the surgery, 1 week and 3 months after the surgery. 14% of patients with EBSLN injury had postoperative voice changes.

CONCLUSION

From the data obtained in our study we have come to a conclusion that EBSLN is often injured to varying degrees during thyroid surgeries.

The Perceptual and Objective measures of voice evaluation show that there is changes in the voice assessment parameters even though majority of patients subjectively, does not complaint of any changes in voice post-surgery.

This study is one of the few pioneering looks into EBSLN injury and voice changes post-surgery using the PRAAT system. Therefore, voice assessment protocol can serve as an adjuvant.

Limitation of this study includes the study population. Hence further studies using PRAAT system in a multi-dimensional aspect is required to evaluate and correlate long-term outcomes of EBSLN injury and associated voice changes.

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