A Dissertation on

‘A COMPARITIVE STUDY FOR ASSESSMENT OF VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY.

Submitted to the

THE TAMILNADU DR. M.G.R. MEDICAL UNIVERSITY

In Partial fulfillment of the requirements

For the award of the degree of

M.S. BRANCH IV

(OTORHINOLARYNGOLOGY)

GOVERNMENT STANLEY MEDICAL COLLEGE & HOSPITAL

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MAY 2022

DECLARATION

I, **Dr. S. DENNY,** solemnly declare that the dissertation, titled "A **Comparative study for assessment of vocal fold vibratory function in patients with thyroid neoplasm preoperatively and postoperatively**" is bonafide work done by me during 2019 to 2022 at Government Stanley Medical College and Hospital, Chennai under the expert guidance and supervision of

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CERTIFICATE

This is to certify that the dissertation - " **A Comparative study for the assessment of vocal fold vibratory function in patients with thyroid neoplasm preoperatively and postoperatively**" presented by **DR.S.DENNY**, is a bonafide original work done in the department of otorhinolaryngology, Government Stanley Medical College and hospital, Chennai in partial fulfilment of regulations of The Tamil Nadu Dr.M.G.R. Medical University, for the award of degree of M.S. (Otorhinolaryngology) Branch IV during the academic period 2019-2022.

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CONTENTS

INTRODUCTION :

A person’s voice is a very personal attribute that is dependent on signals from specialised areas of brain and a coordinated movement of laryngeal muscles. The vibrations of the two vocal folds in the middle of larynx sets up vibrations of air that resonates through the upper airway tract leading to the sounds of the voice. An abnormal voice makes mutual communication difficult, tiring and can lead to great social, occupational and emotional impairment. A generally accepted and pragmatic definition of **normal voice** is one having the following characteristics:

- It is audible, clear or stable in a wide range of acoustic settings
- It is appropriate for the gender and age of that individual
- It is capable of fulfilling its linguistic and paralinguistic functions
- It does not easily fatigue
- It is not associated with pain or discomfort on phonation

Thyroid neoplasms are a commonly encountered disease entity and surgical procedures for thyroid neoplasms, benign or malignant are common operations in the head and neck. Owing to the close anatomical relationship between the thyroid gland and the laryngeal nerves, hoarseness of voice due to intraoperative recurrent laryngeal injury is one of the most common complications. Recurrent Laryngeal Injury may include

- **Mechanical Causes** : Compression, Stretching, Crushing or Laceration
- **Thermal Causes** : due to the heat caused by instruments used to seal blood vessels
- **Vascular Causes** : ischemic injury

However, subjective voice complaints including voice fatigue were observed even in patients in whom the recurrent laryngeal nerves were preserved and vocal fold morbidity was endoscopically normal and the voice quality after thyroid surgery in such patients has not been well studied.

This observation of voice change and a frequent subjective assessment by the patient as to how different or abnormal his/her voice sounds after thyroid surgery are of concern to the patient. Although most post-operative voice changes resolve spontaneously within 3 to 6 months after thyroid surgery, patients might develop maladaptive compensatory mechanisms during the recovery period. Therefore assessment of vocal fold function is important in the preoperative and postoperative evaluation of patients undergoing thyroid surgery

Evaluation of vocal fold function starts with visual examination of the folds which can be done quite easily with an **Indirect Laryngoscopy mirror** in the outpatient setting. This enables the clinician to visualise the movements of vocal folds in response to sounds produced by the patient without the need for any special equipment. However the lack of magnification and poor illumination makes it difficult to get an ideal view of the surface of vocal folds. With the advent of endoscopes it is now possible to get a magnified and better visualization of vocal folds and hence **Videolaryngoscopy** using 70-degree endoscope is a must in the evaluation of vocal fold function. Gross movements of vocal folds alone will not allow the clinician in the complete evaluation of its function, for which understanding and studying about its vibration pattern is crucial. Videolaryngoscopy is limited by its inability to detect vocal fold vibrations. Hence, the use of an advanced technique which can be used to analyse vocal fold vibratory pattern goes leaps and bounds in the evaluation of its vibratory function and this is **Videostroboscopy.** This can be combined with **Acoustic Analysis** for the better understanding of voice changes before and after thyroid surgery.

Subjective evaluation of voice by the patients is equally important in understanding the effect of sound of their voice on their daily activities of life for which **Voice Handicap Index Questionnaire** can be used.

In this study, the vocal fold vibratory function and the voice of patients with thyroid neoplasms were studied before and after thyroid surgery. All the patients participating in this study were subjected to Videolaryngoscopy, Videostroboscopy, Acoustic Analysis and Voice Handicap Index Questionnaire before thyroid surgery. These patients were followed up and at 6 weeks postoperatively were subjected to the same tests and the results were compared.

AIMS AND OBJECTIVES

Aim of this study is to compare the vocal fold vibratory function in patients with thyroid neoplasm preoperatively and postoperatively

Objectives include

- To compare vocal fold vibratory changes in patients with thyroid neoplasm preoperatively and postoperatively
- To compare the parameters of voice in patients with thyroid neoplasm preoperatively and postoperatively
- To assess the importance of voice subjectively in patients with thyroid neoplasm preoperatively and postoperatively using Voice Handicap Index

REVIEW OF LITERATURE

In a study conducted by Alexabder Stojadinovic et al, New York, 2002, 44 patients with preoperative normal vocal function were enrolled to study voice evaluation after undergoing thyroid surgery.14%(7 patients) reported voice change at 6 weeks. 2 of the symptomatic patients had postoperative videostroboscopic changes. 3 of the asymptomatic patients had abnormal videostroboscopy. 1 had irregular contact and the other two had unilateral reduction in mucosal wave.

In a population based study published by Kevin Kovatch et al, Michigan, 2019, 2325 patients with normal preoperative vocal function were enrolled in the study. Of these 599 (25.8%) reported voice change at 8 weeks postop of which 272 patients (12.7%) were identified as having an abnormal VHI-10 score and 4.7% had vocal fold impairment diagnosed by laryngoscopy.

In a study published by Serdar Akyildiz et al. Bornova, 2008, 36 patients with preoperative normal vocal function undergoing thyroid surgery were enrolled. On postoperative examination of objective voice changes, thyroidectomy had no multivariate effect on vocal parameters with preserved laryngeal nerve function.

In a study published by Nisha S et al, India, 2021, 50 patients with normal preoperative vocal function requiring thyroid surgery were enrolled in the study. Postoperative examination at 6weeks, 16 weeks and 24 weeks showed statistically significant changes in VHI (p <0,0005). There were significant changes seen in fundamental frequency, jitter and noise to harmonics ratio during 6 months.

RELEVANT ANATOMY

Embryology:

The embryology of the larynx was well studied during the first half of 20th century. In the 2mm embryo, a median pharyngeal groove presages the first appearance of the respiratory tract. The larynx, bronchi arise from a ventromedial diverticulum of the foregut called the ***tracheobronchial groove*** at about 25 days of intrauterine life. At 33 days of life, laryngeal primordia appear. The laryngeal aditus or slit is altered by the growth of three tissue masses : Anteriorly, the primordium of the epiglottis(from the hypobranchial eminence, arches III and IV) and laterally from the precursors of the arytenoid cartilages (ventral ends of arch VI)

In the 13 to 17mm embryo, laryngeal cartilage and muscle development is clearly identifiable and lateral cricoid condensation is underway. By the seventh week of development, the cricoid ring is complete and the cartilaginous hyoid is visible below the epiglottis. By the end of the embryonic period (27-31mm crown-rump length), the larynx is a well- formed organ.

Anatomy:

The larynx extends from the laryngeal inlet to the inferior border of the cricoid cartilage. In the absence of respiration at neutral lung volume, it lies in front of the third to sixth cervical vertebrae, being a little higher in women.

The infantile larynx is proportionally smaller than that of the adult compared to body size and is more funnel shaped. Its narrowest portion is at the junction of the subglottic larynx with the trachea. In contrast the narrowest portion of an adult larynx is the glottis. Infantile larynx has softer laryngeal cartilages and hence collapse more easily on forced inspiration as a consequence of Bernoulli effect. As larynx grows there is little difference in its size between boys and girls until after puberty when the Antero-Posterior diameter of the larynx almost doubles in men to reach a final AP diameter average of about 36mm in men and 26mm in women.

The larynx is anatomically divided into supraglottis, glottis and subglottis by the false and true vocal folds. In craniocaudal direction, the supraglottis commences at the epiglottis and aryepiglottic folds as they sweep down to the arytenoids. Its lower border is a horizontal line drawn through the apex of the laryngeal ventricle. This line, therefore, forms the upper border of glottis. The glottis extends caudally from this line and includes the vocal folds as well as anterior commissure and posterior commissure. The line of demarcation between glottis and subglottis is accepted to be a line drawn 1cm below the free edge of the vocal folds. The subglottis becomes the trachea at the lower border of the cricoid cartilage.

The framework of the larynx consists of the hyoid bone and a number of cartilages connected by ligaments and membranes as well as intrinsic and extrinsic muscles. It is lined with a mucous membrane that is continuous above with the pharynx and below with that of the trachea. The spaces around the larynx are filled with adipose tissue and loose connective tissue.

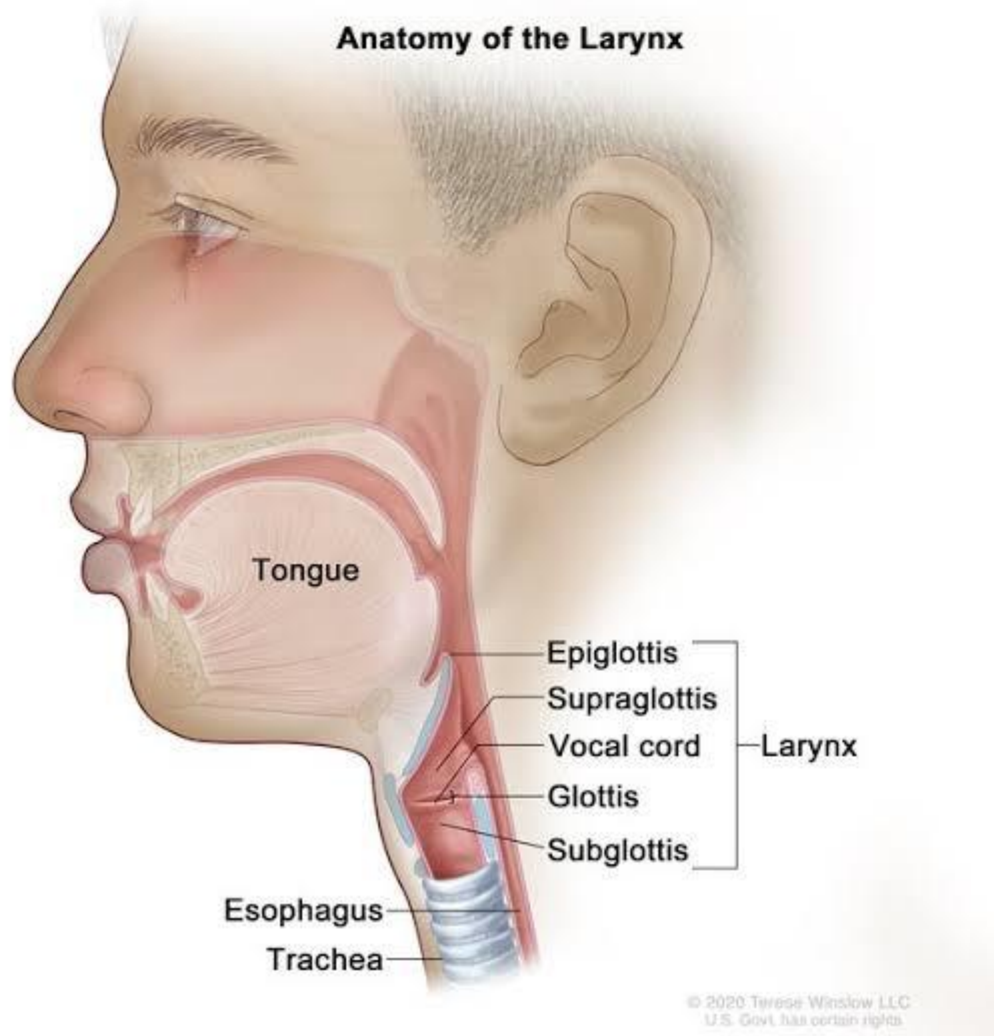
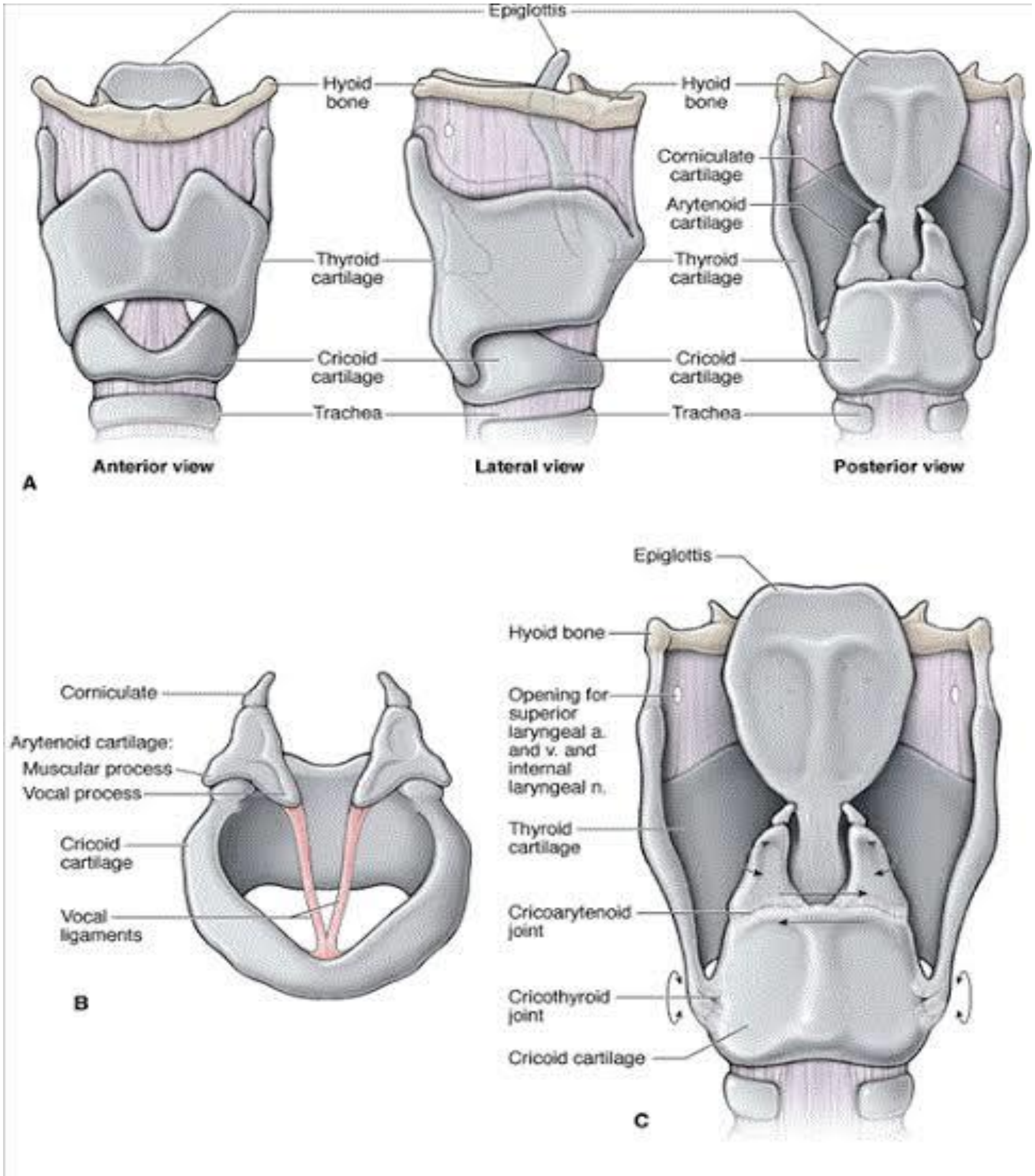


Figure 1 : Sagittal view of larynx anatomy

FRAMEWORK OF LARYNX :

The skeletal framework of the larynx is made up of the following:

- Hyoid bone
- Unpaired cartilages: epiglottis, thyroid cartilage, cricoid cartilage
- Paired cartilages: arytenoid, cuneiform, corniculate.



Source: Morton DA, Foreman KB, Albertine KH: *The Big Picture: Gross Anatomy*: www.accessmedicine.com

Figure 2 : Framework of Larynx

Hyoid Bone:

The hyoid bone is a U shaped bone that is suspended by several suprahyoid muscles and ligaments from the bony structures of the skull base and mandible. The hyoid bone consists of a body anteriorly from which the greater cornua project backwards on each side. The lesser cornua are two small conical eminences that are attached to the upper aspect of the body of the hyoid laterally, either by a fibrous band or, sometimes, by way of a synovial joint

Epiglottis:

The epiglottis is a thin, leaf-like sheet of elastic fibrocartilage that projects upwards behind the tongue and the body of the hyoid. It is attached inferiorly to the thyroid cartilage, just below the thyroid notch in the midline, by the thyroepiglottic ligament and to the hyoid bone anteriorly by the hyoepiglottic ligament. The space between these ligaments forms the pre-epiglottic space. The laryngeal surface of the cartilage is indented by numerous small pits into which mucus glands project. The lingual surface of the cartilage is covered with mucous membrane superiorly and forms the posterior wall of the vallecula.

Thyroid Cartilage:

It is the largest cartilage and forms a prominence in the neck (*Adam's apple*). It is composed of two laminae that are fused in the midline anteriorly giving rise to the laryngeal prominence. The angle of fusion is about 90 degrees in men and 120 degrees in women. The posterior border of each lamina is prolonged above and below to form superior and inferior cornua, respectively. On the external surface of each lamina an oblique line is situated just in front of the root of the superior horn and it marks the attachment of the thyrohyoid, sternothyroid and inferior constrictor muscles. This cartilage is connected to the hyoid bone by the thyrohyoid membrane and to the cricoid cartilage by the cricothyroid membrane.

Cricoid cartilage:

The cricoid cartilage is the only complete cartilaginous ring in the airway. It is thicker and stronger than thyroid cartilage. It is narrow in front and broad behind. There is vertical ridge in the midline of the posterior surface of lamina which gives attachment to the longitudinal muscle of the oesophagus. The cricoarytenoid joint together with its associated functional Posterior cricoarytenoid muscle is regarded as a key functional unit of the larynx, facilitating vocal fold mobility.

Arytenoid cartilage:

They are irregularly shaped, three sided pyramidal hyaline cartilage and its base articulates with the cricoid cartilage. This cartilage has a forward projection, the vocal process, and a lateral projection, the muscular process Has two processes-the vocal process and muscular process. The posterosuperior part of conus elasticus is attached to vocal process and muscular process gives attachment to cricoarytenoid muscle.

Corniculate Cartilage (Cartilage of Santorini):

They are two small conical nodules of elastic fibrocartilage, which articulate through a synovial joint with the aryetenoid cartilages.

Cuneiform Cartilage (Cartilage of Wrisberg):

They are two small, elongated flakes of fibroelastic cartilage, one in each free margin of the aryepiglottic fold.

MUSCLES OF LARYNX:

Muscles of larynx are divided into two groups, extrinsic muscles and intrinsic muscles.

Extrinsic group of muscles:

The extrinsic muscles of the larynx attach the larynx to the neighbouring structures and maintain the position of the larynx in the neck. These include the infrahyoid and suprahyoid muscles.

Intrinsic group of muscles:

The intrinsic muscles are all paired and function in a coordinated fashion to move the cartilages of the larynx thereby governing laryngeal function. They control the overall position and shape of the vocal folds as well as the elasticity and viscosity of each layer.

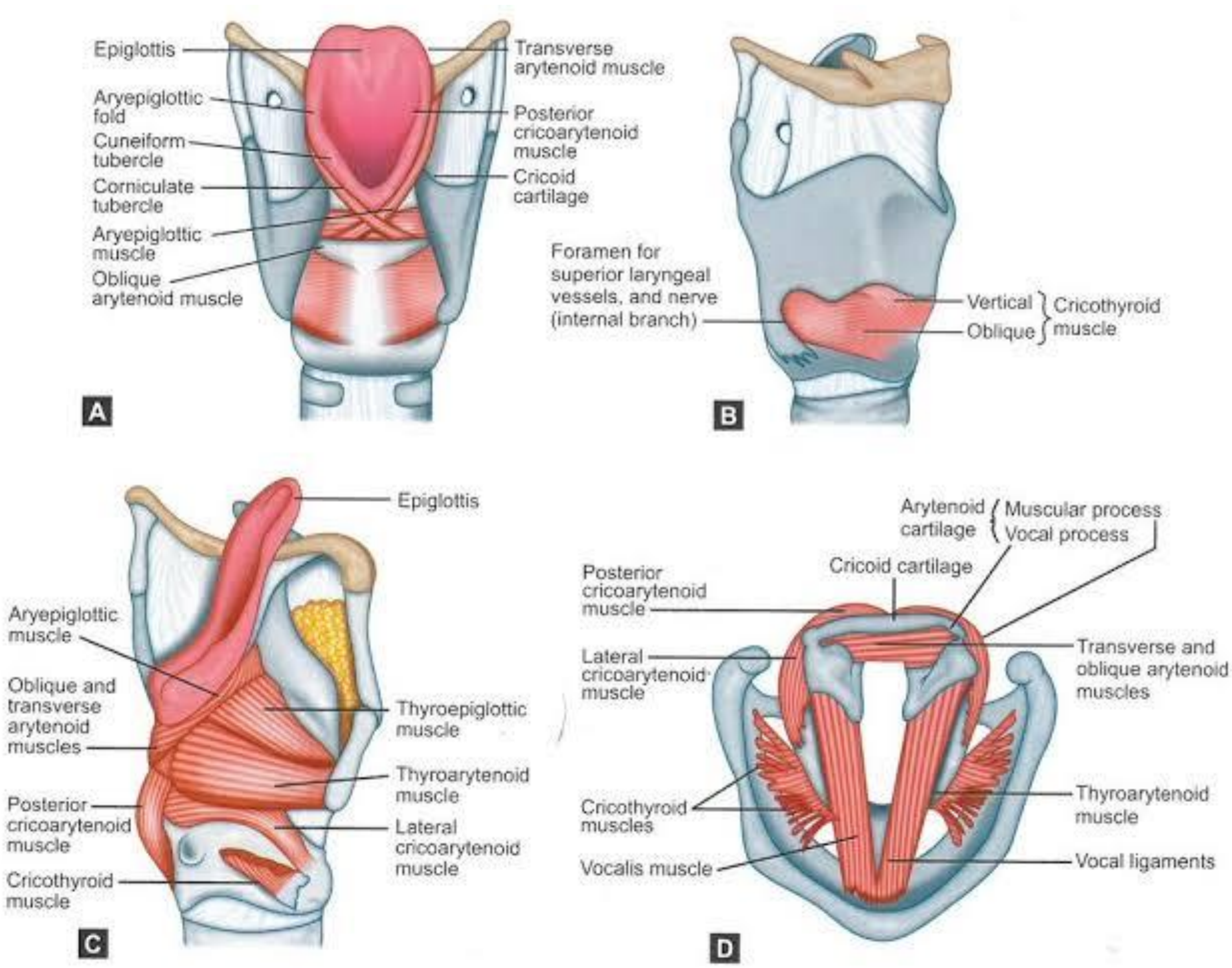


Figure 3 : Muscles of Larynx

The muscles are sub grouped according to their action:

1. **Adductors***:* These include the lateral cricoarytenoid muscles, cricothyroid and the interarytenoid muscle. The lateral cricoarytenoid is the main adductor. It arises from

upper border of the lateral part of the arch of cricoid and gets inserted into the muscular process of arytenoid.

2. **Abductor muscle***:* The posterior cricoarytenoids are the sole abductors of the vocal cords. The muscles arise from the lower and medial surface of the posterior of cricoid lamina and are inserted into the posterior of the muscular process of arytenoid on the same side. When these muscles contract, they move the vocal cords apart causing widening of the glottis.

3. **Tensors of vocal cords***:* These include cricothyroid and thyroarytenoid muscles.

	Cricothyroid	Vocalis	Lateral Cricoarytenoid	Interarytenoid	Posterior Cricoarytenoid
Position	Paramedian	Adduct	Adduct	Adduct	Abduct
Level	Lower	Lower	Lower	-	Elevate
Length	Elongate	Shorten	Elongate	Shorten	Elongate
Thickness	Thin	Thicken	Thin	Thicken	Thin
Edge	Sharpen	Round	Sharpen		Round
Muscle(Body)	Stiffen	Stiffen	Stiffen	Slacken	Stiffen
Muscle(Cover and Transition)	Stiffen	Slacken	Stiffen	Slacken	Stiffen

Table 1 : Functions of laryngeal muscles in vocal fold adjustments

NERVE SUPPLY OF LARYNX: The motor and sensory innervation of the larynx are derived from the vagus by way of its superior and recurrent laryngeal nerves. All the intrinsic muscles of larynx are supplied by recurrent laryngeal nerve except the cricothyroid muscle which is supplied by external branch of superior laryngeal nerve. The internal branch of superior laryngeal nerve supplies the mucous membrane of the lower part of epiglottis, vallecula, vestibule of larynx, aryepiglottic folds down to the level of the vocal folds. The sensory branch of the recurrent laryngeal nerve supplies the laryngeal mucosa below the level of vocal folds.

LIGAMENTS AND MEMBRANES OF LARYNX:

EXTRINSIC LIGAMENTS:

The extrinsic ligaments connect the larynx to the hyoid bone above and trachea below. The thyrohyoid membrane stretches between the upper border of thyroid cartilage and the posterior surface of the body and greater cornua of the hyoid. The membrane consists of fibro elastic tissue and is reinforced by fibrous tissue in the midline which forms the median thyrohyoid ligament and posteriorly forms the lateral thyrohyoid ligament. Cartilage triticea is small nodule of cartilage present in the ligament. The internal branch of the superior laryngeal nerve and the superior laryngeal vessels pierce the membrane. The lower border of the cricoid is connected to the first tracheal ring by the cricotracheal ligament. The cricothyroid ligament links thyroid to cricoid.

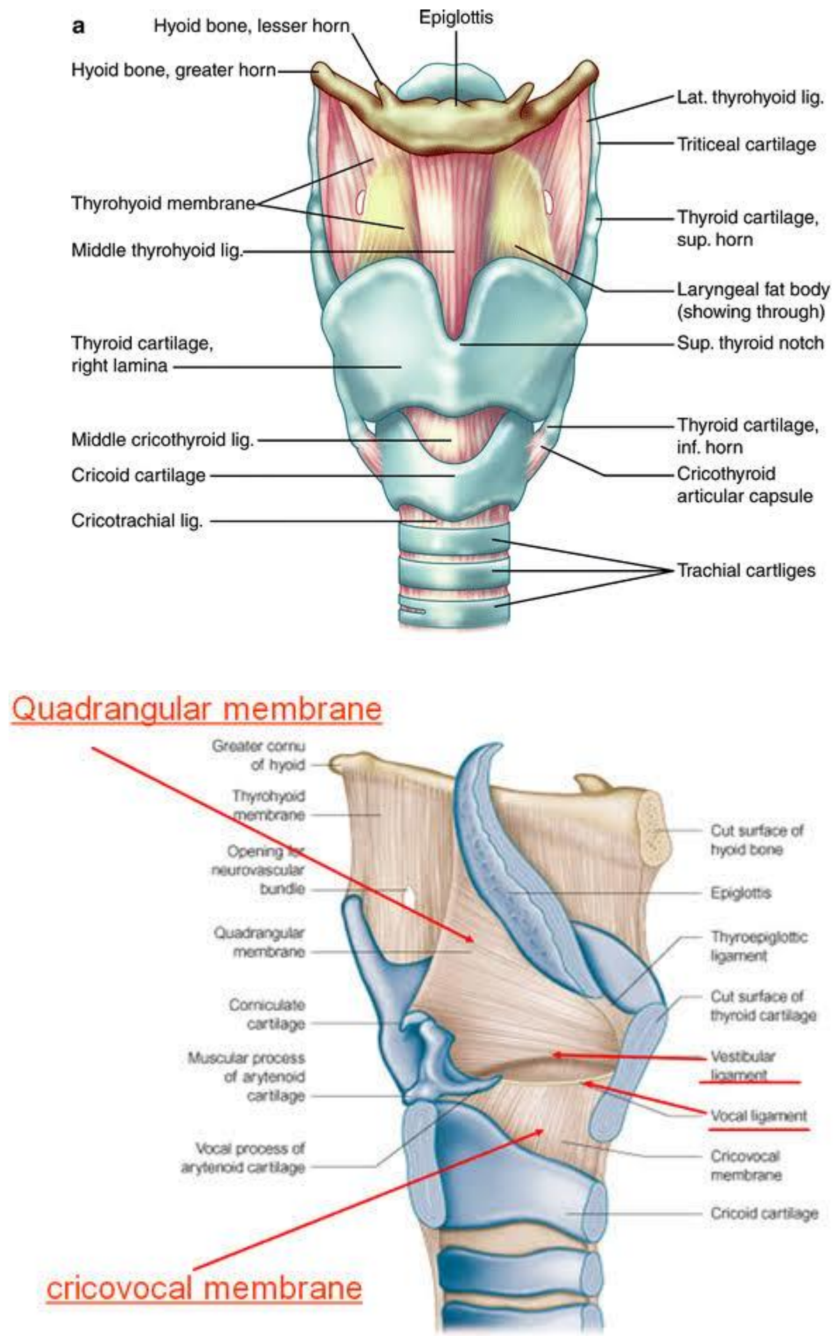


Figure 4 : Ligaments of Larynx

INTRINSIC LIGAMENTS

The intrinsic ligaments connect the laryngeal cartilages together. The quadrilateral membrane extends between the lateral border of the epiglottis and the arytenoid cartilages. The upper margin forms the aryepiglottic fold and the lower margin is thickened to form the vestibular ligament underlying the vestibular fold. The lower part is thicker and contains elastic fibres. It is known as the cricovocal ligament, cricothyroid ligament or conus elasticus.

LYMPHATIC DRAINAGE OF LARYNX

The lymphatic drainage of larynx is separated by the vocal folds into upper and lower drainage systems. The larynx above the vocal folds is drained by vessels that accompany the superior laryngeal vein and empty into the upper deep cervical lymph nodes. The larynx below the vocal folds drains to lower deep cervical chain, often through prelaryngeal and pretracheal nodes.

THE GLOTTIS

The glottis lies between two horizontal lines, one drawn through the apex of the laryngeal ventricle, the other drawn 1cm below the medial free edge of the vocal fold when the larynx is at rest. The glottis is divided into two areas by the line that runs between the tips of the two vocal processes which divides it into anterior glottis and posterior glottis. The anterior glottis includes the vocal folds, while the posterior glottis includes cartilaginous structures. These two regions are different both structurally and functionally. The anterior glottis is the intermembranous portion where vocal fold vibration occurs and voice produced. The posterior glottis is the inter cartilaginous part, which plays main role in respiration. The ratio of the length of the anterior glottis to that of the posterior glottis is approximately 1:1 in newborns and it becomes 2:3 in adults. Clinically more attention is given to the anterior glottis, because most lesions that cause dysphonia occur in anterior glottis. Laterally, a horizontal slit opens into an elongated recess, the laryngeal ventricle. Fibrous tissue surrounds the saccule. It occasionally protrudes through the thyrohyoid membrane. It ascends between the vestibular ligament and the inner surface of the thyroid cartilage as high in some people as the upper border of the thyroid cartilage.

False Vocal Fold

The false vocal folds or vestibular folds are two thick folds of mucous membrane scaffolded on a narrow band of fibrous tissue, the vestibular ligament. It is fixed in front at the angle of the thyroid cartilage just below the attachment of the epiglottic cartilages.

True Vocal Fold

The vocal folds extend from the middle of the angle of the thyroid cartilage to the vocal process of the arytenoid cartilages and scaffolding them is the upper border of the conus elasticus. The vocal fold lies between the anterior commissure and the vocal process of the arytenoid cartilages. The vocal fold has unique vibratory properties that are not seen in any other part of the body. These properties are supported by its histological architecture, It is a layered structure that has the following layers :

- Superficial layer of stratified squamous non-keratinising epithelium

- The lamina propria, which is divided into three layers

  - The superficial layer is composed of sparse fibrous tissue and abundant amorphous substances, which makes it more pliable than the other layers. This layer is called "Reinke's space," and it is a main site where mucosal vibration occurs during phonation. Most benign and malignant pathologies affect this place, resulting in voice problems.

  - The intermediate layer chiefly consists of elastic fibers

  - The deep layer primarily consists of collagenous fibers. These two layers form the vocal ligament, which is connected to the conus elasticus inferiorly and to the anterior commissure tendon anteriorly. They are also contiguous with the quadrangular membrane superiorly.

- Vocalis Muscle (Thyroarytaenoideus)

  - The vocalis muscle lies beneath the vocal ligament and forms the main body of the vocal fold. The muscle is the contractile element that supplies a firm scaffold, while the vocal ligament provides a substrate of appropriate stiffness and elasticity on which the pliable superficial layer vibrates.

COVER BODY THEORY

The muscle is the contractile element that supplies a firm scaffold, while the vocal ligament provides a substrate of appropriate stiffness and elasticity on which the pliable superficial layer vibrates Stiffness decreases from the muscle to the superficial layer of the lamina propria, that is the pliability of the tissues gradually increases in the same order. This gradation of the different tissue properties is thought to be ideal for the vibratory function of the vocal fold. This concept is called the “cover body theory”, according to which the cover consists of the epithelium and the superficial layer of the lamina propria, while the body consists of the muscle, and the intermediate-to deep layers of the lamina propria (ILP, DLP) are referred to as the transition.

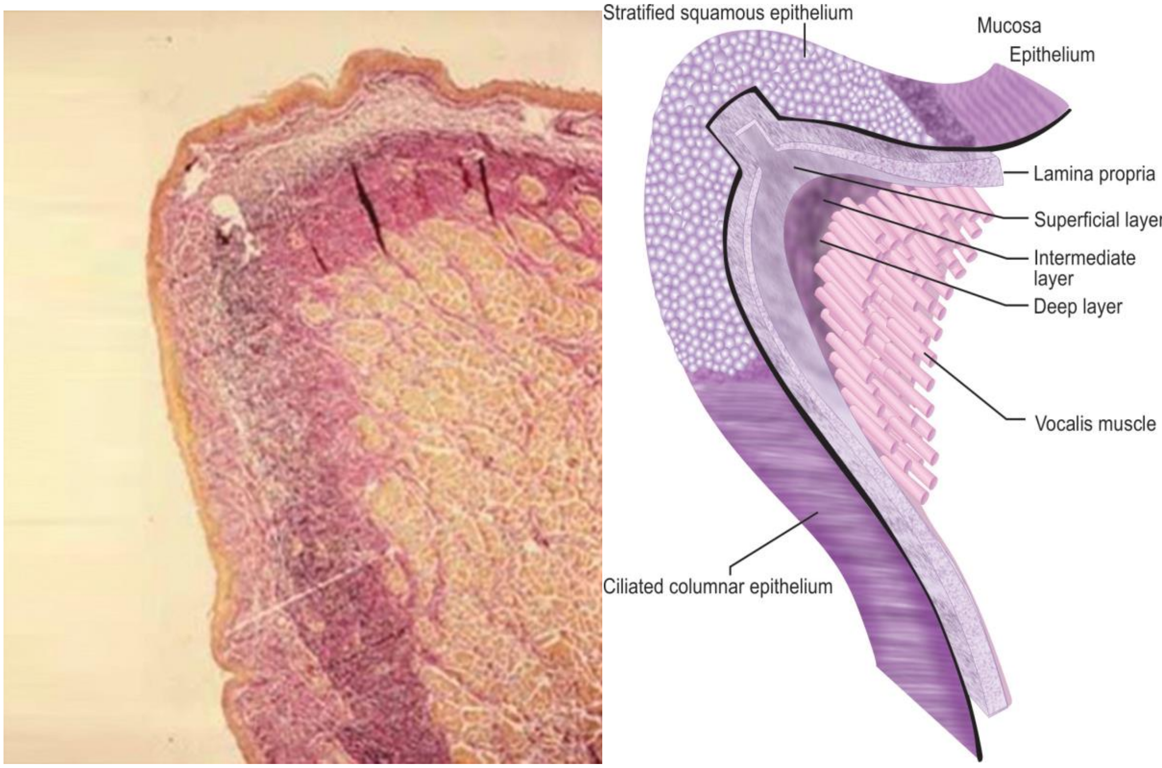


Figure 5 : Layered structure of vocal fold mucosa

BASEMENT MEMBRANE ZONE

The basement membrane zone (BMZ) forms the boundary between the epithelium and the superficial layer of the lamina propria (SLP), and it plays an important role in securing this boundary. This zone is directly affected by phonotrauma and any other injuries to the vocal fold. The basement membrane consists mainly of laminin and type IV collagen. The type VII collagen fibers connect the basement membrane with the SLP, thus firmly maintaining the relationship between them. These are called “anchoring fibers”. There are also type III collagen fibers, called “reticular fibers," in the SLP. The reticular fibers are thin fibrils that may contribute in maintaining the architecture of the SLP. The collagen network consisting of collagen types IV, VII, and III in the BMZ and SLP is thought to be important for maintaining the structure of the "cover".

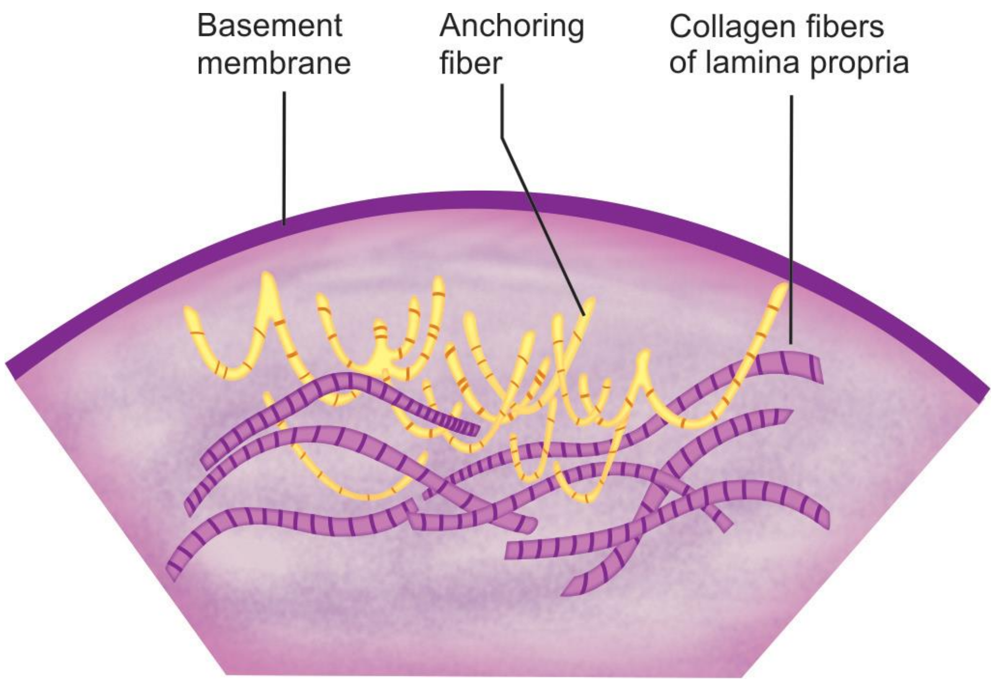


Figure 6 : Basement membrane structure

EXTRACELLULAR MATRIX IN SUPERFICIAL LAYER OF LAMINA PROPRIA

The SPL primarily vibrates together with the epithelium, forming a traveling wave. After the vocal fold mucosa has been injured, the SLP is the most important and main site of wound healing. The tissue properties of the SLP are defined by deposition of ECM. As mentioned above, the SLP has a low content of fibrous proteins but is rich in a variety of interstitial proteins (proteoglycans) and glycosaminoglycans. These molecules play a key role in determining the properties of the SLP. One of the most important molecules is hyaluronic acid (HA). Hyaluronic acid is a mucopolysaccharide and is one of the glycosaminoglycans in the vocal fold. It is abundant in the SLP and is thought to be a key molecule. for determining the viscoelasticity of the vocal fold mucosa. In general, a higher content of HA leads to an increase in tissue viscosity. Rheological studies have revealed that HA has a similar viscoelasticity to the human vocal fold mucosa, while removal of HA alters the stiffness and viscosity of the vocal fold.

Fibronectin is another important molecule that may affect the properties of the vocal fold mucosa. Fibronectin is a glycoprotein and is one of the proteoglycans in the vocal fold. It is an adhesion molecule that has binding sites for fibrin, collagen, and proteoglycans. It has functions that contribute to intercellular adhesion, cell-ECM adhesion, cell migration and differentiation, and maintenance of cellular structure. Fibronectin participates in wound healing, and is deposited excessively in scar tissue. As mentioned above, excessive deposition of fibronectin has been found in chronic vocal fold nodules. Although fibronectin is an essential molecule that maintains cell and tissue architecture, many studies have suggested that there are negative effects of excessive fibronectin deposition on the vibratory properties of the vocal fold.

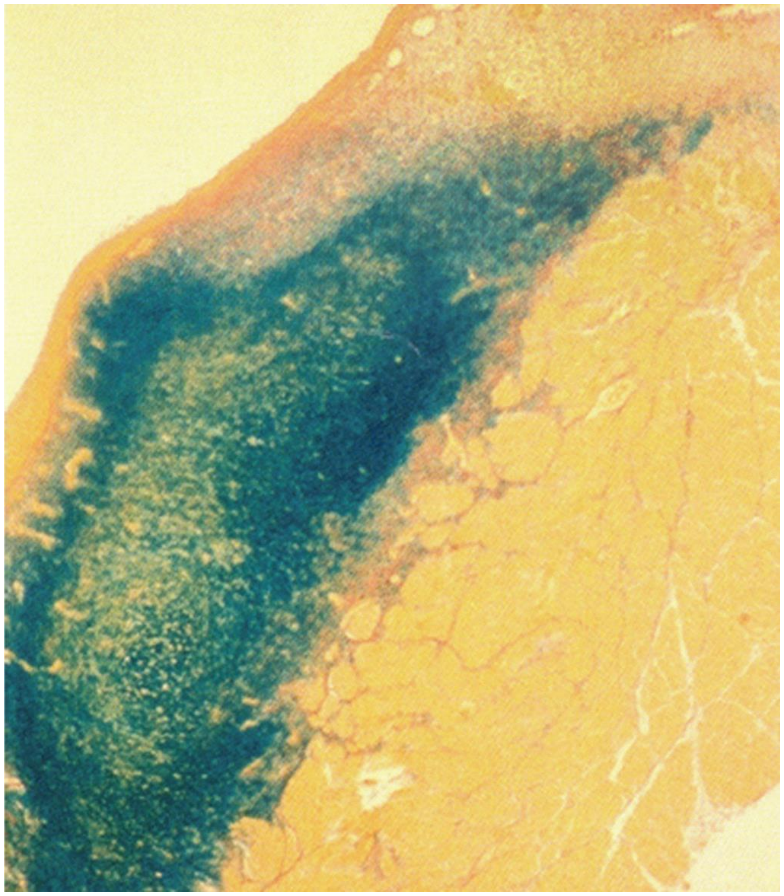


Figure 7 : Distribution of Hyaluronic acid in Lamina Propria

Various other types of proteoglycans have been investigated in the lamina propria. Short-chain proteoglycans include decorin, biglycan, and fibromodulin.

Decorin is chiefly distributed in the SLP. This molecule regulates collagen fibrils by binding to collagen and altering the kinetics of fibril formation. Because decorin reduces collagen fiber formation, it prevents scar formation. It is speculated that this biological characteristic of decorin may be the reason why collagen fibers are sparse in the SLP.

Biglycan is primarily distributed in the deep layer of the lamina propria and is less prominent in the SLP. Biglycan seems to have opposing biological effects to decorin, because its presence is associated with a decrease in decorin. Biglycan is deposited excessively in hypertrophic scars, while decorin is decreased in such scars.

Fibromodulin has been chiefly found in the ILP and DLP. It is structurally similar to decorin, but is not associated with the same biological effects. In general, fibromodulin has a close relationship with tendons and ligaments, regulates collagen fibrillogenesis, and maintains the tensile strength of tissues. Thus, fibromodulin may support the architecture of the vocal ligament.

DEVELOPMENT OF VOCAL FOLD MUCOSA

The vocal fold of a newborn infant is significantly different from that of an adult in terms of size and structure. The lamina propria of the neonatal fold is thick relative to the length. Most of the lamina propria is loose and does not contain the vocal ligament and thus a layer structure is not observed in the newborn. An immature macula flava is seen. The macula flava is composed of fibroblasts, collagenous, and elastic fibers. The fibroblasts are abundant, but the fibers are fewer than in adults. It is suggested that the fibroblasts are stellate and activated for the synthesis of collagenous, reticular, and elastic fibers.

During infancy, fibroblasts increase in the macula flava. An immature ligamentous structure is first seen between the ages of 1 and 4 years, but there is no distinct differentiation of the layers. Collagenous and elastic fibers extend from the macula flava to Reinke’s space. Differentiation of the intermediate and deep layers begins at some point between 6 and 12 years of age, and the vocal ligament is clearly formed after the age of puberty. The layer structure is completed by around the end of adolescence.

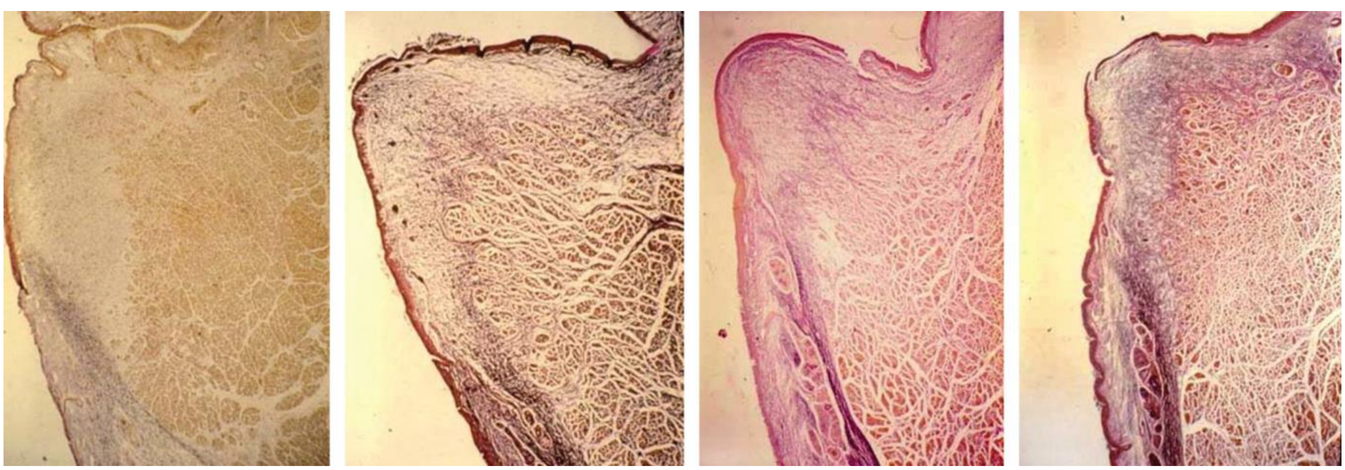


Figure 8 : Development of vocal fold mucosa. A)Newborn B) 4 years old C) 10 years old and D) 16 years old

AGING OF VOCAL FOLD MUCOSA

The vocal fold mucosa changes with age. In general, the SLP becomes thinner and atrophic, which is often prominent in males, while females occasionally show more edematous change of the SLP. The intermediate layer becomes thinner with decreased or disorganized elastic fibers, whereas the deep layer becomes thicker with an increase in collagenous fibers. These changes of the intermediate and deep layers are more prominent in males. Collagenous fibers are disorganized and form thick bundles, leading to fibrosis of the mucosa. Hyaluronic acid (HA) tends to decrease in all layers of the lamina propria with age. Fibroblasts in the macula flava form a stellate shape, as is the case in young adults, but they contain less golgi apparatus and rough endoplasmic reticulum while having more lipofuscin granules and glycogen. Mitochondria become swollen and undergo degeneration. These histologic findings suggest the deteriorating ability of aging fibroblasts to produce ECM.

PHYSIOLOGY OF VOICE PRODUCTION

Normal voice production requires three essential elements:

- a pressure gradient across the vocal folds created by the flow of expired air from the lungs against the partly close vocal folds
- vocal folds of appropriate structure, mass and elasticity that approximate with appropriate tension to allow them to vibrate at a range of frequencies

• a resonating chamber, the vocal tract, whose size and shape can be changed to modulate the acoustic properties of sound generated by the vocal folds.

The acoustic output results from the interaction between vocal fold vibration and modulating effect on the sound by the vocal tract in the production of vowels. To understand the relevance of some of these measures it is important to summarize the essential features of the acoustic properties of voice. Vocal fold vibration, acting as the sound source, produces a laryngeal tone which is a complex sound wave that, if heard without the vocal tract, has a buzzing quality.

The sound wave can be characterized acoustically in terms of **fundamental frequency** (Hertz or Hz**), frequency spectrum amplitude and intensity** (dB). The rate of vibration of the vocal folds (cycles per second) determines the fundamental frequency (F0). Normal vocal fold vibration, however, does not simply produce a pure tone (sine wave). It consists of a spectrum of frequencies which are multiples of this fundamental frequency. They are called harmonics or overtones and are of varying amounts of energy or sound intensity. Sound intensity decreases by approximately 12 dB for every doubling of the fundamental frequency. This relationship between the harmonics and sound intensity can be displayed in the form of a spectrum. For breathy voices the energy decreases more rapidly at higher frequencies but is maintained in more strident voices which project more.

In addition, the vocal tract acts as a filter, selectively reducing the energy in specific bands of frequencies from the sound source (vocal folds) while allowing others to pass with maximum level. The bands of frequencies that retain their energy levels reflect the resonant properties of the vocal tract and are known as **formants**. Altering the shape and dimensions of the vocal tract by changing the height of the larynx, position of the tongue, soft palate and lips changes the resonant properties of the vocal tract and formants. Correct production of formants is essential to allow distinction between different speech sounds.

For good and 'normal' voice production three conditions are required:

• quasi-periodic vibration of the vocal folds

• a well-defined harmonic structure of the voice signal radiating from the mouth

• a voice signal that is loud enough or has enough sound intensity (energy) to overcome the threshold of hearing of the listener.

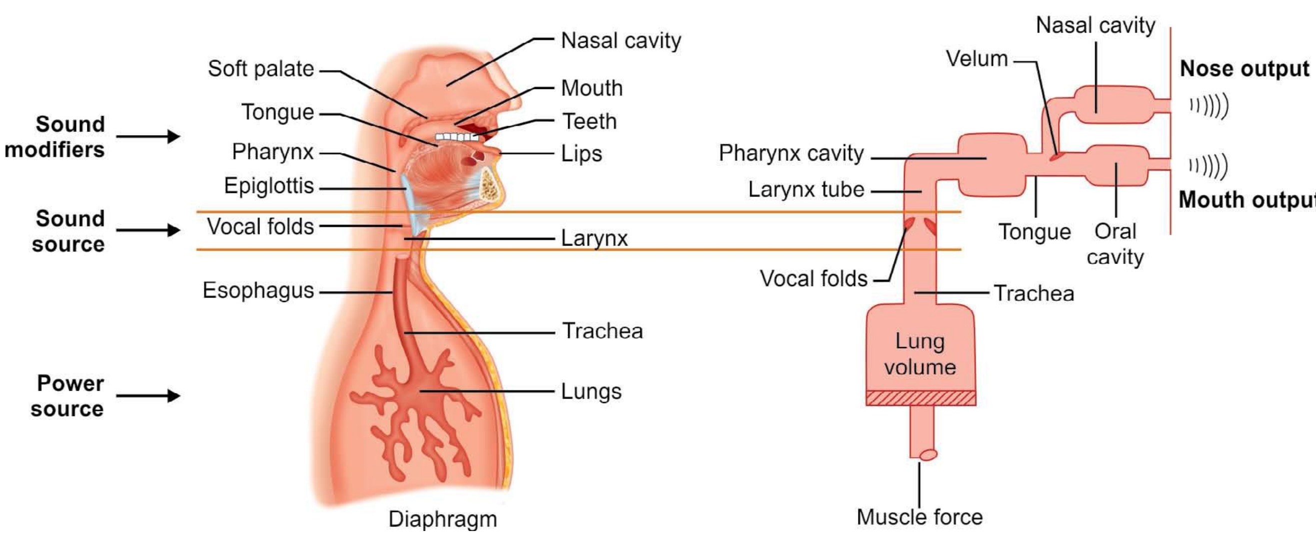


Figure 9 : Vocal organs and a representation of their main acoustical features

THE VIBRATORY CYCLE

Each vibratory cycle of the vocal folds consists of three phases: adduction, aerodynamic separation and recoil. As the increased subglottic air pressure overcomes the resistance of the adducted vocal folds at the onset of phonation, the vocal folds peel apart from their inferior border. When they finally separate at their superior margin, a puff of air is released. The resulting negative pressure in the glottis caused by the Bernoulli effect results in the vocal folds closing rapidly as they are sucked together, the inferior vocal fold margins closing first. The Bernoulli effect is a drop in pressure dependent on particle velocity. As a result of the drop in pressure at the glottis, the vocal fold mucosa is drawn into the space between the vocal folds.

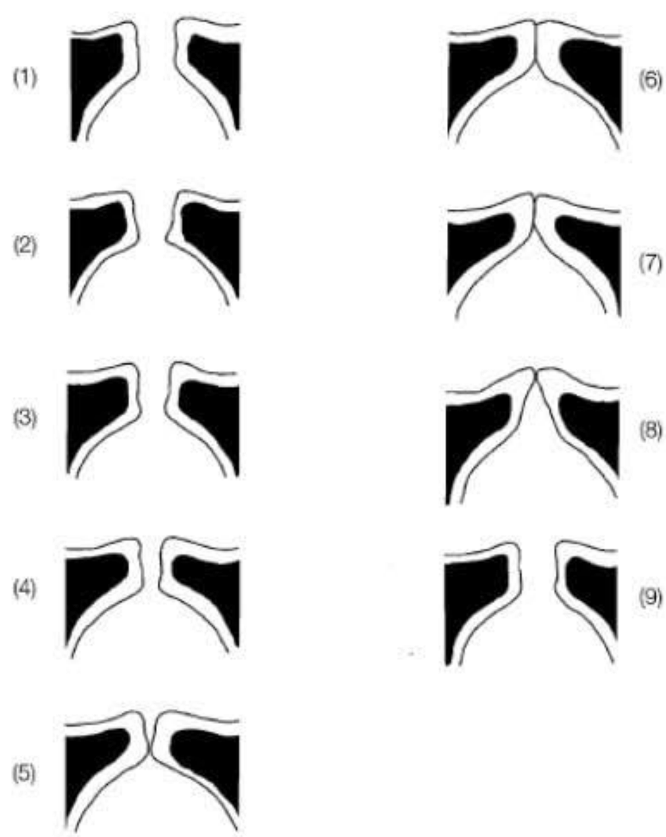


Figure 10 : Vocal fold vibratory cycle

Contact between the vocal folds increases until the subglottic air pressure is high enough to blow the vocal folds apart again, and the cycle recommences. Each cycle of adduction, separation and recoil is the manifestation of a mucosal wave travelling from the inferior to the superior surface of each vocal fold. The undulations of the vocal folds thin cover and any abnormalities of the mucosal wave, can only be observed using laryngostroboscopy or high-speed photography.

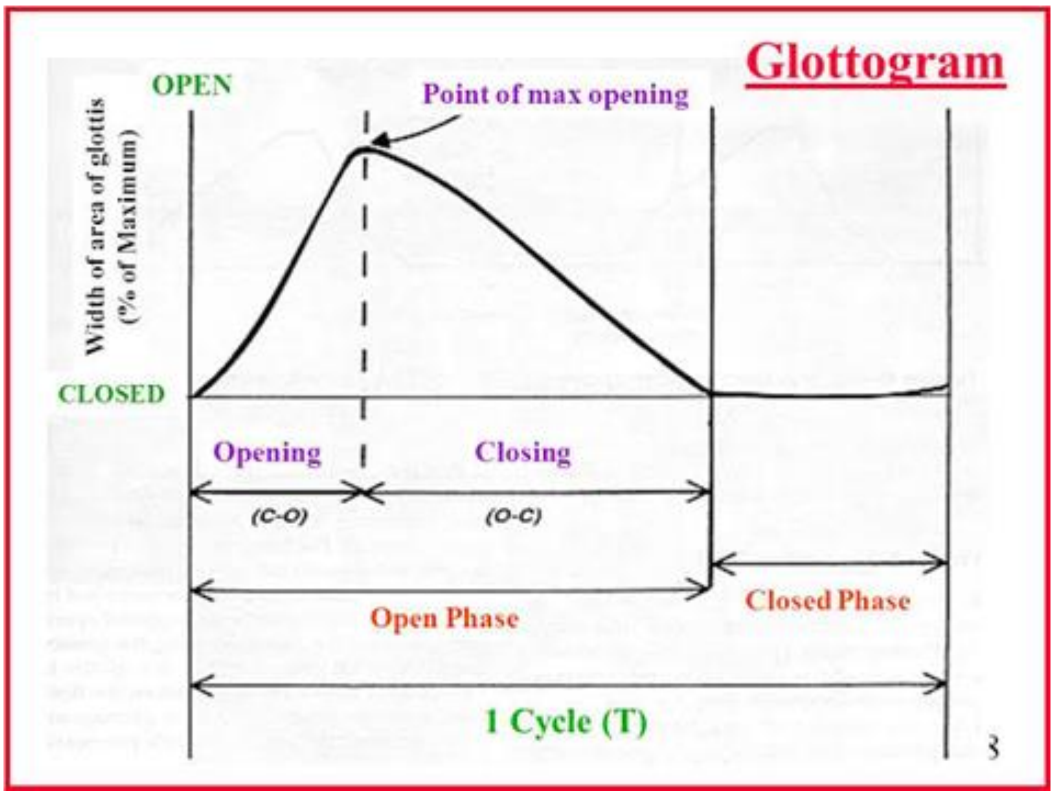


Figure 11 : Glottic cycle waveform

The periods of vocal fold contact and lack of contact in one vibratory cycle can be divided broadly into closed and open phases, respectively, with associated closing and opening phases. The closing phase of the vocal folds is more rapid than the opening phase. The phases of the vibratory cycle can be classified, therefore, into four stages

- **Opening Phase**: The vocal fold is blown upward on the whole by the increasing subglottic pressure and the undulating wave moves on the membranous cord from the lower part to the upper part. A puff of air is released as the Vocal cords are separated.
- **Open Phase** : The vocal folds are completely separated. This is the longest phase of a normal vibratory cycle.
- **Closing Phase** : After the width of the glottis reaches a maximum, elastic recoil and aerodynamic forces draw the vocal folds toward the midline and the glottis begins to be closed by the protruding lower lip.
- **Closed Phase** : The upper lip moves inward and the closure of the glottis becomes firm. The folds remain approximated for a brief portion of the cycle. Subglottic pressure builds up again and the next cycle begins.

VOCAL REGISTERS

Significant variations in vocal fold vibratory characteristics and adduction can also be observed according to the vocal register that is being used. Registers have been regarded as the perceptually distinct regions of vocal quality over certain ranges of pitch and loudness. There are mainly three vocal registers :

- **Loft register (or falsetto)** : This register covers the highest frequencies of the voice. The vocal folds are lengthened, extremely tense and thinned so that there is minimal vibration. The knife-thin free edges are almost adducted and subglottic air pressure is high. During the production of these high frequencies, the larynx is raised by the suprahyoid muscles and the pharynx is shortened.

- **Modal register** : This register encompasses the range of frequencies usually employed in speech and singing. The membranous portions of the vocal folds are adducted and make complete closure in the closed phase of each vibratory cycle. In cross-section, the vocal folds are triangular in shape. In low notes the intrinsic muscles relax, the folds increase in bulk and their opposing surfaces deepen from 3 mm to 5 mm. They vibrate slowly along their whole length, the lower surfaces of their 'lips' making contact and separating as the upper surfaces approximate in a rolling motion or figure of eight. In lowest notes the infrahyoid muscles pull the larynx down.

- **Pulse register (or glottal fry or vocal fry or creaky voice)** occurs during the lowest vocal frequencies and is a feature of normal speech. This terminology reflects the pulsatile nature of the laryngeal sound generated. There is a long closed phased in each vibratory cycle.

	Register may include	Equivalent Terms	Vocal folds	F0 range (Hz)
Loft Register	Highest vocal frequencies	Falsetto	Thin, tense, lengthened Minimal vibration	275 - 1100
Modal Register	Frequencies most commonly used in singing and speaking	Chest, Head, Middle, Heavy Voice	Complete adduction	100 - 300
Pulse Register	Lowest range of vocal frequencies	Vocal fry, Glottal fry, Creaky Voice	Long closed phase	20 - 60

Table 2 : The vocal registers

EVALUATION OF VOICE

There are many methods of assessment of the voice and voice production that have been developed over the years. Broadly these methods can be divided into **Subjective** and **Objective.**

Subjective Methods:

The most commonly used subjective measure to evaluate the voice is by using self-administered, validated disease specific or generic questionnaires to assess the patient's perception of the impact of the voice condition on their quality of life in terms of physical complaints and restriction in participation in daily activities.

The most commonly employed questionnaire is **Voice Handicap Index Questionnaire** (VHI-30) which contains 30 questions in total each scaled from 0 to 4

Objective Methods:

The objective methods are further subdivided into Direct and Indirect methods.

Indirect methods:

- Acoustic Analysis : vocal fold source and resonance/ wave form
- Aerodynamic Analysis : respiratory system/ air motion
- Electroglottography : vocal fold contact/ tissue motion

Direct methods:

- Videostroboscopy - vocal fold oscillations / tissue motion
- Videokymography - vocal fold oscillations / tissue motion
- High speed digital laryngeal imaging

ACOUSTIC ANALYSIS

Acoustic analysis provides quantitative measures based on the voice signal (waveform and spectrum) recorded using a microphone placed near the mouth. The microphone acts as a transducer, converting the acoustic signal into an electrical signal. The amplified electrical signal is most commonly recorded directly to hard disk as uncompressed .wav files. A variety of free and commercial software programmes are available for display, measurement and statistical analysis of the acoustic waveform and spectrum.

Voice Materials:

- Sustained Vowels
- Fluent Speech
- Consonant-Vowel sequences

Microphone:

Ideally it should have a minimum sensitivity of -60dB and reasonably flat frequency response across the range of human hearing (20 to 20000Hz). The microphone to mouth distance should be kept constant. Usually it is kept a distance of 8cm from the corner of mouth and offset by 45 degrees to avoid overstimulation from the breath stream.

Acoustic Parameters:

1, Fundamental frequency:

It is a measure of the rate of vibration of the vocal folds. It is the inverse of the time taken to complete a single vibratory cycle and is measured in cycles per second or Hertz (Hz). It can be measured from short segments (1–2 s) of a sustained vowel made at a comfortable pitch and loudness or from speech (speaking fundamental frequency (SFF)). It can be measured from either the acoustic (F0) or the ELG (Fx) signal. In males the SFF drops from young adulthood into middle age and rises again in old age. In women the SFF remains fairly constant from 20–50 years and then drops. It is measured with a sustained phonation for a minimum for 4 seconds. The average speaking frequency ranges from

- 80 to 140 Hz for adult males

- 190–230 Hz for adult females 32
- 280–365 Hz for children

<u>2, Intensity</u>:

Intensity is a physical correlate of loudness. It is primarily determined by the subglottal pressure, amplitude of vibration and duration of closed phase of glottal cycle. It is measured in decibels (dB). Increased intensity is seen in individuals with vocal phonotraumatic behaviour and also in individuals with hearing loss. Reduced voice intensity occurs in individuals with reduced breath support and incomplete glottal closure as seen in age-related changes like presbyphonia. Mean intensity ranges from 75 to 80 Db

<u>3, Perturbation Measures:</u>

Refers to cycle-to-cycle changes of period and amplitude measured during phonation. It is measured during sustained phonation of an open vowel. Two types of perturbation measures are used commonly to characterize aperiodicity in the pitch and loudness of voice.

- Jitter - cycle-to-cycle variability in the frequency
- Shimmer - cycle-to-cycle variability in the amplitude.

The most commonly used jitter measurement is jitter percentage / jitter in milliseconds. The most commonly used shimmer measurement is shimmer percentage / shimmer in db.

4, Spectral Measures:

One of the commonly used measurement to objectively quantify the degree of hoarseness is Harmonics to noise ratio (HNR). It is the mean intensity of an average waveform divided by the mean intensity of the isolated noise component for the series of waveforms in the utterance. The greater the noise, the lower the HNR. The normal range is 7 to 17

5, Voice Range Profile (Phonetogram):

A voice range profile (VRP) or phonetogram is a visual display of the dynamic range of the voice in terms of frequency and vocal intensity and has been used in both adults and children. It is usually produced by recording the patient's ability to produce sustained vowels (usually 10 continuous, periodic cycles of an /a/ vowel) across their frequency range at the quietest and loudest note they can produce. In routine practice it more time consuming and laborious to do.

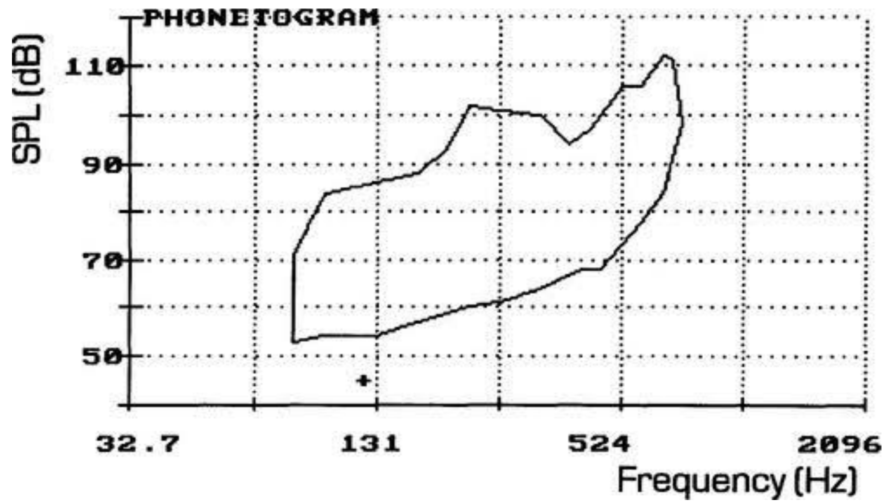


Figure 12 : Phonetogram

VIDEOSTROBOSCOPIC EXAMINATION

Videostroboscopy has evolved as the most practical and useful technique for clinical evaluation of visco-elastic properties of phonatory mucosa. It is a painless, office based procedure helpful in the evaluation of laryngeal mucosa, vocal fold motion biomechanics and mucosal vibration

It uses synchronized flashing light passed via flexible or rigid telescope. Flashes of light are synchronized to vocal fold vibration at slightly slower speed allowing examiner to observe it during sound production in slow motion. It provides useful, real time information concerning the nature of vibration, image to detect vocal pathology and permanent video record of examination. Its working principle is based on Talbot's Law.

TALBOT'S LAW

The observation in which microseconds of flashing light shining on physiological persistence of vision lasts 0.2 seconds after exposure. When flashes of light are presented to retina at same rate as the oscillating object it will have the appearance of freezing the object. When the rate of flash is increased to one cycle greater than the frequency of the vibrating object the retina will assemble successive images from the multiple cycles of vibration into one slow moving image.

It is an optical illusion of apparent motion from series of images presented in rapid succession. If the flashes of light are exactly equal to and in phase with the vocal fold vibratory cycles the folds will appear motionless. If the flashes of light are triggered after the onset of the vibratory cycle by a fixed time interval, the adjacent phases of several vibratory cycles will be illuminated successively

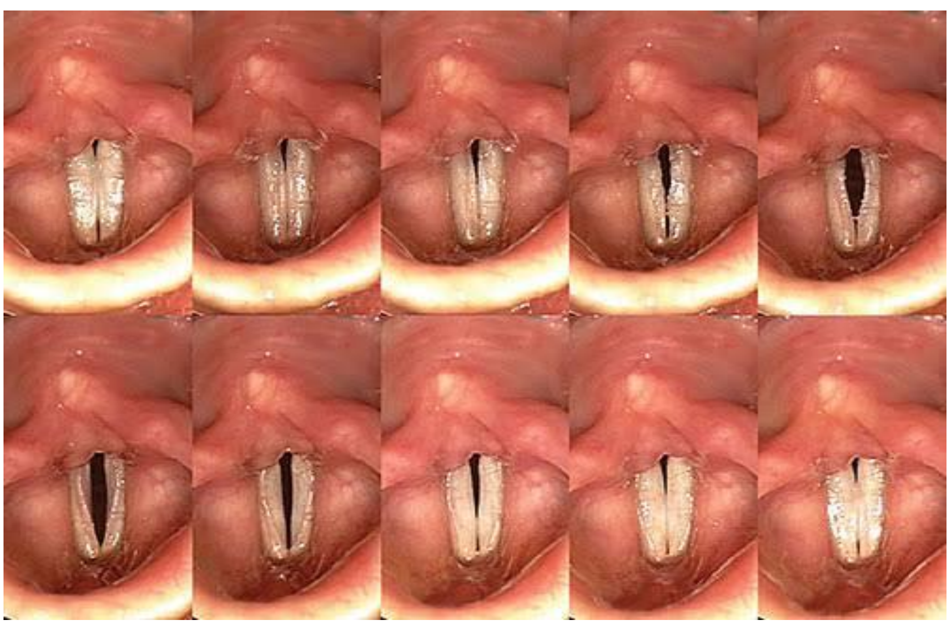


Figure 13 : Stroboscopic images

PARAMETERS IN VIDEOSTROBOSCOPY

1, Amplitude : It is the extent of lateral excursion of muscular body of vocal folds during their displacement away from midline during oscillation. In normal habitual phonatory conditions the extent of the horizontal excursion of the VF approximates one half the width of the visible part of the Vocal fold.

The amplitude of vibration:

- Decreases with raising the pitch of phonation.
- Increases with increasing the loudness of phonation.

The four point rating scale for the amplitude of vibration:

0 =No observable horizontal excursions.

1 = Diminished amplitude of Vibration.

2 =Normal amplitude of Vibration.

3 = Greater amplitude of Vibration.

The amplitude of vibrations affected by vocal cord stiffness and subglottal pressure.

Pathological conditions leading to decreased amplitude of vibration:

- Increased vocal cord stiffness e.g. Sulcus Vocalis

- Tight glottic closure patterns e.g. hyper functional dysphonia

2, Symmetry: Phase symmetry is defined as whether the each vocal fold is a mirror image of the other. Normal vocal folds should vibrate together with a mirror image between the right and the left vocal folds. When the vocal folds are not vibrating in phase, it results in a less efficient flow converter and oscillator and will result in an open-phase relationship. When this happens, the vocal folds are said to lack phase symmetry. Phase symmetry is easy to detect when one vocal fold seems to open before the other.

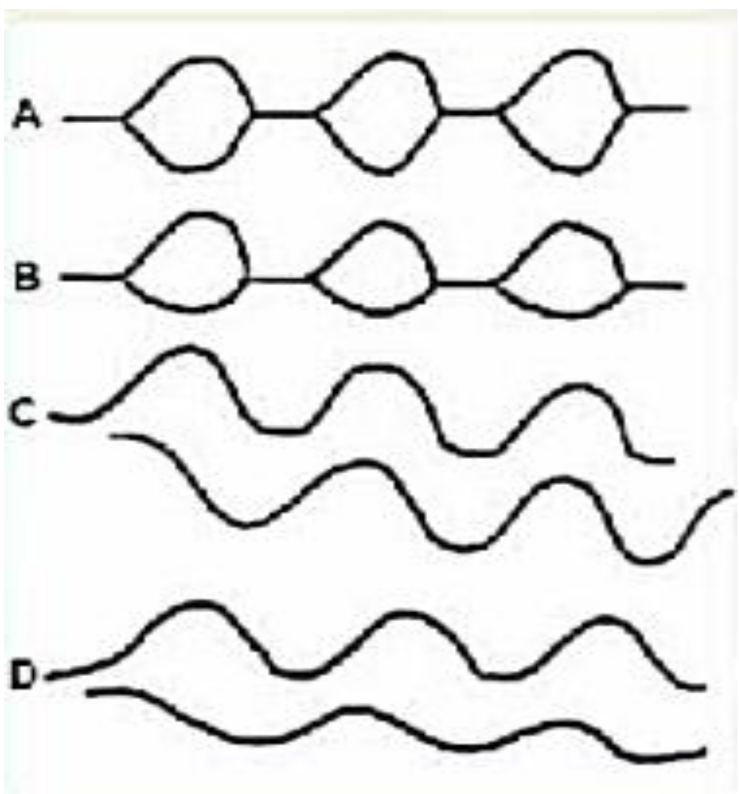


Figure 14 : Graphical representation of Symmetry

• Graph A displays the normal amplitude and timing patterns of both vocal cord. The upper graph represents the right vocal fold movement during the opening, closing and closed phase of the glottal cycle. The lower graph represents the left vocal fold movement during the opening, closing and closed phases of the same glottic cycle.

• Graph B displays asymmetry in amplitude where the range of the left vocal fold excursion is less than that of the right vocal fold.

• Graph C displays asymmetry in phase where the right vocal fold is closing while the left vocal fold is opening.

• Graph D displays asymmetry both in phase and amplitude.

Asymmetry in phase or amplitude between both vocal cords is caused by induced differences in the mechanical properties between both vocal folds as in:

- Laryngeal lesions affecting mass, tension or shape of vocal fold.
- Neurological lesions affecting neuromuscular control of vocal fold.
- Functional conditions affecting laryngeal muscle tension.

3, Periodicity: This is the regularity of successive glottic cycles. Aperiodicity could be either in amplitude or timing or both. Normally the laryngeal image will be static. In aperiodicity the flashes will not coincide with glottal cycle which causes hazy shivering of laryngeal image

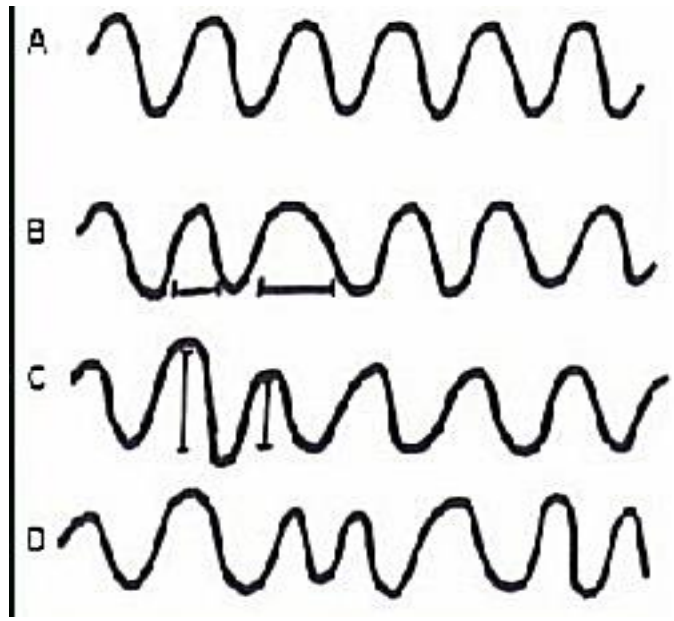


Figure 15 : Graphical representation of Periodicity

- Graph A displays the glottal waveform of normal periodic vibrations where successive glottal cycles are uniform in amplitude and timing.
- Graph B displays aperiodicity in timing between successive glottal cycles.
- Graph C displays aperiodicity in amplitude between successive glottal cycles.
- Graph D displays total aperiodicity in timing and Amplitude

Aperiodicity is caused by disturbance in the balance between the mechanical properties of the vocal cords and the applied aerodynamic forces. This may be due to:

- Inadequate expiatory air during phonation.
- Disrupted laryngeal muscle tension.
- Imbalance of neuromuscular control of the larynx.
- Disturbed mechanical properties of the VFs.

4, Mucosal Wave: When the vocal folds oscillate, the superficial tissue of the vocal fold is displaced in a wave like fashion creating the mucosal wave. Visualization and quantification of mucosal wave properties have become useful in the management of vocal fold pathologies.

In normal phonatory conditions the mucosal wave travels across the vertical plane of the vocal fold then rolls laterally across at least 50% of the width of visible part of the vocal fold. It is affected by the pliability of the covering mucosa and the presence of the natural difference in the mechanical properties between the pliable mucosal cover and stiffer muscular core.

Normally the mucosal wave

- Decreases with raising the pitch of phonation.
- Increases with increasing the loudness of phonation

The four point grading scale for the mucosal wave:

0 =No observable traveling wave

1 = Restricted mucosal wave

2 =Normal mucosal wave

3 = Greater mucosal wave in which the traveling wave moves from the glottal margin to the most lateral portion of the vocal fold.

Pathological conditions leading to **decreased mucosal waves**:

- Increased stiffness of the vocal folds due to
  - Structural changes in the mucosa (cover) e.g.: polypoid degeneration, sulcus vocalis, vocal cord dysplasia
  - Increased muscle tension (body) leading to tight glottic closure patterns .eg: hyperfunctional dysphonia
  - Decreased muscle tension (body) leading to weak glottic closure patterns e.g.: hypofunctional dysphonia

Pathological conditions leading to **loss of mucosal wave** as in:

- Any infiltrative process that fixes the mobile mucosa to the deeper structure.

- Recurrent laryngeal nerve paralysis lesions where vocalis muscle loses its natural tone and the vocal cord body becomes as flaccid as the covering mucosa.

Pathological conditions leading to **increased mucosal wave** are usually associated with: - increased subglottic pressure as in Reinke's edema

5, Glottic Closure: Is the average timing of the closed phase in relation to the whole glottic cycle. Normally there is complete closure along the vocal fold edges in males and closure along the vibrating edges with a small triangular posterior chink in females.

Abnormal glottic closure patterns :

- The hour-glass shape phonatory gap that may be seen with vocal fold nodules.
- The slit shape phonatory gap that may be seen in in patients with hyperfunctional dysphonia.
- The oval shape phonatory gap that may be seen in patients with hypofunctional dysphonia.
- Irregular phonatory gap as in cancer larynx.
- No closure as in bilateral vocal cord paralysis.

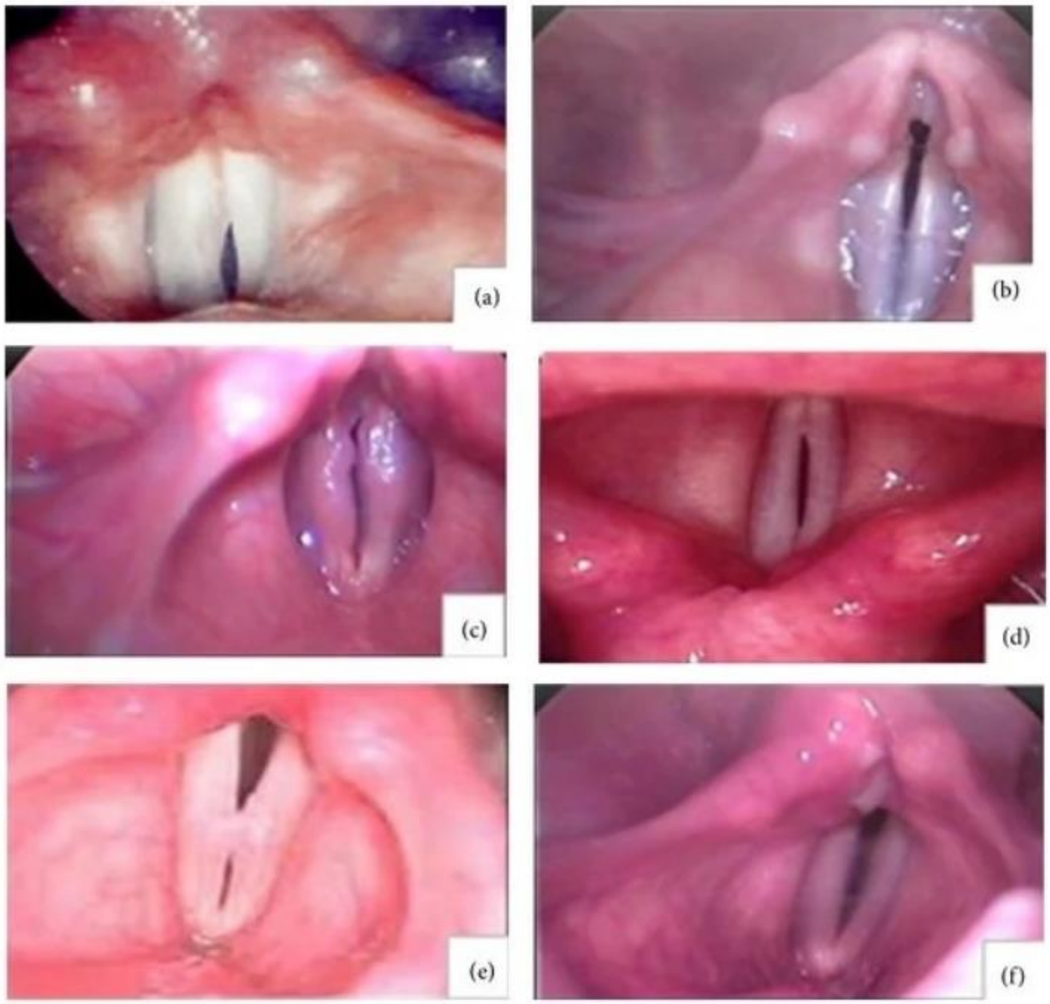


Figure 16: Abnormal glottic closure patterns A) Anterior gap B) Posterior gap C) Irregular D) Spindle gap E) Hour glass F) Incomplete

Gender differences seen on stroboscopy:

- Females have less massive folds with smaller amplitude and wave
- Males have larger and thicker vocal folds
- Larger amplitude and wave at modal voice in males
- Females have greater open phase

- Females more sinusoidal in oscillation pattern
- Females have a greater incidence of posterior chink
- Females have greater velocity and acceleration of the vocal folds

Effects of increased amplitude of sound at the same fundamental frequency on the glottal cycle:

- Shorter vocal fold length
- Shorter open phase
- Greater amplitude
- Greater mucosal wave
- Greater velocity of opening and closing
- Greater acceleration of vocal fold movement
- Increased amplitude
- Longer closed phase
- Bigger mucosal wave propagation
- Greater phase difference between the upper and lower lip

Effect of increasing frequency on the glottal cycle

- More open phase: 50% to 65% open phase

- Move to thinner vocal fold
- Sinusoidal vibratory pattern
- Greater velocity and acceleration
- Increase frequency
- Less amplitude due to increased tension on the vocal folds
- Thinner vocal fold with less two mass model of upper vs lower lip oscillation
- Mucosal wave is less distinct

THYROID GLAND

The thyroid is an endocrine gland, situated in the lower part of the front and sides of the neck. It regulated the basal metabolic rate, stimulates somatic and psychic growth and plays an important role in calcium metabolism

Development:

The thyroid develops from median endodermal thyroid diverticulum which grows down in front of the neck from the floor of the primitive pharynx, just caudal to the tuberculum impar. The lower end of the diverticulum enlarges to form the gland. The rest of the diverticulum remains narrow and is known as the thyroglossal duct

Histology And Function

The thyroid gland has two of the following cells :

1, Follicular cells – secrete tri-iodo-thyronin and tetra-iodo-thyronin(thyroxine) which stimulates basal metabolic rate and somatic and psychic growth of the individual.

2, Parafollicular cells (C cells) – these cells lie in between the follicles. They secret thyrocalcitonin which promotes deposition of calcium salts in skeletal and other tissues and tends to produce hypocalcemia

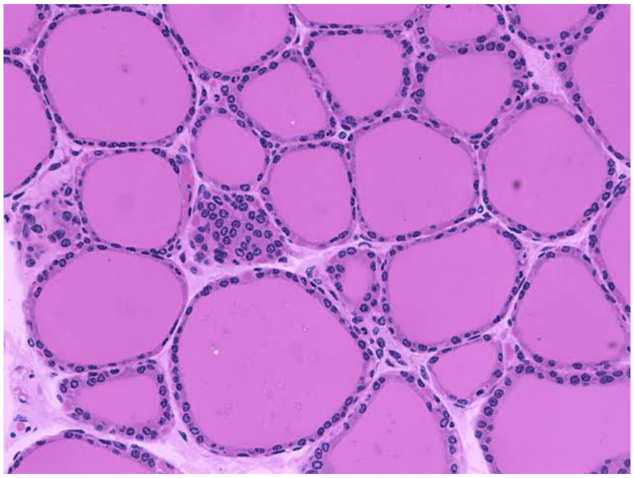


Figure 17 : Histology of thyroid

Anatomy

The gland lies against vertebrae C5, C6, C7 and T1, embracing the upper part of the trachea. Each lobe extends from the middle of the thyroid cartilage to the fourth or fifth tracheal ring. The isthmus extends from the second to the fourth tracheal ring. Each lobe measures about 5cm*2.5cm*2,5cm and the isthmus 1.2cm*1,2cm

It has two capsules. The true capsule is the peripheral condensation of the connective tissue of the gland. The false capsule is derived from the pretracheal layer of the deep cervical fascia. A dense capillary network is present just deep to the true capsule

The lobes are conical in shape having an apex, a base, three surfaces – lateral, medial and posterolateral and two borders – anterior and posterior. The isthmus connects the lower parts of the two lobes and has two surfaces – anterior and posterior; and two borders – superior and inferior

Arterial supply : The thyroid gland is supplied by

- Superior Thyroid Artery, the first anterior branch of External Carotid Artery and
- Inferior Thyroid Artery, branch of the thyrocervical trunk
- Thyroidea Ima Artery, branch of brachiocephalic trunk or arise directly from the arch of aorta (in 3% cases)

Venous Drainage : The thyroid gland is drained by

- Superior Thyroid Vein – drains into either the internal jugular vein or into the common facial vein
- Middle Thyroid Vein – drains into the internal jugular vein
- Inferior Thyroid Vein – drains into the left brachiocephalic vein
- Thyroid vein of Kocher – drains into the internal jugular vein

Lymphatic Drainage:

- Upper part of the gland – drains into upper deep cervical nodes
- Lower part of the gland – drains into lower deep cervical nodes

CLASSIFICATION OF THYROID LESIONS

BENIGN	MALIGNANT
Multinodular Goitre (sporadic) (Colloid Adenoma)	Papillary Carcinoma
Solitary Nodular Goitre (Adenoma)	Follicular Carcinoma - Minimally invasive - Widely invasive
Cysts : Colloid, Simple or Haemorrhagic	Medullary Carcinoma
Follicular Adenomas - Macrofollicular adenoma - Microfollicular adenoma	Anaplastic Carcinoma
Hashimoto's Thyroiditis	Primary Thyroid Lymphoma
Hurthle Cell Adenomas - Macrofollicular pattern - Microfollicular pattern	Metastatic Carcinoma (Breast, Renal cell, others)

Table 3: Classification of thyroid nodules

MATERIALS AND METHODS

The present study was conducted in the Department Of Otorhinolaryngology, Head And Neck Surgery at Government Stanley Medical College And Hospital for a time period of one year from November 2020 to October 2021. A total of forty patients within the age group 12 to 50 years planned for Hemithyroidectomy or Total Thyroidectomy presenting to Department of Otorhinolaryngology, Head and Neck Surgery and Department of General Surgery were enrolled for this study.

DESIGN OF STUDY : Prospective Study

PERIOD OF STUDY : One year (November 2020 to October 2021)

INCLUSION CRITERIA :

- Patients with thyroid neoplasms planned for Hemithyroidectomy or Total Thyroidectomy
- Age more than 12 years and less than 50 years
- Both sex

EXCLUSION CRITERIA

- Patients with medical illness like Chronic Obstructive Pulmonary Disease, Coronary Artery Disease, Chronic Renal Failure
- Patients with preoperative voice disorders

- Pregnancy
- Psychiatric and mentally challenged patients
- Patients who are lost to follow up during the period of study

METHODOLOGY

Forty patients who satisfied the inclusion and exclusion criteria were enrolled in this study. After obtaining proper informed consent from the patients preoperatively, each patient underwent four procedures namely Videolaryngoscopy, Videostroboscopy, Acoustic Voice Analysis and Voice Handicap Index Questionnnaire. The patients were reviewed at six weeks after surgery and each patient was subjected to same four procedures. The preoperative and postoperative results were compared

STUDY PROCEDURE

The following information were collected:

- Clinical Details of the Patients : Name, Age, Sex, In patient number, Occupation, Address
- Chief presenting complaint and duration
- Associated Co-morbidities
- Routine Preoperative Investigations
- Ultrasound Neck

- Thyroid Function Tests
- Fine Needle Aspiration Cytology Thyroid

Preoperative Procedures

1, Videolaryngoscopy :

Videolaryngoscopy is a non invasive office procedure that is used for visual assessment of the larynx by using a 70 degree Hopkins rod endoscope. Informed consent was obtained from the patient after explaining the procedure. 10% lignocaine spray was used to anesthetize the larynx. After waiting for five minutes, the endoscope was introduced into the oropharynx after asking the patient to protrude the tongue to visualize the glottis. The endoscope is negotiated past the uvula and adjusted to visualise the laryngeal inlet and the vocal folds. The patient was asked to phonate intermittent vowel sound “aa” while the movement of vocal folds were observed. After proper observation, the endoscope was withdrawn out of the oral cavity.

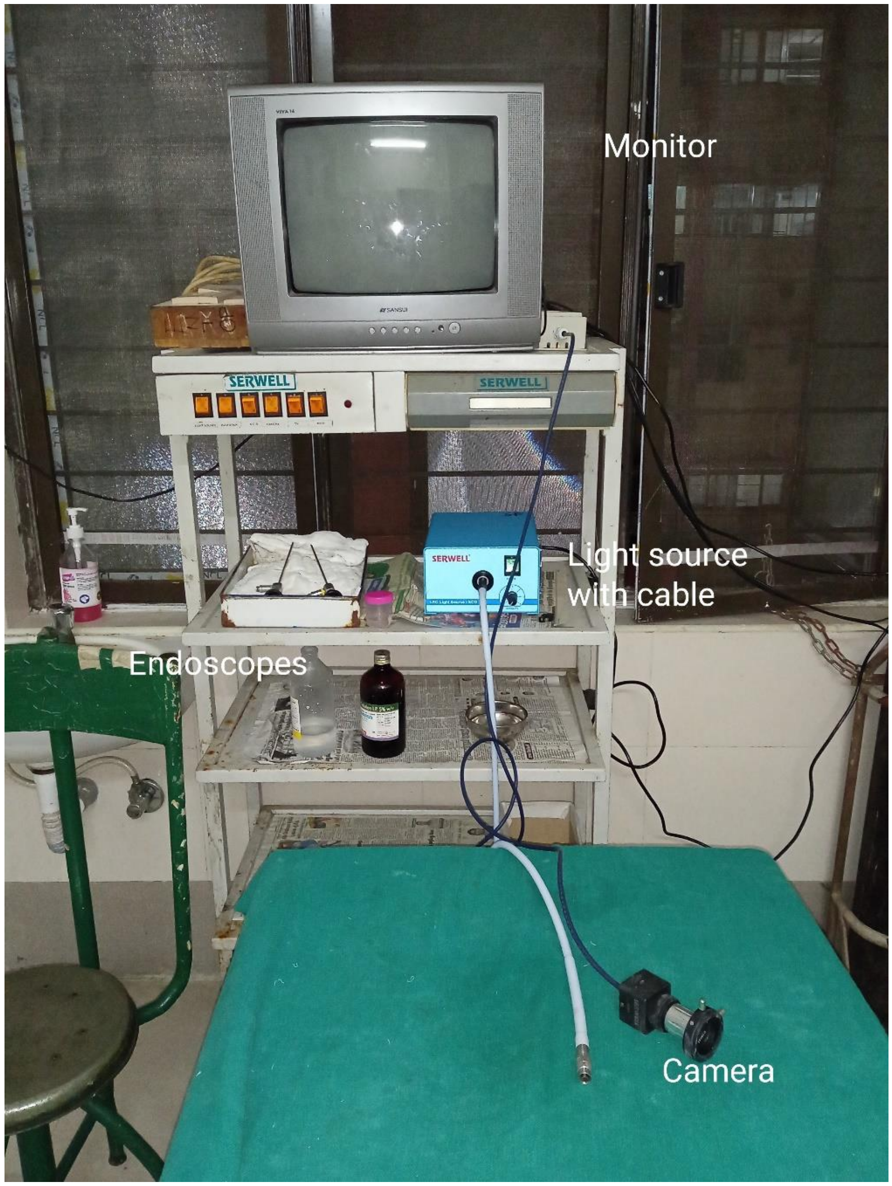


Figure 18 : Videolaryngoscopy

2, Videostroboscopy:

Videostroboscopy is a non invasive procedure that is used for the dynamic assessment of the vocal folds that is done using a 70 degree Hopkins rod endoscope. Informed consent was obtained from the patient after explaining the procedure. 10%

lignocaine spray was used to anesthetize the larynx. After waiting for five minutes, the endoscope was introduced to the oropharynx to visualize the glottis. The patient was asked to phonate long vowel sound “aa” to see the vocal folds in motion. While the patient phonates, the stroboscopy pedal was pressed so as to produce pulsed light in accordance to the fundamental frequency of the patient. The output picture and sound was recorded onto a computer screen and analysed later. Karl Strobz endoscope was used for the procedure.

The following parameters were analysed :

- Symmetry
- Mucosal Wave – Right and Left
- Glottic closure
- Periodicity

Figure 19 : Components of Videostroboscopy

3, Acoustic Voice Analysis

Voice analysis was done using PHONOLAB ECLERIS software in a sound proof room after obtaining informed consent from each patient. Voice was recorded using a low impedance commercial microphone kept four centimetres from the corner of mouth. Sustained vowels were used as voice materials and each patient was asked to phonate vowel sounds “aaa” in their low and comfortable sounds for atleast 15 to 20 seconds. Voice signals were recorded in a computer and used for analysis later. Good quality continuous signal was selected and used for analysis.

The parameters studied were

- Fundamental Frequency
- Jitter
- Shimmer
- Harmonics to Noise Ratio
- Maximum phonation time

4, Voice Handicap Index Questionnaire

Standardised questionnaire for the functional and subjective assessment of voice was used .In this study the Voice Handicap Index Questionnaire -30 developed by Jacobson et al was used. The questionnaire has 30 questions related to the impact of the patient's voice on their functional, physical and emotional aspects of life. The patients were asked to mark the response that indicated how frequently they had the same experience. The total possible score is 120. The completed questionnaire was collected and the Voice Handicap Index was calculated according to which the patients were placed

in the following categories :

SCORE RANGE	SEVERITY
0 to 30	Mild
31 to 60	Moderate
61 to 120	Severe

Table 4 : Grading according to Voice Handicap Index

Patients were admitted the day before surgery. Case sheets were written with complete history of chief complaints, systemic examination and local examination of thyroid swelling. Informed written consent for the surgery was obtained

Antibiotic sensitivity testing was done. All the patients were given tetanus toxoid and one full dose of intravenous antibiotic preoperatively. Serum calcium levels were checked for patients undergoing total thyroidectomy

ANESTHESIA : General Anesthesia

- Inducing agent : Injection Thiopentone Sodium 5mg/kg IV
- Muscle Relaxant : Injection Atracurium 0.5mg/kg bolus IV followed by 0.1mg/kg IV maintenance
- Premedication : Injection Glycopyrrolate 5 micrograms/kg IV, Injection Fentanyl 2 micrograms/kg IV and Injection Midazolam 50 micrograms/kg IV

- For Reversal at the end of surgery : Injection Glycopyrrolate 10 micrograms/kg IV and Injection Neostigmine 50 micrograms/kg IV

OPERATIVE TECHNIQUE

Under sterile aseptic precautions, with the patient in supine position and a soft head ring, under orotracheal intubation and general anesthesia, parts painted and draped. A horizontal cervical incision in a skin crease halfway between cricoid cartilage and sternal notch was made with 15 surgical blade. Skin and subcutaneous tissue dissected. Subplatysmal flaps were raised to a level above the thyroid cartilage and down to the suprasternal notch. Anterior jugular vein identified and grasped with Babcock's forceps. Strap muscles retracted laterally. The investing layer of deep cervical fascia was identified and incised in the midline, The thyroid isthmus was identified. The vascular pedicles were identified, ligated and cut. Unilateral or bilateral identification of recurrent laryngeal nerve was done for hemithyroidectomy or total thyroidectomy respectively. Berry's ligament was identified and dissected using fine and judicious bipolar diathermy and divided with size 15 blade scalpel. The pyramidal lobe was identified, dissected and excised along with the specimen. Thyroid gland dissected off the anterior tracheal wall and removed. Saline wash was given. Complete haemostasis was achieved. Operative wound drainage achieved by placing a negative pressure drain and positioned fixed. Subcutaneous layer closed with absorbable sutures and skin closed with interrupted ethilon sutures. Compressive bandage was applied.

POST OPERATIVE CARE

In the immediate post-operative period patients were given intravenous antibiotic (Injection Cefotaxime 1g IV BD), intravenous fluids and adequate analgesia. Oral feeds were started after six hours. Serum calcium levels were checked for patients who underwent total thyroidectomy.

Regular sterile dressing was done for all the patients. The drain was removed on post-operative days 3 to 4.

Calcium supplementation was given to patients with documented hypocalcemia. Thyroxine was given to all patients who underwent total thyroidectomy

Skin sutures were removed on post-operative days 7 to 10. The patients were given post-operative instructions and discharged. They were asked for regular follow-up

DISCHARGE ADVICE

- Tab. Amoxyclav 625mg 1-0-1
- Cap. Omeprazole 20mg 1-0-1
- Tab. Paracetamol 500mg 1-1-1
- Tab. Chlorpheniramine maleate 0-0-1
- Tab. Calcium (for indicated patients)
- Tab. Thyroxine (for patients who underwent total thyroidectomy)
- Regular weekly once follow up for the first month

Each patient was followed up regularly and at six weeks post-operative period were subjected to the following procedures :

- Videolaryngoscopy
- Videostroboscopy
- Acoustic Voice Analysis
- Voice Handicap Index Questionnaire

The methodology used was similar to the preoperative analysis and the results were compared.

RESULTS AND OBSERVATIONS

The collected data were analysed with IBM SPSS Statistics for Windows, Version 23.0.(Armonk, NY: IBM Corp).To describe about the data descriptive statistics frequency analysis, percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significant difference between the bivariate samples in Paired groups the Paired sample t-test was used. To find the significance in categorical data Chi-Square test was used. In both the above statistical tools the probability value .05 is considered as significant level.

Table 1: Age distribution

Age distribution		
	Frequency	Percent
12 - 35 years	14	35.0
36 - 40 years	13	32.5
41 - 45 years	7	17.5
45 - 50 years	6	15.0
Total	40	100.0
Mean ± S.D = 39 ± 5 years		

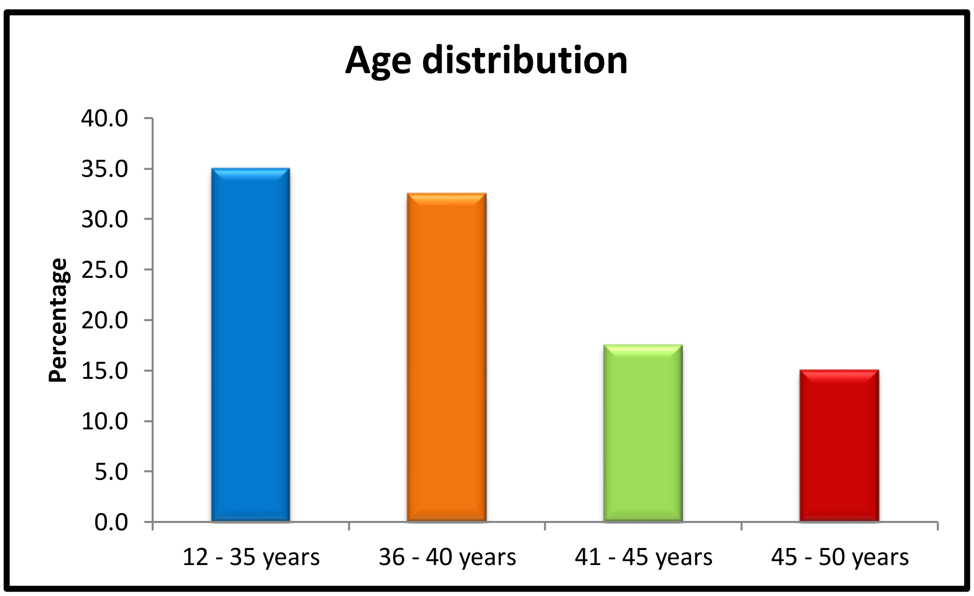


Figure 1

The above table shows Age distribution were 35.0% is 12-35 years, 32.5% is 36-40 years, 17.5% is 41-45 years, 15.0% is 45-50 years.

Table 2: Gender distribution

Gender distribution		
	Frequency	Percent
Female	29	72.5
Male	11	27.5
Total	40	100.0

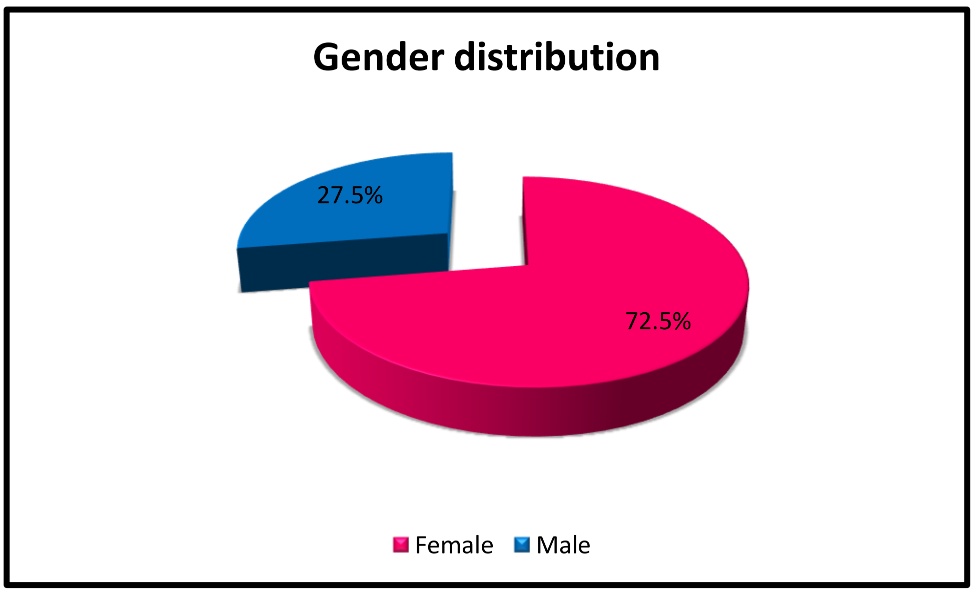


Figure 2

The above table shows Gender distribution were 72.5% is Female, 27.5% is Male.

Table 3: Diagnosis distribution

Diagnosis		
	Frequency	Percent
Colloid Goitre	7	17.5
Follicular CA	3	7.5
Left SNG	10	25.0
Pap. CA	11	27.5
Right SNG	9	22.5
Total	40	100.0

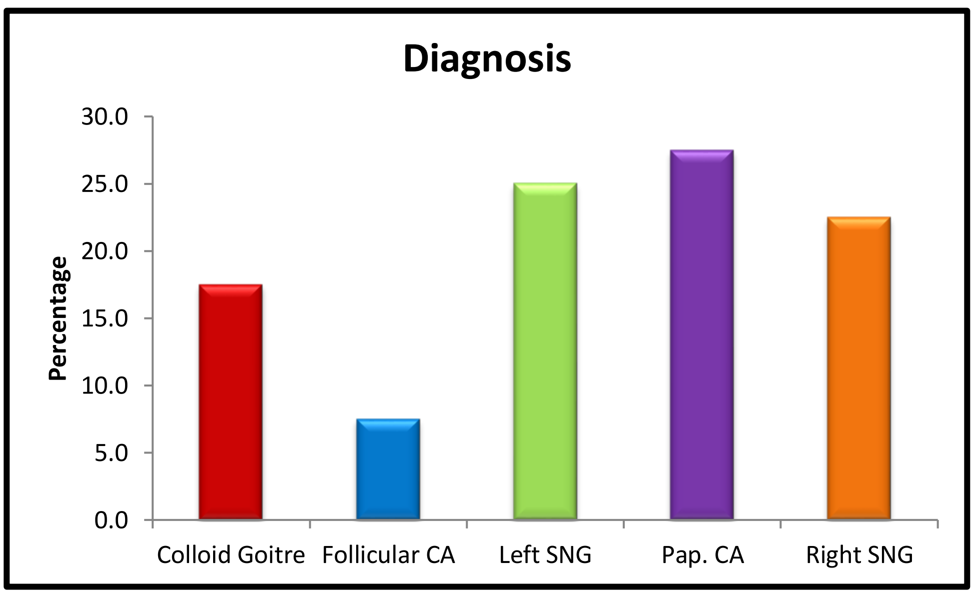


Figure 3

The above table shows Diagnosis distribution were 72.5% is Colloid Goitre, 7.5% is Follicular CA, 25.0% is Left SNG, 27.5% is Pap.CA, 22.5% is Right SNG.

Table 4: Surgery done distribution

Surgery done		
	Frequency	Percent
Hemithyroidectomy	26	65.0
Totalthyroidectomy	14	35.0
Total	40	100.0

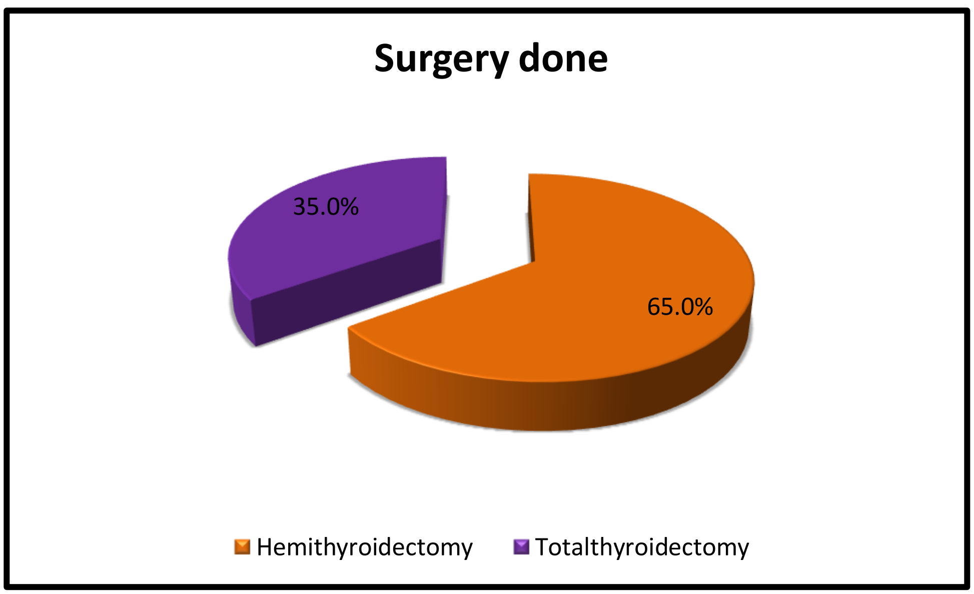


Figure 4

The above table shows Surgery done distribution were 65.0% is Hemithyroidectomy, 35.0% is Total thyroidectomy.

Table 5: Right mucosal wave distribution between Pre op and Post op

Right mucosal wave			Postop			Total
			Normal	Small	Absent	
Preop	Normal	Count	34	5	1	40
		%	85.0%	12.5%	2.5%	100.0%
Total		Count	34	5	1	40
		%	85.0%	12.5%	2.5%	100.0%

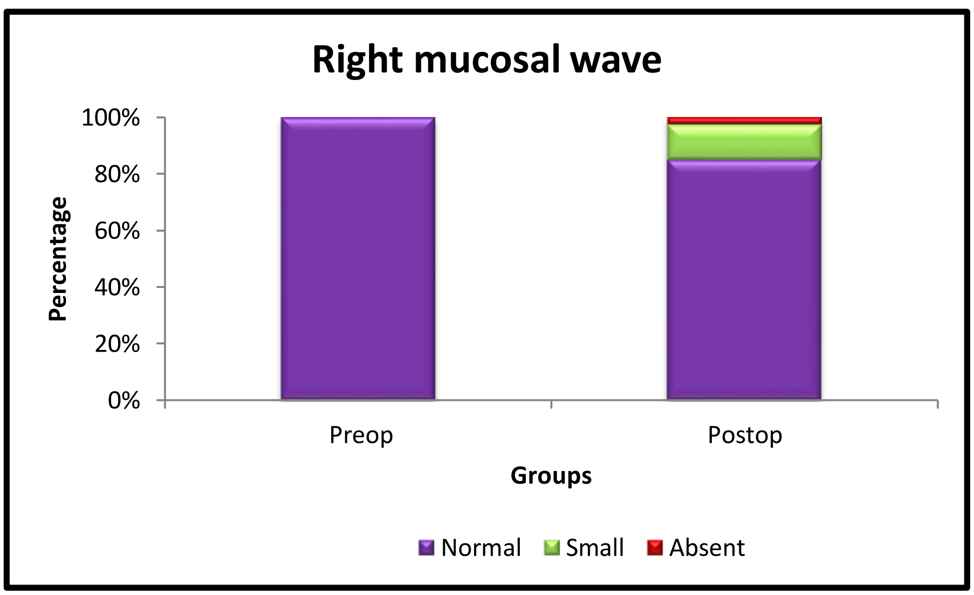


Figure 5

The above table shows Right mucosal wave distribution of Pre op and Post op.

Table 6: Left mucosal wave distribution between Pre op and Post op

Left mucosal wave			Postop			Total
			Normal	Small	Absent	
Preop	Normal	Count	35	4	1	40
		%	87.5%	10.0%	2.5%	100.0%
Total		Count	35	4	1	40
		%	87.5%	10.0%	2.5%	100.0%

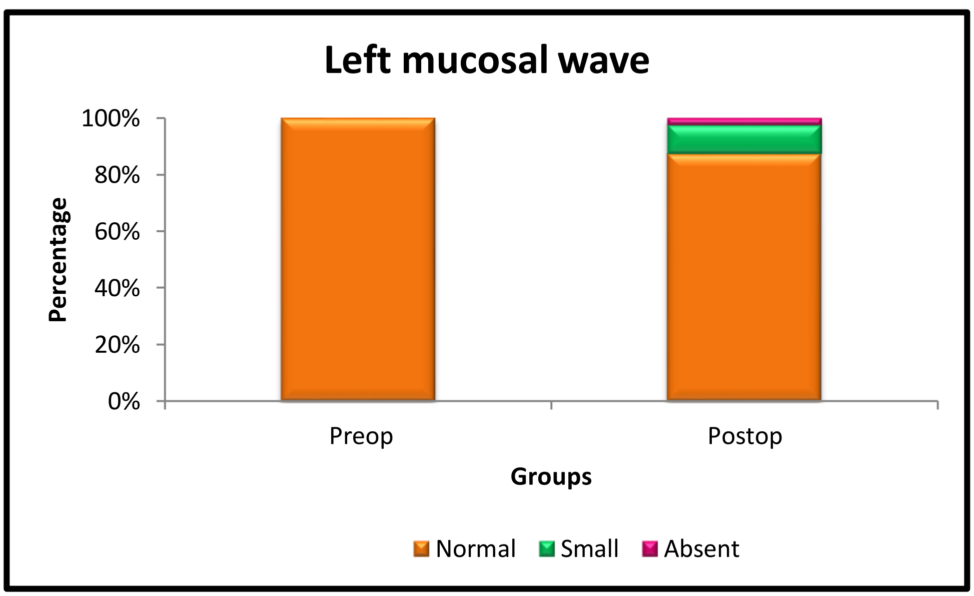


Figure 6

The above table shows Left mucosal wave distribution of Pre op and Post op.

Table 7: Symmetry distribution between Pre op and Post op

Symmetry			Postop		Total
			Present	Absent	
Preop	Present	Count	37	3	40
		%	92.5%	7.5%	100.0%
Total		Count	37	3	40
		%	92.5%	7.5%	100.0%

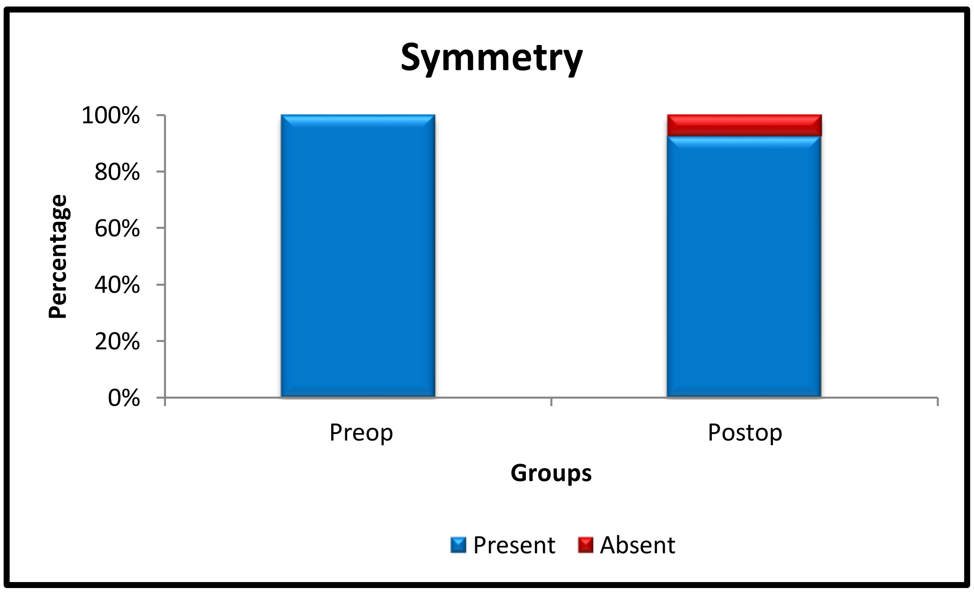


Figure 7

The above table shows Symmetry distribution of Pre op and Post op.

Table 8: Periodicity distribution between Pre op and Post op

Periodicity			Postop Present	Postop Absent	Total
Preop	Present	Count	37	3	40
		%	92.5%	7.5%	100.0%
Total		Count	37	3	40
		%	92.5%	7.5%	100.0%

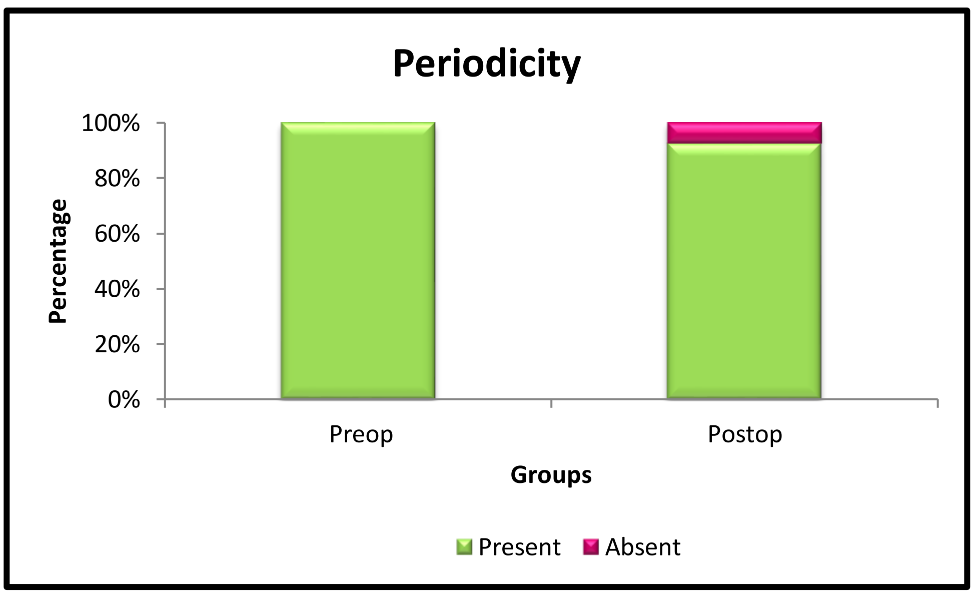


Figure 8

The above table shows Periodicity distribution of Pre op and Post op.

Table 9: Videolaryngoscopy distribution between Pre op and Post op

Videolaryngoscopy			Postop			Total
			L VC palsy	N	R VC palsy	
Preop	N	Count	1	38	1	40
		%	2.5%	95.0%	2.5%	100.0%
Total		Count	1	38	1	40
		%	2.5%	95.0%	2.5%	100.0%

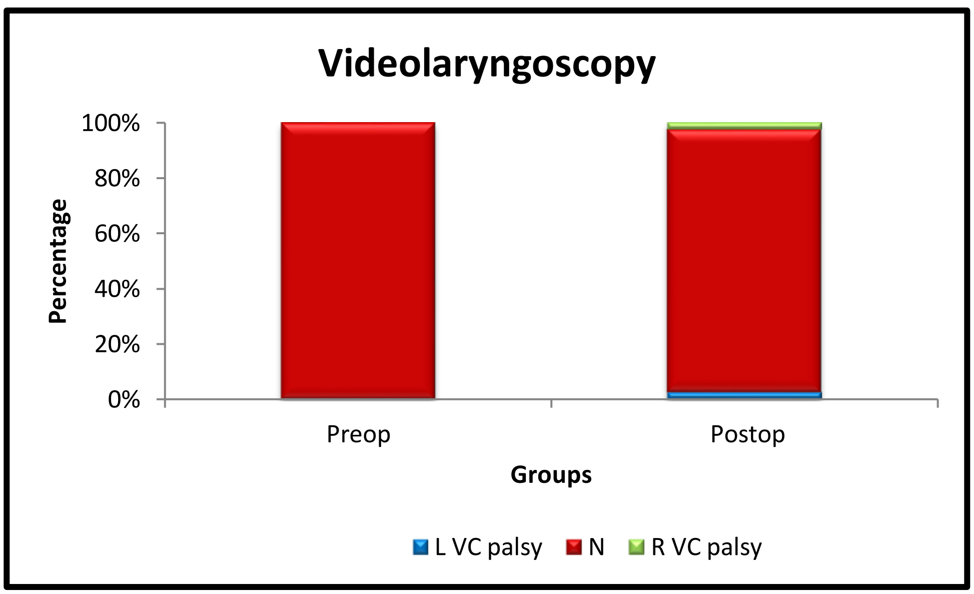


Figure 9

The above table shows Videolaryngoscopy distribution of Pre op and Post op.

Table 10: VHI-30 distribution between Pre op and Post op

VHI-30			Postop			Total
			Mild	Moderate	Severe	
Preop	Mild	Count	32	6	2	40
		%	80.0%	15.0%	5.0%	100.0%
Total		Count	32	6	2	40
		%	80.0%	15.0%	5.0%	100.0%

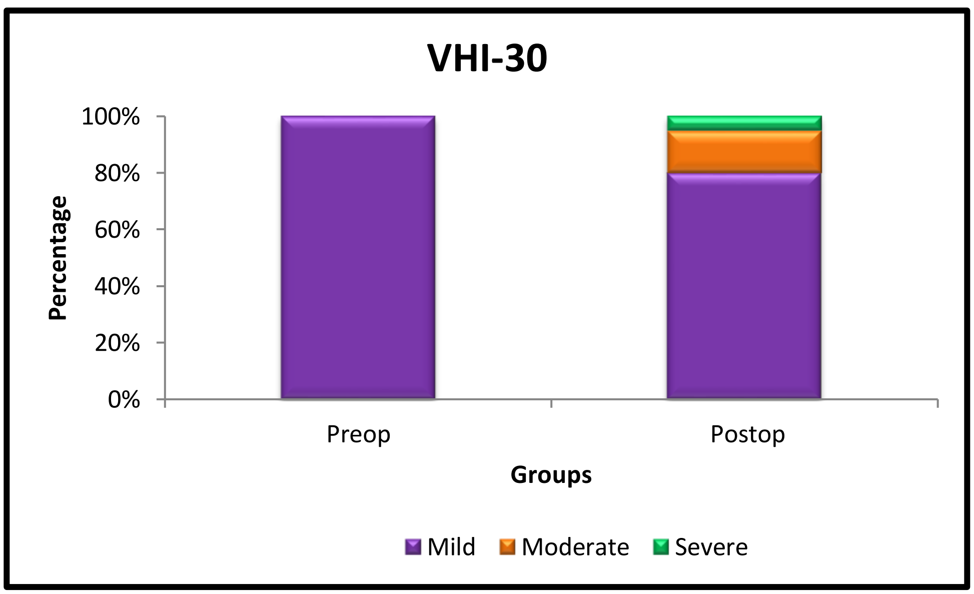


Figure 10

The above table shows VHI-30 distribution of Pre op and Post op.

Table 11: Comparison of Glottic Closure between Pre op and Post Op

Glottic Closure			Postop			Total
			Complete closure	Incomplete closure	Posterior gap	
Preop	Complete closure	Count	32	2	0	34
		%	80.0%	5.0%	0.0%	85.0%
	Posterior gap	Count	0	0	6	6
		%	0.0%	0.0%	15.0%	15.0%
Total		Count	32	2	6	40
		%	80.0%	5.0%	15.0%	100.0%
χ^2 - value= 40.000, p-value=0.0005 ** ** Highly Statistical Significance at p < 0.01 level						

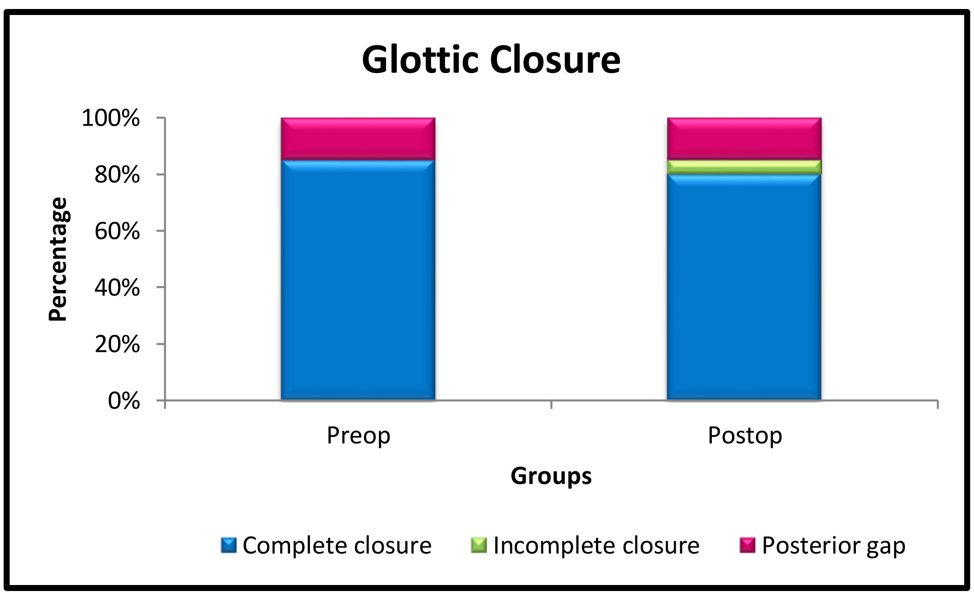


Figure 11

The above table shows comparison between Preop and Postop of Glottic Closure by Pearson's chi-squared test were $\chi 2$=40.000, p=0.0005<0.01 which shows highly statistical significant association between Preop and Postop of Glottic Closure.

Table 12: Comparison of Fund. Freq by Paired sample t-test

		N	Mean	S.D	t-value	p-value
Fund. Freq	Preop	40	177.73	37.87	0.303	0.763 #
	Postop	40	177.07	39.05		
# No Statistical Significance at p > 0.05 level						

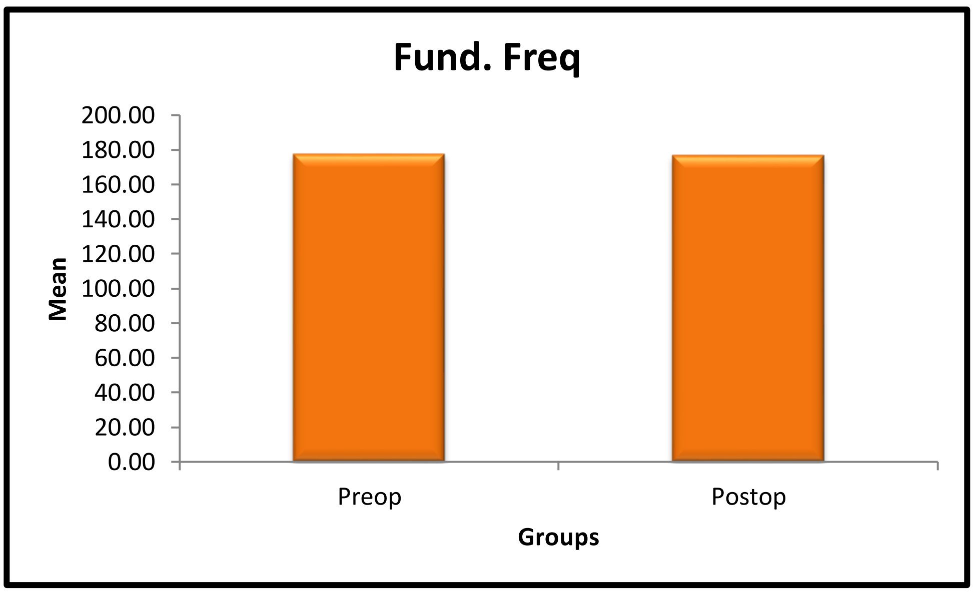


Figure 12

The above table shows comparison of Fund. Freq by Paired sample t-test were t-value=0.303, p-value=0.763>0.05 which shows no statistical significant difference at $p > 0.05$ level.

Table 13: Comparison of Jitter (%RAP) by Paired sample t-test

		N	Mean	S.D	t-value	p-value
Jitter (%RAP)	Preop	40	0.74	0.10	2.784	0.008 **
	Postop	40	0.72	0.12		
** Highly Statistical Significance at p < 0.01 level						

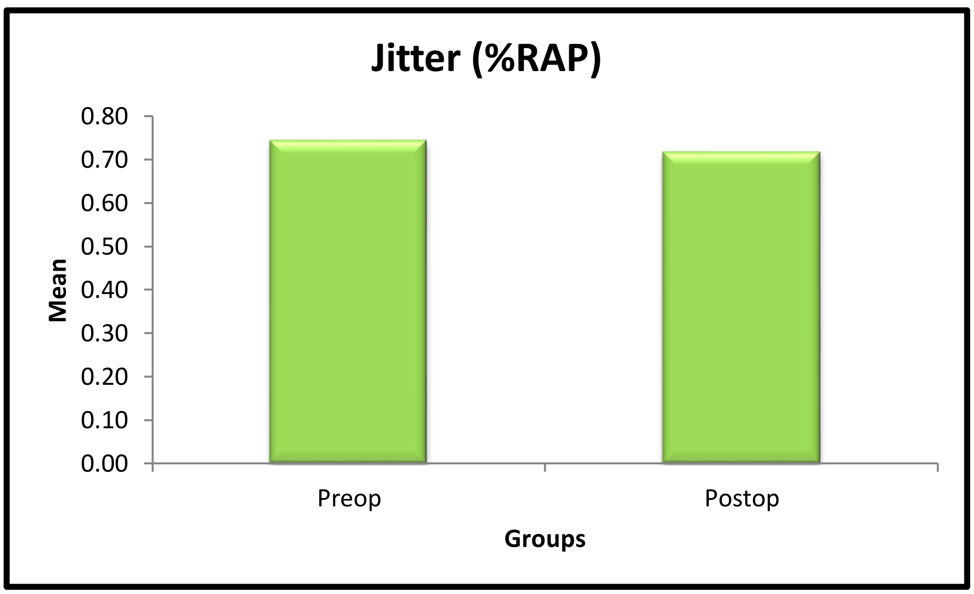


Figure 13

The above table shows comparison of Jitter (%RAP) by Paired sample t-test were t-value=2.784, p-value=0.008<0.01 which shows highly statistical significant difference at $p < 0.01$ level.

Table 14: Comparison of Shimmer(%APQ) by Paired sample t-test

		N	Mean	S.D	t-value	p-value
Shimmer(%APQ)	Preop	40	1.96	0.17	0.189	0.851 #
	Postop	40	1.95	0.18		
# No Statistical Significance at p > 0.05 level						

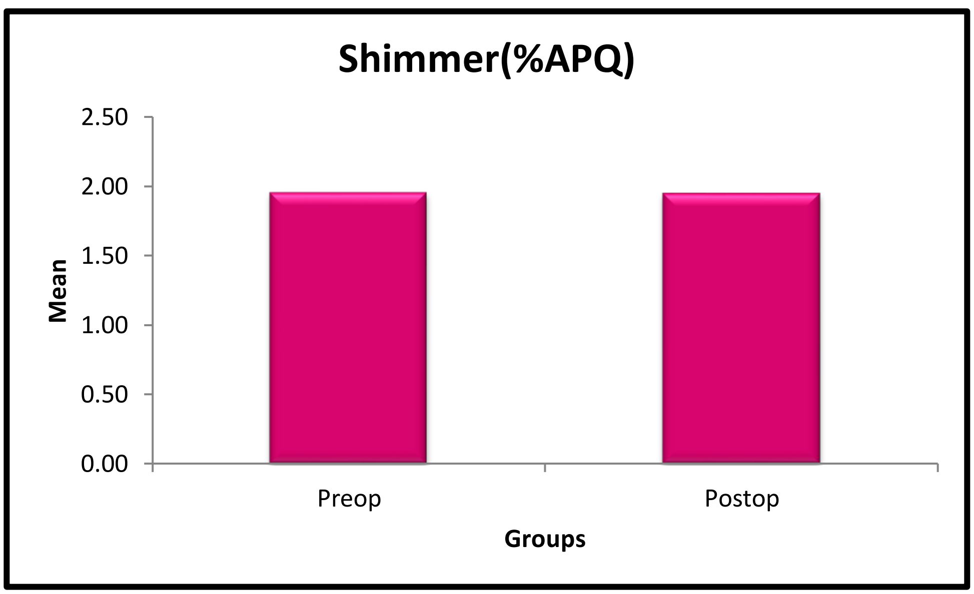


Figure 14

The above table shows comparison of Shimmer(%APQ) by Paired sample t-test were t-value=0.189, p-value=0.851>0.05 which shows no statistical significant difference at $p > 0.05$ level.

Table 15: Comparison of HNR by Paired sample t-test

		N	Mean	S.D	t-value	p-value
HNR	Preop	40	0.12	0.02	2.459	0.018 *
	Postop	40	0.13	0.03		
* Statistical Significance at $p < 0.05$ level						

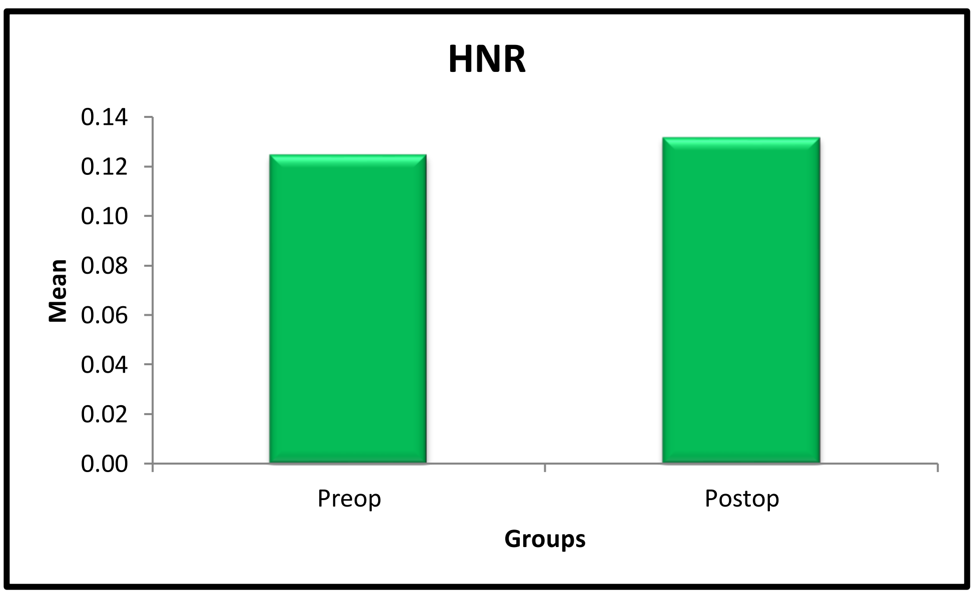


Figure 15

The above table shows comparison of HNR by Paired sample t-test were t-value=2.459, p-value=0.018<0.05 which shows statistical significant difference at $p < 0.05$ level.

Table 16: Comparison of Max Phon. Time by Paired sample t-test

		N	Mean	S.D	t-value	p-value
Max Phon. Time	Preop	40	18.20	1.77	2.145	0.038 *
	Postop	40	19.40	3.86		
* Statistical Significance at p < 0.05 level						

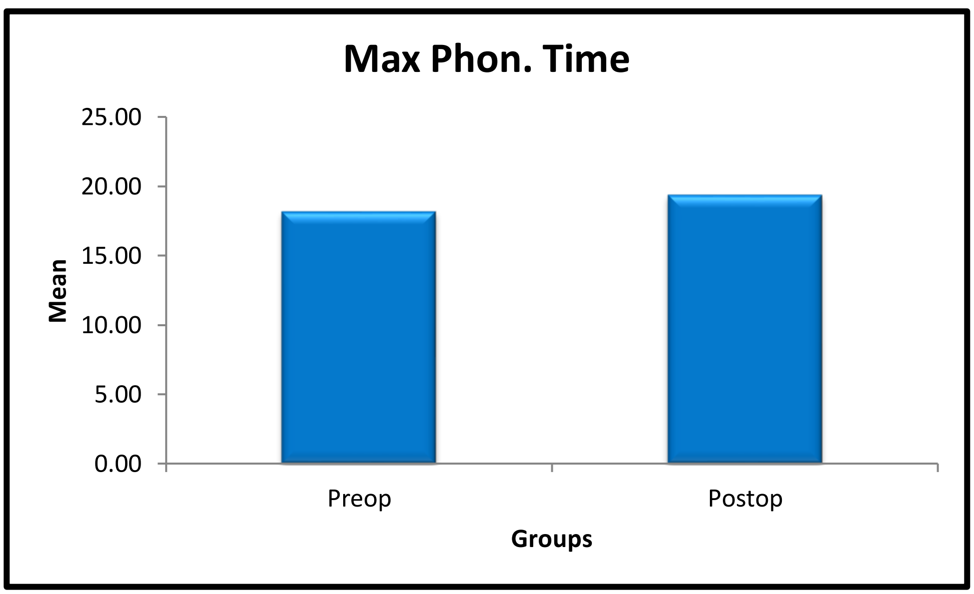


Figure 16

The above table shows comparison of Max Phon. Time by Paired sample t-test were t-value=2.145, p-value=0.038<0.05 which shows statistical significant difference at $p < 0.05$ level.

Summary

- Age distribution were 35.0% is 12-35 years, 32.5% is 36-40 years, 17.5% is 41-45 years, 15.0% is 45-50 years.
- Gender distribution were 72.5% is Female, 27.5% is Male.
- Diagnosis distribution were 72.5% is Colloid Goitre, 7.5% is Follicular CA, 25.0% is Left SNG, 27.5% is Pap.CA, 22.5% is Right SNG.
- Surgery done distribution were 65.0% is Hemithyroidectomy, 35.0% is Total thyroidectomy.
- Preop and Postop of Glottic Closure by Pearson’s chi-squared test were $\chi^2=40.000$, $p=0.0005<0.01$ which shows highly statistical significant association between Preop and Postop of Glottic Closure.
- Fund. Freq by Paired sample t-test were t-value=0.303, p-value=0.763>0.05 which shows no statistical significant difference at $p > 0.05$ level.
- Jitter (%RAP) by Paired sample t-test were t-value=2.784, p-value=0.008<0.01 which shows highly statistical significant difference at $p < 0.01$ level.
- Shimmer(%APQ) by Paired sample t-test were t-value=0.189, p-value=0.851>0.05 which shows no statistical significant difference at $p > 0.05$ level.
- HNR by Paired sample t-test were t-value=2.459, p-value=0.018<0.05 which shows statistical significant difference at $p < 0.05$ level.
- Max Phon. Time by Paired sample t-test were t-value=2.145, p-value=0.038<0.05 which shows statistical significant difference at $p < 0.05$ level.

DISCUSSION

The main aim of this study was to determine the effect of thyroid surgery whether hemi thyroidectomy or total thyroidectomy on the subjective and objective voice quality using multipara-meter approach. In addition, the study 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 this study, 40 patients presented with swelling in thyroid gland. 29 patients were female and 11 patients were male. Preoperative fine needle aspiration was done after which all these patients underwent thyroidectomy. 26 patients underwent hemi thyroidectomy and 14 patients underwent total thyroidectomy. The voice assessment was done preoperatively and postoperatively using the same voice assessment methods. All patients who underwent hemi thyroidectomy did not report significant subjective voice changes at six weeks postoperatively. Acoustic Voice analysis revealed all these patients to have mild improvement of fundamental frequency, jitter, shimmer, harmonics to noise ratio and maximum phonation time. Videostroboscopic examination preoperatively and postoperatively showed no significant changes in the vocal fold parameters.

20% of the patients (8 patients) reported subjective voice changes at six weeks postoperative period with significant changes observed in VHI-30 score. All these patients had undergone total thyroidectomy of which 2 patients (5% of the patients) developed unilateral vocal fold palsy. They developed significant reduction in all acoustic analysis parameters as well as severe impairment in their functional, emotional and physical aspects of voice as evidenced by the increased VHI-30 score. The remaining 6 patients (15% of the patients) had moderate voice impairment according to the VHI-30 grading.

- Netto et al. found in their study that about 28 percent patients, who underwent total thyroidectomy, had shown higher VHI than presurgical value. statistically significant.

Videostroboscopic examination of vocal folds revealed significant changes in atleast one parameter in 15% of the patients (6 patients). The two patients who developed unilateral vocal fold palsy showed significant changes in all five parameters. 6 patients, all female, had Posterior gap glottic closure pattern preoperatively and postoperatively.

- The comparison between preoperative and postoperative glottic closure pattern by Pearson's chi-squared test showed a p value of 0.0005 (<0.01), indicating statistical significant association between preoperative and postoperative glottic closure pattern

Objective voice assessment was done using PHONOLAB ECLERIS Software from which 5 acoustic parameters of sound were evaluated.

- Wong et al. found significant changes in fundamental frequency and shimmer in early postoperative period while in this study statistical significant changes were found in jitter, Harmonics to Noise Ratio and maximum phonation time but not in fundamental frequency and shimmer.

- Chun et al. did acoustic analysis and found no statistically significant changes in fundamental frequency, shimmer, jitter, noise harmonic ratio. In this study mixed results were found when compared with Chun et al. as there were significant changes in jitter, noise harmonic ratio and maximum phonation time but not in shimmer and fundamental frequency.

P values by paired sample t-test for Fundamental frequency was 0.763 (>0.05) and for shimmer was 0.851(>0.05), indicating no statistical significant difference. The p values by paired sample t-test for jitter was 0.008, Noise to Harmonics Ratio was 0.018 and for Maximum phonation time was 0.038 (<0.05), indicating statistical significant difference.

CONCLUSION

- Subjective voice changes are found in upto 20% of the patients in the early postoperative period (6 weeks). VHI-30 index was more affected in patients undergoing total thyroidectomy
- Factors other than laryngeal nerve injury appear to alter the post thyroidectomy voice.
- Statistically significant changes were observed in acoustic parameters of voice, namely jitter, Noise to Harmonics Ratio and Maximum phonation time
- 15% of the patients showed an alteration in atleast 1 parameter in videostroboscopic examination
- The natural history of post thyroidectomy voice disturbances in patients with normal preoperative voice has not been systematically studied and its characterization is important for voice rehabilitation

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CASE SHEET PROFORMA

Name:
Age:
Sex:
IP/OP no:
Occupation:
Address:

Chief complaint
Duration
Voice change
Duration
Co-MORBIDITIES

Diagnosis
Surgical plan
DOA
DOS
DOD

INVESTIGATIONS:
Urine :albumin, sugar, deposits
Blood:
Complete Haemogram:

- Total count
- Differential count
- Haemoglobin
- ESR
- Platelet count
- Bleeding time
- Clotting time
- Blood grouping and typing
- Cross matching

Blood sugar
Renal function test: Urea, Creatinine
X ray: chest (PA view)
ECG in all leads
USG NECK
THYROID FUNCTION TESTS
FNAC THYROID

PREOPERATIVE ANALYSIS

STROBOSCOPIC PARAMETERS

Symmetry : Present-1 ; Absent-2

Mucosal Wave : Right : Greater-1, Normal-2, Small-3, Absent-4

Left : Greater-1, Normal-2, Small-3, Absent-4

Glottic Closure : Complete-1, Incomplete-2, Irregular-3, Posterior gap-4, Anterior gap-5, Hourglass-6, Spindle gap-7, Variable pattern-8

Periodicity : Present-1 ; Absent-2

ACOUSTIC ANALYSIS

1, Fundamental Frequency

2, Jitter

3, Shimmer

4, Harmonics to Noise Ratio

5, Maximum Phonation Time

VIDEOLARYNGOSCOPY REPORT

VOICE HANDICAP INDEX SCORE

Functional : Physical : Emotional :

Total :

POST-OPERATIVE ANALYSIS

STROBOSCOPIC PARAMETERS

Symmetry : Present-1 : Absent-2

Mucosal Wave : Right : Greater-1, Normal-2, Small-3, Absent-4

Left : Greater-1, Normal-2, Small-3, Absent-4

Glottic Closure : Complete-1, Incomplete-2, Irregular-3, Posterior gap-4, Anterior gap-5, Hourglass-6, Spindle gap-7, Variable pattern-8

Periodicity : Present-1, Absent-2

ACOUSTIC ANALYSIS

1, Fundamental Frequency

2, Jitter

3, Shimmer

4, Harmonics to Noise Ratio

5, Maximum Phonation Time

VIDEOLARYNGOSCOPY REPORT

VOICE HANDICAP INDEX SCORE

Functional : Physical : Emotional :

Total :

VOICE HANDICAP INDEX QUESTIONNAIRE

Circle the response that indicates how frequently you have the same experience.

0-neve r 1-almost never 2-sometimes 3-almost always 4-always

Part 1- functional

My voice makes it difficult for people to hear me. 0 1 2 3 4

People have difficulty understanding me in a noisy room. 0 1 2 3 4

My family has difficulty hearing me when I call them throughout the house0 1 2 34

I use the phone less often than I would like to. 0 1 2 3 4

I tend to avoid groups of people because of my voice. 0 1 2 3 4

I speak with friends, neighbors, or relatives less often because of my voice0 1 2 3 4

People ask me to repeat myself when speaking face-to-face. 0 1 2 3 4

My voice difficulties restrict my personal and social life. 0 1 2 3 4

I feel left out of conversations because of my voice. 0 1 2 3 4

My voice problem causes me to lose income. 0 1 2 3 4

Part 2-physical

I run out of air when I talk. 0 1 2 3 4

The sound of my voice varies throughout the day. 0 1 2 3 4

People ask, “What’s wrong with your voice?” 0 1 2 3 4

My voice sounds creaky and dry. 0 1 2 3 4

I feel as though I have to strain to produce voice. 0 1 2 3 4

The clarity of my voice is unpredictable. 0 1 2 3 4

I try to change my voice to sound different. 0 1 2 3 4

I use a great deal of effort to speak. 0 1 2 3 4

My voice is worse in the evening. 0 1 2 3 4

My voice “gives out” on me in the middle of speaking. 0 1 2 3 4

Part 3-emotional

I am tense when talking to others because of my voice. 0 1 2 3 4

People seem irritated with my voice. 0 1 2 3 4

I find other people don’t understand my voice problem. 0 1 2 3 4

My voice problem upsets me. 0 1 2 3 4

I am less outgoing because of my voice problem. 0 1 2 3 4

My voice makes me feels handicapped. 0 1 2 3 4

I feel annoyed when people ask me to repeat. 0 1 2 3 4

I feel embarrassed when people ask me to repeat. 0 1 2 3 4

My voice makes me feel incompetent. 0 1 2 3 4

I am ashamed of my voice problem. 0 1 2 3 4

FUNCTIONAL PHYSICAL EMOTIONAL TOTAL SCORE

PATIENT INFORMATION SHEET

TITLE: ‘A COMPARITIVE STUDY FOR ASSESSMENT OF VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY

I, Dr.S.DENNY, post graduate, MS in ENT and head and neck surgery,Government Stanley Medical College is going to undertake the study on the above mentioned topic.

Aim is to study the VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY. If you are willing to participate in this study you will be asked some questions regarding duration of your illness, treatment history, family history regarding the illness. And you may need to undergo some non invasive tests such as VLS,Videostroboscopy,Acoustic voice analysis

This is to study the VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY’. I assure that all the information provided by you will be kept highly confidential and privacy is assured. Your identity won’t be revealed to anyone. The study may be published in scientific journal, but your identity will not be revealed.

Your participation in this study is voluntary and you can withdraw from this at any point of time.

Signature/left thumb impression of the participant

INFORMED CONSENT

TITLE: ‘A COMPARITIVE STUDY FOR ASSESSMENT OF VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY

The content of the information sheet dated ___________ that was provided have been read carefully by me/explained in detail to me, in a language that I comprehend and fully understood the contents.

I confirm that I had the opportunity to ask questions.

The nature and purpose of the study and its potential risks/benefits and expected duration of the study and other relevant details of the study have been explained to me in detail.

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my medical care or legal right being affected.

I agree to take part in the above study

____

(Signature/Left thumb impression)

Name of the Participant: ___________________________

Son/Daughter/Spouse of ___________________________

Complete postal address: ___________________________

This is to certify that the above consent has been obtained in my presence.

________________________________ Date:

Signature of the principal investigator Place:

1)Witness – 1 2) Witness – 2

____

____

Signature: Signature:

Name: Name:

Address: Address:

PATIENT INFORMATION SHEET

தகவல் நகல்

TITLE: ‘A COMPARITIVE STUDY FOR ASSESSMENT OF VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY

இந்த ஆய்வில் உங்களிடம் கேட்கும் கேள்விகளுக்கு முழு மனதுடன் பதில் அளிக்க வேண்டும்.

இந்த ஆய்வில் உங்களின் நாள்பட்ட நோய்கள், உடல்நலம் தொடர்பாக விவரங்கள் கேட்கப்படும்..

உங்களிடம் கேட்கும் கேள்விகளில் உங்களின் சுயவிபரம், குடும்பவிபரம், தொழில் விபரம் மற்றும் இதர விபரம் அடங்கும்.

உங்களுக்கு பணம் எதுவும் அளிக்கபடாது என்பதை இதன் மூலம்   தெறிவிக்கிறேன்.

உங்களின் விபரங்கள் எதுவும் மற்றவர்களுக்கு தெரிவிக்கப்படாது என்பதை உறுதியளிக்கிறேன்.

இந்த ஆய்வின் முடிவுகள் பத்திரிக்கைளில் பிரசுரிக்கபடலாம் ,ஆனால் உங்களின் அடையாளம் எதுவும் காட்டப்படாது.

உங்களுக்கு விருப்பம் இல்லை என்றால் எப்போது வேண்டுமானாலும் இந்த ஆய்வில் இருந்து விலகிக்கொள்ளலாம். அதனால் உங்களுக்கு எந்த பாதிப்பும் இல்லை.

கையொப்பம்/ இடது பெருவிரல் ரேகை

INFORMED CONSENT

தகவல் தொடர்பு ஒப்புதல் படிவம்

TITLE: ‘A COMPARITIVE STUDY FOR ASSESSMENT OF VOCAL FOLD VIBRATORY FUNCTION IN PATIENTS WITH THYROID NEOPLASM PREOPERATIVELY AND POSTOPERATIVELY

நான் தகவல் நகலில் கொடுக்கபட்டுள்ள முழு விவரங்களையும் கவனமாகப் படித்தேன். ஆய்வின் முழு விவரங்களையும் தமிழில் எனக்கு விளக்கமாக எடுத்துக் கூறப்பட்டது.

நான் இந்த ஆய்வின் விவரங்களை முழுமையாக புரிந்துகொண்டேன்.

ஆய்வில் பங்கு எடுக்கும் போது ஏற்படும் சாத்தியமான அபாயங்கள் மற்றும் பயன்களை நான் அறிந்துள்ளேன்.

மேலும், நான் எந்த ஒரு வேளையிலும் ஆய்வில் இருந்து திரும்ப முடியும் என்றும், அதன் பின்னர் நான் வழக்கம்

போல் மருத்துவச் சிகிச்சைப் பெற முடியும் என்றும் புரிந்துக் கொள்கிறேன்.

நான் ஆய்வில் பங்கு கொள்ள பணம் எதையும் பெற முடியாது என்று அறிந்துள்ளேன்.

நான் இந்த ஆய்வில் பங்கு எடுப்பதன் மூலம் நான் என்ன செய்ய போகிறேன் என்று தெரியும்.

நான் இந்த ஆய்வில் என் முழு ஒத்துழைப்பையும் கொடுப்பேன் என்று உறுதியளிக்கின்றேன்.

ஆய்வில் பங்கேற்பவர் பெயர்:

சாட்சி:

பெயர் மற்றும் முகவரி:

பெயர் மற்றும் முகவரி:

கையொப்பம்/விரல் ரேகை

கையொப்பம்/விரல் ரேகை

ஆராய்ச்சியாளர் கையொப்பம் மற்றும் தேதி

ABBREVIATIONS

BMZ – Basement Membrane Zone

SLP – Superficial layer of Lamina Propria

ECM – Extracellular Matrix

HA – Hyaluronic Acid

ILP – Intermediate Layer of Lamina Propria

DLP – Deep Layer of Lamina Propria

Hz – Hertz

dB – Decibels

SFF – Speaking Fundamental Frequency

VRP – Voice Range Profile

RMW – Right Mucosal Wave

LMW – Left Mucosal Wave

HNR – Harmonics Noise Ratio

VLS – Videolaryngoscopy

VHI – Voice Handicap Index