# FUNCTIONAL ENDOSCOPIC EVALUATION OF SWALLOWING IN PATIENTS TREATED FOR HEAD AND NECK MALIGNANCIES

**By**

**DR. HARSHITHA N**

**DISSERTATION SUBMITTED TO**

**SRI DEVARAJ URS ACADEMY OF HIGHER EDUCATION AND RESEARCH CENTRE, KOLAR**

In partial fulfillment of the requirements for the degree of

**MASTER OF SURGERY IN OTORHINOLARYNGOLOGY**

Under the guidance of

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**Dr. HARSHITHA N**

## LIST OF ABBREVIATIONS

| | | |
|---|---|---|
| FEES | □ | Fibreoptic endoscopic evaluation of swallowing |
| HNSCC | □ | Head and neck squamous cell carcinomas |
| CNS | □ | Central nervous system |
| NTL | □ | Near total laryngectomy |
| DOI | □ | Depth of invasion |
| ENE | □ | Extranodal extension |
| AC | □ | Anterior commissure |
| TOLR | □ | Transoral laser resection |
| RT | □ | Radiotherapy |
| VC | □ | Vocal cord |
| CT-RT | □ | Concurrent chemoradiation |
| SCPL | □ | Supracricoid partial laryngectomy |
| FLPL | □ | Frontolateral partial laryngectomy |
| TL | □ | Total laryngectomy |
| VFS | □ | Videofluoroscopy |

| | | |
|---|---|---|
| GBS | □ | Gingivobuccal sulcus |
| PMMC | □ | Pectoralis major myocutaneous flap |
| MRND | □ | Modified radical neck dissection |
| RMT | □ | Retromolar trigone |
| SOHND | □ | Supraomohyoid neck dissection |
| EBRT | □ | External beam radiotherapy |
| NVBS | □ | Normal vesicular breath sounds |
| CPG | □ | Central pattern generator |
| CCC | □ | Central compartment clearance |
| VPL | □ | Vertical partial laryngectomy |
| HPL | □ | Horizontal partial laryngectomy |
| PAS | □ | Penetration/ Aspiration Score |

# ABSTRACT

**BACKGROUND:**

Head and neck malignancies are most common group of malignancies (30%) in India. There is high prevalence of head and neck cancer in Kolar region. Treatment protocols and prognosis vary widely and are based on the stage of the disease at the time of diagnosis. Most patients present with locally advanced disease requiring aggressive, multimodality treatments resulting in dysphagia.

As a result of disease or aggressive treatment, there can be structural and functional deficit in the upper aerodigestive tract in the form of restriction of movement, loss of bone and muscle, fibrosis, adynamic segments, denervated areas and stenosis. These factors can lead to compromise in nutrition as well as complications like cachexia and aspiration leading to life threatening pneumonia. Therefore early and objective identification of the site and cause for dysphagia and supportive care, swallowing therapy or diet modification will help in better recovery of patient.

Fibreoptic endoscopic evaluation of swallowing (FEES) is a useful tool for identifying and diagnosing the severity of dysphagia and the site of structural or functional deficit.

**OBJECTIVES:**

1. To perform endoscopic evaluation of swallowing using a fibreoptic laryngoscope in all patients treated for head and neck malignancies involving upper aerodigestive tract.
2. To document the structural and functional deficit and the site, nature and severity of problems in swallowing associated with each structural deficit or dysfunction.

**METHODS:**

The study was done in 73 patients treated for head and neck cancer involving upper aerodigestive tract with surgery followed by radiotherapy or concurrent chemoradiation in the Department of Otorhinolaryngology and Head and Neck Surgery in R.L. Jalappa

Hospital And Research Centre, Tamaka, Kolar from December 2017 till June 2019 using fibreoptic laryngopharyngoscope.

**RESULTS**

In our study, the major cause for dysphagia in oral composite resections and PMMC flap reconstruction was loss of floor of mouth tissue, restricted mobility of tongue, poor initiation of swallow, reduced support to floor of mouth muscles, denervation and presence of a groove ( gutter) between lateral wall of oral cavity and tongue. The major cause of dysphagia in tongue resections was loss of bulk, poor initiation of swallow, loss of support and restriction of remnant of tongue movement, denervation, inability to build a tight seal during swallow thereby causing prolonged transit time, retention of food in oral cavity, inadequate masticatory movements, incoordinated swallow and aspiration. The most severe aspiration in our study was following subtotal glossectomies particularly involving oropharyngeal tongue. Aggressive swallowing therapy and compensatory mechanisms along with protection of airway and proper head positioning benefited these patients over a period of time. The major swallowing problems after concurrent chemoradiation to larynx and hypopharynx were incoordinated swallow, restriction of mobility of epiglottis and larynx, edema, ulceration and fibrosis leading to repeated swallow, pooling in hypopharynx and spill over into larynx and aspiration. The major cause of the pharyngeal stenosis and persistent dysphagia in our laryngectomized patients were because they

had hypopharyngeal or supraglottic cancer in a locally advanced stage and the bulky disease required resection of a large part of the pharynx thereby affecting mobility and innervations. This resulted in narrow neo-pharynx and denervation and dilatation is the most frequent therapeutic solution. The major cause of dysphagia in maxillectomy for locally advanced tumors patients is due to surgical resection of the maxilla along with part of the soft palate resulting in a communication between the oral and nasal regions that causes difficulty in swallowing, nasal regurgitation, unintelligible speech, and loss of facial support and most maxillary and palatal defects required prosthetic obturation. On periodic FEES 86.3% of patients improved, 12.3% of patients required further swallowing therapies and diet modifications and 1 death due to aspiration in post operative carcinoma tongue patient.

Therefore early detection by FEES will help to identify the site and severity of swallowing problem. Timely intervention in the form of diet modification, swallowing therapy, airway protection and motivation will help to reduce morbidity and mortality and improve the quality of life in these patients.

**CONCLUSION:**

**1.** In our country, majority of patients present with locally advanced tumors requiring aggressive multimodality treatment resulting structural and functional deficits in upper aerodigestive tract. These lead to compromise in nutrition due to dysphagia and predisposed to complications like cachexia and aspiration.

**2.** Functional endoscopic evaluation of swallowing is a useful tool in detecting these structural and functional deficits with minimum discomfort to the patient and can be done as office procedure in OPD.

3. Major cause for dysphagia in oral composite resections and PMMC flap reconstructions was masticatory dysfunction and delayed and inefficient transit of bolus from oral cavity to pharynx. Some of them had minor aspirations.

4. The major morbidity with regard to swallowing after major head and neck surgeries is with subtotal glossectomies who have incoordinated swallow and major aspirations requiring long term airway protection and interventions.

5. Concurrent chemoradiation in laryngeal and hypopharyngeal cancers also have significant morbidity with regard to swallowing as they have high chances of aspiration and incoordinated swallow requiring long term airway protection and interventions.

6. Maxillectomy followed by obturator did not have major dysphagia except when part of the soft palate was resected leading to nasal regurgitation and incoordinated swallow.

7. Timely intervention in the form of diet modification, swallowing therapy, airway protection and motivation will help to reduce morbidity and mortality and improve the quality of life in these patients.

**KEYWORDS**:

Functional endoscopic evaluation of swallowing, Head and Neck cancer, Dysphagia, Swallowing, Aspiration.

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# I. INTRODUCTION

Head and neck malignancies are the sixth most common group of malignancies across the world, but it is the most common malignancy encountered in India.[1,2] Treatment protocols and prognosis vary widely and are based on the stage of the disease at the time of diagnosis. Most patients present with locally advanced disease requiring aggressive, multimodality treatments. There is high prevalence of head and neck cancer in Kolar region and large number of patients undergo multimodality treatment resulting in dysphagia.

Head and neck cancer patients are often malnourished. Dysphagia, trismus, ankyloglossia and aggressive surgery and radiation as treatment , lead to cachexia and aspiration resulting in life threatening pneumonia.

As a result of disease or aggressive treatment, there can be structural and functional deficit in the upper aerodigestive tract in the form of restriction of movement, loss of bone and muscle, fibrosis, adynamic segments, denervated areas and stenosis. One or more of the above mentioned factors can lead to compromise in nutrition as well as complications like cachexia and aspiration. Therefore early and objective identification of the site and cause for dysphagia and supportive care, swallowing therapy or diet modification will help in better recovery of patient.[3]

In order to evaluate the site and function of the compromised segment of the aerodigestive tract and exact problem, following investigations can be used: Videofluoroscopy, fibreoptic pharyngolaryngoscopy, telescopy, direct pharyngolaryngo oesophagoscopy, barium swallow and dynamic MRI.

Fibreoptic endoscopic evaluation of swallowing (FEES) is a useful tool for identifying and

diagnosing the severity of dysphagia and the site of adynamic or insensitive segment. FEES is now considered the investigation of choice in cases of dysphagia in Europe.

The advantages of FEES include:

- It is easy to perform with minimal discomfort to the patient
- Possibility of bedside or office examination
- Cost effective
- Avoids radiation exposure
- Provides illumination and magnification
- Facilitates detailed and dynamic examination of upper aerodigestive tract.
- It helps to evaluate swallowing by patient in terms of complete swallowing, residual food in oral cavity and pharynx, spill over into larynx and aspiration.[3,4]

This observational study will help to document the involved site and severity in patients with dysphagia and will help to provide diet modification, swallowing therapy or intervention to facilitate swallowing in future. This will decrease the morbidity in these patients.

There is no validated scale to assess the severity of dysphagia incorporating all events during deglutition. The existing scales only address severity of aspiration and quality of life. This study analysing the factors causing dysphagia according to the site and stage of primary cancer and structural loss may contribute to develop a comprehensive scale to assess the severity of dysphagia.

# OBJECTIVES OF THE STUDY

## II. OBJECTIVES OF THE STUDY

1. To perform endoscopic evaluation of swallowing using a fibreoptic laryngoscope in all patients treated for head and neck malignancies involving upper aerodigestive tract.

2. To document the structural and functional deficit and the site, nature and severity of problems in swallowing associated with each structural deficit or dysfunction.

# REVIEW OF LITERATURE

## III. REVIEW OF LITERATURE

Head and neck cancer is the sixth most common malignancy across the world but is the most common group of malignancies in India. Squamous cell cancer constitutes the most common head and neck malignancy, which encompasses cancer of the oral cavity, oropharynx, larynx and hypopharynx, nasopharynx, nasal cavity and paranasal sinuses with oral cancer being the most common type accounting for one-third of all cancers.[1,2]

Men are two to three times more commonly affected than women and the incidence increases with age with 98 per cent of cases occurring in patients over 40 years of age. The two most important factors in the aetiology of head and neck cancer are tobacco and alcohol. There is a synergistic interaction between these two agents. However, in our region oral cancer is more prevalent among women due to the addiction to the tobacco quid.[2]

Two-thirds of head and neck squamous cell carcinomas (HNSCC) present at an advanced stage and despite many recent advances in medical and surgical oncology, there has been little evidence of an improvement in long-term survival. Novel reconstruction techniques have made radical surgical approaches more feasible, but significant trend towards organ preservation therapy has been seen.[2]

## PHYSIOLOGY OF SWALLOWING

Swallowing requires coordination between the action of muscles of : oral cavity, pharynx, larynx and oesophagus. It is the passage of bolus of food or liquid from oral cavity to stomach via the pharynx and oesophagus.

## MUSCLES :

1. **ELEVATORS AND DEPRESSORS OF JAW:**

Helps in bolus preparation by grinding and reducing the food between teeth. This is done by 2 group of muscles, the supramandibular and inframandbular muscles. Supramandbular muscles include muscles of mastication : masseter, temporalis, medial pterygoid and lateral pterygoid. Inframandibular muscles include suprahyoid ( digastrics, stylohoid, geniohyoid and mylohyoid muscles) and infrahyoid muscles (sternohyoid, sternothyroid, omohyoid and thyrohyoid muscles).

2. **TONGUE MUSCLES:**

Help in bolus formation. This includes intrinsic muscles of tongue which changes the shape of the tongue and extrinsic muscles which change the position of the tongue.

3. **SPHINCTER OF LIP :** Orbicularis oris maintains the seal.

4. **BUCCINATOR :**

Helps in returning food from vestibule into oral cavity, ensures food remains in place.

5. **SOFT PALATE :**

Prevents nasal regurgitation and premature movement of food material into oropharynx.[5]

**PHARYNX**:

Food leaves oral cavity and enters the pharynx, a midline tube approximately 15cm long, continuous with the oesophagus inferiorly. Above the soft palate it is continuous with the nasal

cavities anteriorly. In relation with anterior anatomical structures, pharynx is divided into three regions: nasopharynx, oropharynx and laryngopharynx.

Pharyngeal wall is composed of four layers from outside in : the areolar, the musculature, the submucous and the innermost mucous membrane. The muscular layer is composed of circular and longitudinal muscles. The circular muscles are: superior, middle and inferior constrictors. Inferior constrictor is subdivided into thyropharyngeus and cricopharyngeus. The cricopharyngeus forms a sphincter at the point where the laryngopharynx joins the oesophagus and it contains a high proportion of elastic fibres for sphincteric function. Two longitudinal muscles on each side, the palatopharyngeus and the stylopharyngeus attach to the thyroid cartilage on the posterior border.[5,6]

**LARYNX**:

Larynx contains various cartilages, the main cartilages being the thyroid, cricoid and arytenoid. These cartilages move at the cricothyroid and cricoarytenoid joints. Thyrohyoid membrane and thyrohyoid muscle suspends the larynx from hyoid bone. Movement of hyoid bone by suprahyoid and infrahyoid muscles also alter the height of the larynx. Behind the base of tongue, the epiglottis projects above the hyoid and is attached to the thyroid cartilage on the posterior border. Quadrangular membrane is attached between the epiglottis anteriorly and posteriorly to the arytenoids cartilages, the superior margin of which forms the laryngeal inlet boundaries. Aryepiglottic muscles control the inlet, together with the small thyroepiglotticus muscle that help in depressing the epiglottis to prevent aspiration. Intrinsic muscles of the larynx help in adduction of vocal cords providing a second line of defense to the accidental ingestion of food material.[5,6]

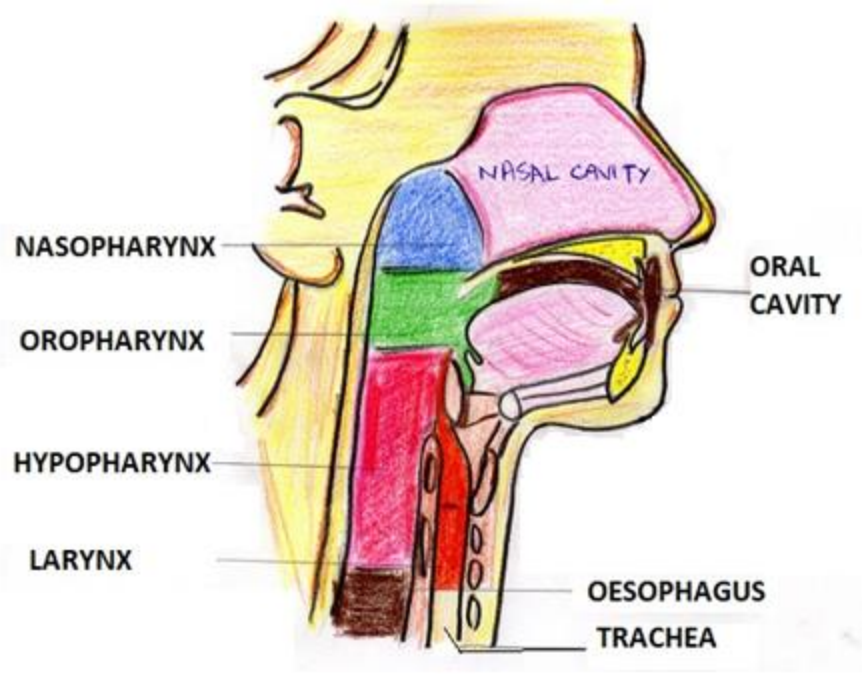



**Figure 1: Air and food passage converging in the pharynx.**

Oesophagus, a muscular tube continuous with the pharynx, has a short cervical course before it enters the thorax where it lies posteriorly in the mediastinum. It passes through a hiatus in the diaphragm entering the stomach.

Swallowing involves a common passage for the stream of liquid and food and that of breathing which occurs within the pharynx. Several mechanisms ensure that during normal swallowing, no liquid or food is aspirated into the lungs through the larynx. Aspiration results in serious complications such as asphyxiation caused by airway blockage or of occult aspiration resulting in pneumonia.[5,6,7]

Swallowing has two components: 1) The passage of bolus from oral cavity to the stomach 2) Airway protection. Videoendoscopic and videofluoroscopic investigations clearly show that the airway protection mechanism is activated first. The sphincteric mechanisms protecting the airways are the soft palate at the pharyngeal isthmus and those guarding the laryngeal inlet.

Swallowing is carefully timed in relation to the respiratory phases and a failure in this coordination may be one of cause of swallowing difficulties. The interaction between swallowing and respiration has been extensively studied with the help of various techniques which includes electromyography.[8,9,10]

## SEQUENCE OF EVENTS IN THE NORMAL SWALLOW

Swallowing process is continuous with overlapping sequence of events that is divided into three distinct phases: oral (preparatory and transit phase), pharyngeal and oesophageal.

## ORAL PHASE FOR LIQUIDS

## ORAL PREPARATORY PHASE

In the oral preparatory phase, liquids are taken into the mouth and held either on floor of the mouth or against the hard palate by upward movement of the tongue. Throughout this first phase, the soft palate is kept lowered by contraction of the palatoglossus and palatopharyngeus. The posterior tongue is simultaneously elevated, thus preventing spillage of the bolus into the nasopharynx. Liquids require minimal preparation and are diluted with saliva before swallowing. The airways remain open during this phase.[5]

## ORAL TRANSIT PHASE

The bolus is transported through the palatoglossal and palatopharyngeal arches into the oropharynx. Tongue is moved by the action of intrinsic muscles together with genioglossus elevating the tongue tip and dorsum of the tongue towards hard palate. Orbicularis oris and buccinator contract to keep the lips and cheeks taut and sealed.

Liquid bolus is accommodated in a shallow midline gutter that forms along the dorsum of the tongue, and stabilization and elevation of the mandible provides adequate lingual pressure generation. The bolus is compressed by the elevation of the tongue against the palate. Tongue is lifted by the action of stylohyoid along with elevation of floor of mouth. Bolus moves backwards by flattening of tongue and anterior part of tongue provides the greatest amount of pressure. Contraction of the styloglossus and mylohyoid elevates the posterior part of the tongue. As the frequency and speed of swallowing increase, the tongue movements are simplified during sequential swallowing. As the bolus reaches the oropharyngeal tongue, soft palate is elevated by levator and tensor veli palatini muscle action to protect the nasopharynx from the regurgitation of food by closing the airways superiorly.[5,6]

## ORAL PHASE FOR SOLIDS

Swallowing mechanism for solid food is slightly different. Food material is mixed with the saliva and reduced to smaller particles by chewing. Duration varies from less than 1 second to 10 seconds. When the bolus has been converted to a suitable consistency to be swallowed, it is passed down to oropharynx, valleculae and posterior part of tongue, where it is retained for a few seconds prior to swallowing. This is called '**retrolingual loading**'.[5,6,7]

During this time, chewing can continue to reduce the size of food particle in bolus progressively, until swallow initiates and pharyngeal phase begins. Thus, oral preparatory, oral transportation and pharyngeal phases overlap when solid food material is being swallowed.

Chewing helps in fragmenting solids, by a combination of shearing and compression forces. Mandible movement occurs by action of the jaw elevators – temporalis, masseter and medial pterygoid – and jaw depressors associated with increased parotid salivary flow. The lips maintain

a tight seal by contraction of orbicularis oris. The buccinator performs a similar function for the cheeks. Lateral and rotatory tongue movements, ensure that the position of food remains under the occlusal surfaces of the molar teeth. Lingual forces vary according to the consistency of the bolus. This is cyclical with the movements of the jaw and hyoid bone. This avoids tongue bite during chewing.[5,6]

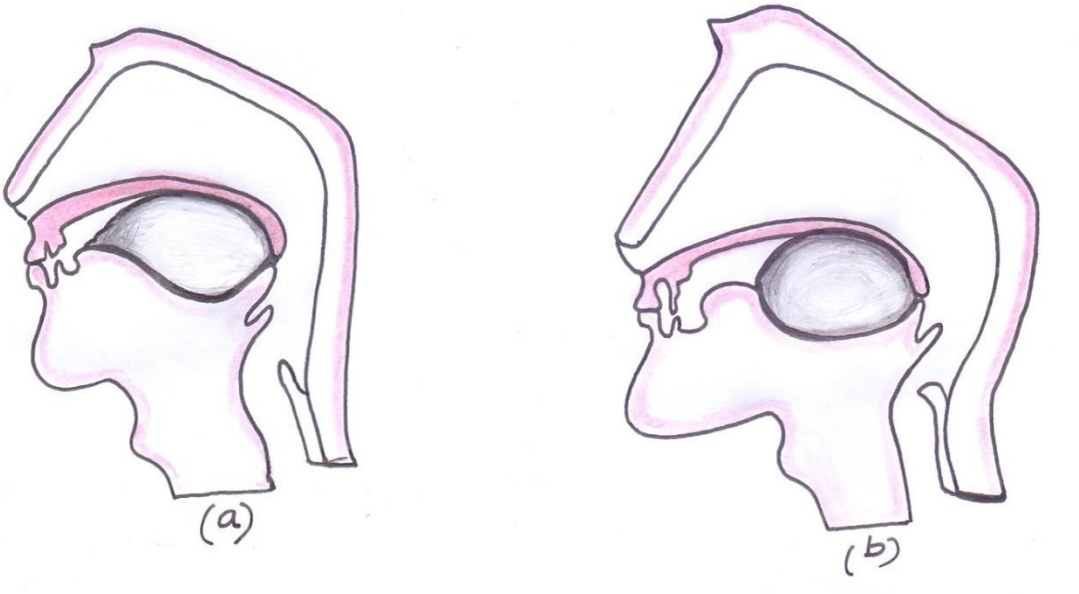



**Figure 2: (a) oral phase, food is reduced and the bolus prepared; (b) the bolus is moved to the posterior part of the tongue.**

## PHARYNGEAL PHASE

Pharyngeal phase starts when the bolus leaves oral cavity to enter the oropharynx and continues till it passes into the oesophagus. This is an involuntary phase where the respiratory and digestive streams cross and therefore it is important to prevent blockage of airways or aspiration. As bolus is passed into the pharynx by the movement of tongue, a sequence of events is initiated that ensures that the airways are protected during bolus transport. Diaphragmatic contraction is inhibited, to ensure that simultaneous respiration and swallowing is impossible under normal

circumstances. The oropharynx is sealed off from the nasopharynx by action of the superior pharyngeal constrictor and palatopharyngeal fibres to form Passavant's ridge against which, the soft palate is abutted.

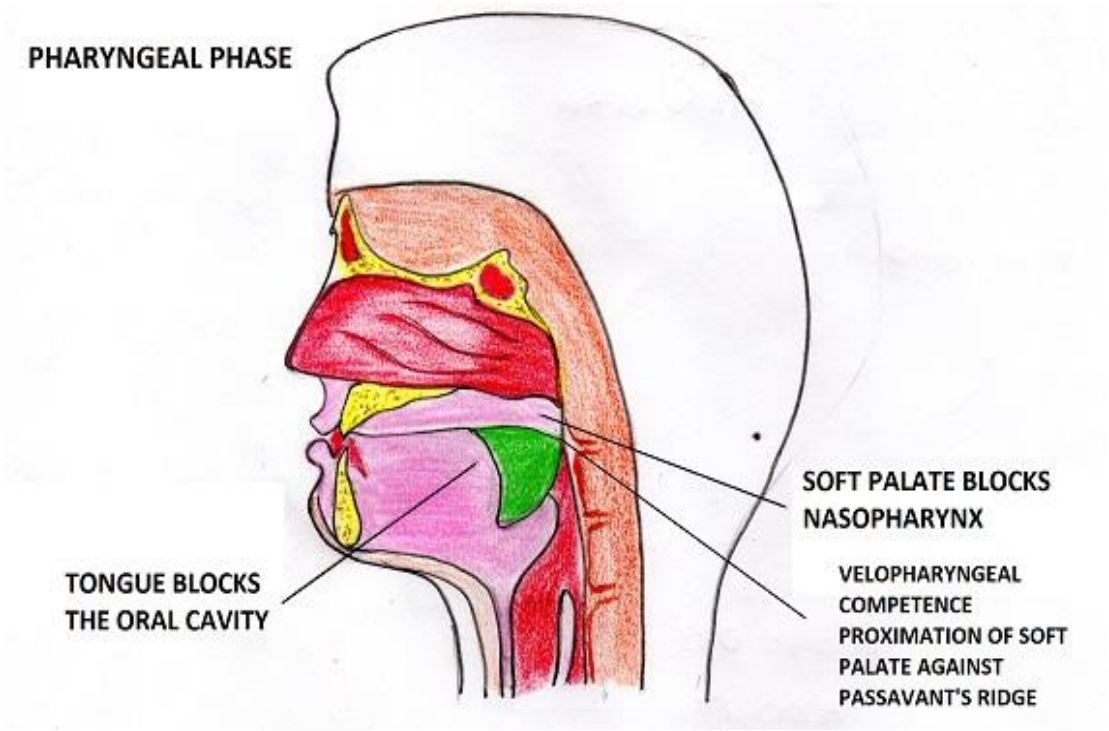



**Figure 3 : Velopharyngeal competence, proximation of soft palate against the Passavant's ridge.**

As bolus enters the oropharynx, it touches the key trigger points and initiates a sequence of events in which the constrictors relax to dilate the pharynx, while the longitudinal muscles elevate the pharynx and larynx. Laryngeal elevation occurs as the suprahyoid muscles contract and result in the movement of hyoid bone anteriorly, contributing to pharyngeal dilation. This action helps to expand the hypopharyngeal space and relax the cricopharyngeal sphincter. The contraction of the constrictors propel the bolus food material over or by the side of the epiglottis and then the larynx is closed by action of the muscles of the laryngeal inlet, aryepiglottic folds

being the most important among them. This brings the epiglottis from a vertical to a nearly horizontal position and upper one third of the epiglottis to below the horizontal covering the narrowed laryngeal inlet. As food passes down to the posterior aspect of the curved epiglottis, it is then diverted into the lateral food channels and the pyriform fossae. Solids usually go straight over epiglottis, while liquids get diverted laterally. Throughout this stage, respiration does not occur.[5,7,11]

Swallowing process gets initiated when food comes in contact with the palatoglossal and palatopharyngeal arches or with the mucosal surface of posterior pharyngeal wall which is innervated by the glossopharyngeal nerve. Once the bolus of food material has passed the palatoglossal and palatopharyngeal arches, swallowing becomes reflexive and involuntary. As the bolus enters the oropharynx, arytenoids move towards the midline and results in closure of glottis. Events vary according to bolus consistency and laryngeal closure duration ranges from 0.31 seconds to 1.07 seconds.[5,7]

Bolus remains in the valleculae and pyriform sinuses in 60% of liquid and 76% of solid swallows before the swallow is initiated called the 'premature spillage' which is an indicator of dysphagia. Multiple attempts of swallowing is also a sign of impairment in swallowing. Vocal folds are adducted to prevent aspiration. A protective cough reflex is a strong expiratory airflow assisted by abdominal muscles and compression of the lungs initiated to remove any spillage into the airway.

Bolus is carried down the pharynx by a well coordinated peristaltic wave in which the three constrictor muscles act in the appropriate sequence, hence driving the bolus towards the oesophagus. The bolus moves faster than the peristaltic wave of the pharyngeal contraction suggesting that, the kinetic energy imparted to the bolus food material as it is pushed backwards

from the mouth may be sufficient to carry it to the pharynx. The tongue driving force is a strong positive pressure that squeezes the bolus down to the laryngopharynx. This occurs by upward movement of the tongue pressing the bolus food material against the contracting pharyngeal wall and requires a tight nasopharyngeal seal. A hypopharyngeal suction force is caused by the elevation and the anterior movement of the hyoid and larynx. This creates a negative pressure in the laryngopharynx, guiding the bolus towards the oesophagus, aided by even more negative pressure inside the oesophagus. The pharyngeal constrictors generate a positive pressure wave behind the bolus. Their sequential contraction may facilitate clearance of any pharyngeal wall or pyriform sinus residue.[5,6]

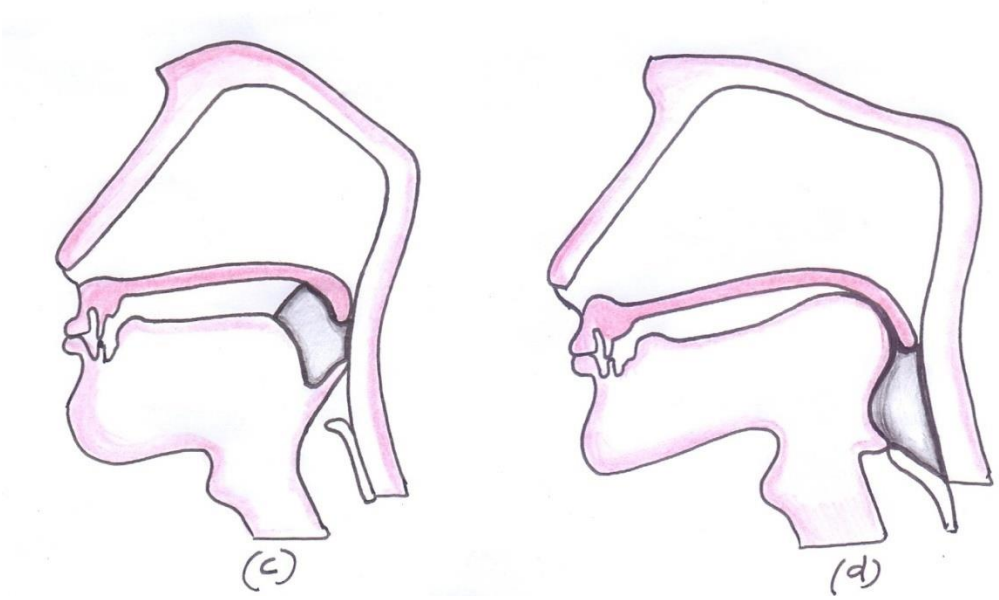



**Figure 4: (c) the bolus contacts the trigger points in the oropharynx and the pharyngeal phase is initiated; (d) the bolus is moved past the closed larynx.**

The pharyngeal phase ends, as the bolus is propelled towards the cricopharyngeal sphincter. At rest, this sphincter is closed by active contraction. Just before the bolus arrives, the sphincter opens by the relaxation of cricopharyngeus. The sphincter is then opened actively by the combined action of the suprahyoid muscles, in moving the larynx anteriorly and superiorly and

passively by pressure from the arriving bolus.[5,6,7]

**OESOPHAGEAL PHASE**

The oesophageal phase begins after the relaxation of cricopharyngeal sphincter allowing the bolus to enter the oesophagus. Hence, this is a true peristalsis in which a relaxation wave is in front of the bolus and a constriction is behind the bolus moving it towards the stomach. Sequential wave of contractions of the oesophageal musculature subsequently propel the bolus down towards the lower oesophageal sphincter, which opens momentarily to receive the bolus into the stomach.[5,6]

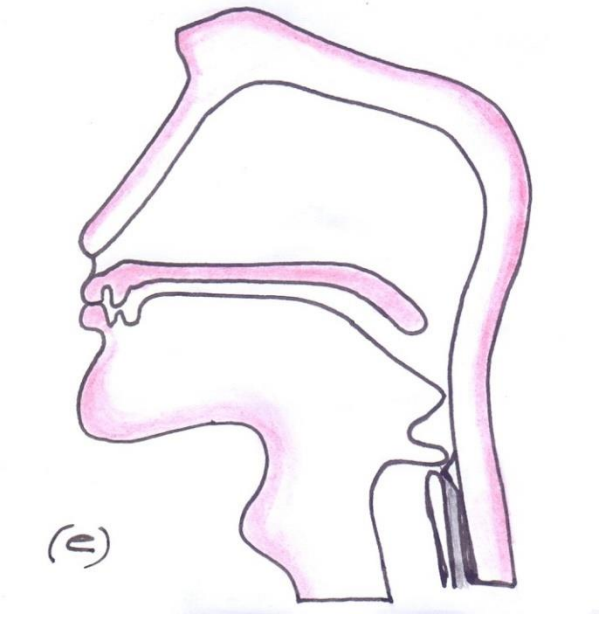



**Figure 5: (e) the bolus enters the oesophagus.**

## NEUROLOGICAL CONTROL

Neurological control of the complex activity of normal swallowing process involves a number of different regions of the central nervous system (CNS). Swallowing mechanism is organized and

coordinated by series of structures within the brain extending from the motor neurons within the motor nuclei of the brainstem and spinal cord (for ventilation) up to the cortex. Cortical control of movement is regulated by reciprocal connections between the cortex and basal ganglia and between the cortex and the cerebellum. These help in coordinating movement and monitors the movements and acts as an error detector.[5,12]

Swallowing is regulated by sensory input from posterior part of oral cavity, epiglottis and oropharynx. Swallowing is partly reflexive and partly voluntary, it's neurological control is divided between two major regions of the brain: the cerebral cortex and the brainstem. Definitive areas of the cortex bring about voluntary control of swallowing and these movements are regulated by basal ganglia and cerebellum. The major overlap in the brainstem areas controlling the mechanisms of swallowing, ventilation and mastication ensure coordination.[12,13]

The cortical control of swallowing function involves connections to numerous groups of motor neurons including the primary motor and sensory cortices, premotor and supplementary cortices, posterior parietal cortex, cingulate cortex, the insula and frontal operculum. Corticobulbar connections to motor nuclei controlling muscle groups are bilateral, except those for pharyngeal muscles because left hemisphere is swallowing dominant.

The voluntary initiation of swallowing (oral phases) involves: bilateral areas of the prefrontal, frontal and parietal cortices. These comprise the face areas of both the primary sensory and motor cortex, and the prefrontal swallowing areas called Brodman's area. Activation of cingulate cortex, anterior cingulate gyrus, supplementary motor cortex and insula just before the onset of the swallow, helps in motivation to swallow, and planning of the act of swallowing.[12,13,14]

Reflexive swallowing (Pharyngeal phase) involves primary motor cortex, premotor cortex and areas of sensorimotor cortex within the parietal lobe. Both voluntary and reflexive swallowing involve the primary sensory and primary motor cortical areas, as these control fine distal motor movement.

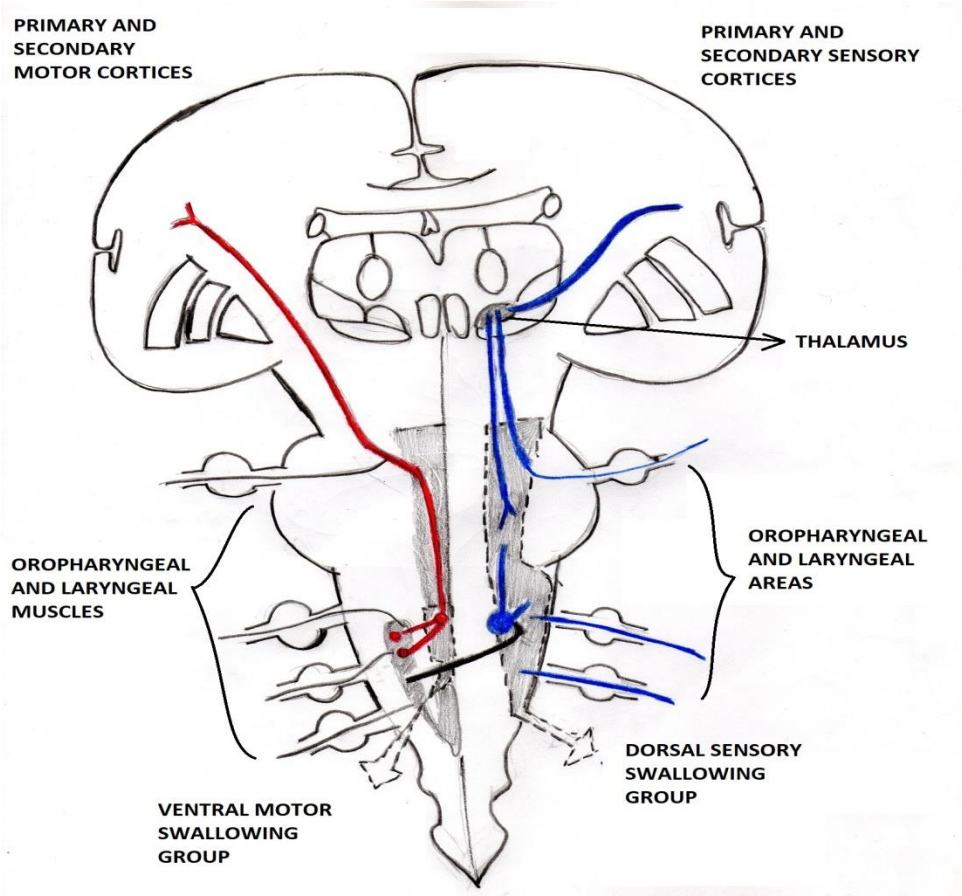



**Figure 6: Central neurological control of swallowing function.**

Execution of swallowing also depends on properties of bolus food material such as its size, texture and consistency and the force and speed of pharyngeal muscle contraction to ensure that the bolus is safely moved from the pharynx into the oesophagus.[5]

Important areas in the brainstem control swallowing. They are located in the medulla. Descending pathways project to these medullary swallowing centres from the frontal swallowing

areas within the cortex. These comprise pathways in both dorsolateral and ventromedial descending systems through ventral and lateral corticobulbar tracts. Brainstem control the patterns of swallowing movements, in both voluntary and reflexive phases.[15]

Swallowing process is initiated by touch sensation or pressure from the liquid or food bolus within the posterior part of the oral cavity, epiglottis or oropharynx. Thus, the nuclei receiving afferent input from these regions are nucleus tractus solitarius and the spinal trigeminal nucleus. Afferent input from the jaw, muscles of mastication, lips and tongue is also essential to the control of swallowing process during the pharyngeal phase and oral phase. Oral cavity consists highest concentration of mechanoreceptors to protect delicate tissues from the high forces generated during mastication, to trigger the reflex and to sense the size and consistency of the bolus.[5,7]

Several cranial motor nuclei in medulla and pons control the muscles involved in swallowing. Most important are the nucleus ambigus for the muscles of palate, pharynx and larynx, the hypoglossal nucleus for muscles of tongue, and the motor nuclei of the trigeminal and facial nerves for muscles of  jaws and lips. Motor neurons within the cervical spinal cord, control the muscles of neck including the infrahyoid muscles.[15]

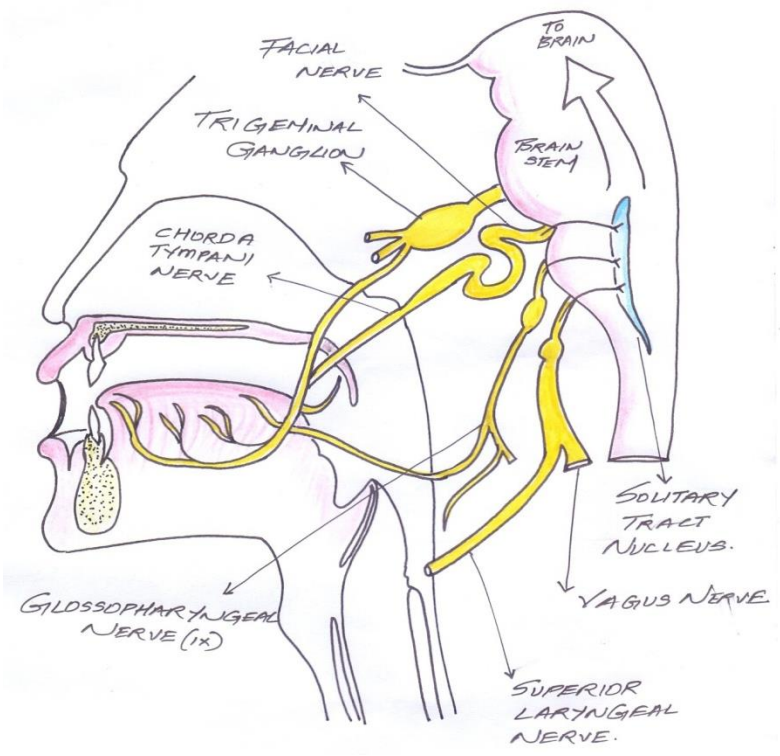



**Figure 7: Brainstem neurological control of swallowing function.**

Among these afferent and efferent pathways are two groups of neurons essential for the coordination and regulation of swallowing function by the medulla. The first lies in the dorsal region of the medulla above the nucleus of the solitary tract and second group lies more ventrally around the nucleus ambiguous, referred to as the lateral and medial medullary swallowing centres. The dorsal group is the site of convergence of sensory input from the various nuclei and important in the sequencing of swallowing. The ventral group distributes outputs to the various cranial nerve motor nuclei. Outputs from this region are excitation of agonist muscles and the synergists. These are accompanied by inhibitory outputs to the corresponding antagonist muscles. The correct sequencing of events for healthy swallowing is controlled by a central pattern generator (CPG). CPGs are groups of neurons capable of generating outputs that will ensure the sequencing of a movement in time and space by the muscle contractions needed for

automatic movements such as swallowing, ventilation and locomotion.[5,15]

## ORAL CAVITY

The oral cavity comprises the seven sub sites: lips, buccal mucosa, retromolar trigone, floor of mouth, hard palate, oral tongue, upper and lower alveolar ridge. The tumor and the consequences of its treatment can adversely affect one or more of the several important functions of oral cavity such as mastication, speech, taste, swallowing, oral sensation and continence. This can have a devastating effect on the patient's quality of life.[16]

### LIP AND ORAL CAVITY STAGING

**PRIMARY TUMOR (T)**

Tx - Primary tumor cannot be assessed

Tis - Carcinoma in situ

T1 - Tumor ≤ 2 cm in greatest dimension, ≤ 5 mm depth of invasion (DOI not tumor thickness) OR tumor > 2 cm but ≤ 4 cm, and ≤ 10 mm DOI

T2 - Tumor ≤ 2 cm, DOI > 5mm and ≤ 10 mm OR tumor > 2 cm but ≤ 4 cm and ≤ 10 mm DOI

T3 - Tumor > 4 cm OR any tumor > 10 mm DOI

T4a - Moderately advanced local disease, Tumor invades adjacent structures: cortical bone of the mandible or maxilla, inferior alveolar nerve, floor of mouth or involves the maxillary sinus or skin of the face

T4b - Very advanced local disease, Tumor invades masticator space, pterygoid plates, or skull base and/or encases internal carotid artery.

**REGIONAL LYMPH NODES (N)**

Nx - Regional lymph nodes cannot be assessed

N0 - No regional lymph node metastasis

N1 - ≤3 cm in greatest dimension and ENE ( – ) Metastasis in a single ipsilateral lymph node,

N2a - Metastasis in single ipsilateral lymph node > 3 cm but ≤ 6 cm in greatest dimension and ENE ( – )

N2b - Metastasis in multiple ipsilateral lymph nodes, ≤ 6 cm in greatest dimension and ENE ( – )

N2c - Metastasis in bilateral or contralateral lymph nodes, > 3 cm but ≤ 6 cm in greatest dimension and ENE ( – )

N3a - Metastasis in a lymph node > 6 cm in greatest dimension and ENE ( – )

N3b - Metastasis in any lymph node(s) with clinically overt ENE ( + ).[17]

## TREATMENT OF CARCINOMA ORAL CAVITY

Locally advanced Squamous carcinoma of oral cavity is managed by surgery followed by post op radiation. Chemotherapy and targeted therapy protocols are for patients with poor prognostic factors or for palliation. The treatment depends on several factors – co morbidity conditions, cardiopulmonary status and tumor factors. For early lesions, a single modality treatment is used either radiation or surgery. Surgery involves wide excision of primary lesion with adequate margins and neck dissection. In advanced lesions, primary surgery followed by adjuvant radiation therapy or chemoradiation is the standard treatment. Resection can involve muscles of mastication, tongue, segment or partial thickness of mandible, pharyngeal musculature and part of larynx based on the site. All these areas are important in mastication, deglutition as well as preventing aspiration.[16]

## TREATMENT GUIDELINES IN CARCINOMA OROPHARYNX

Choice of modality in early stage is single modality with Radical Radiotherapy or Surgery may be considered where the functional deficit will be minimal/organ preservation is possible.

If elective nodal dissection is planned, bilateral neck dissection is indicated for tumors on or near the midline; ipsilateral neck dissection is sufficient for lateralized primary tumors.

Treatment for Advanced Oropharyngeal Carcinoma stage III, IV –non metastatic is **Combined modality** treatment with Chemoradiation for Organ preservation and Functional outcomes more acceptable. Composite resection is reserved as salvage for radiation failures.[18]

## CARCINOMA LARYNX

Carcinoma larynx is the 11$^{th}$ most common type of cancer among men across the world and is the second most common malignancy of head and neck. Most common form is Squamous Cell carcinoma which accounts for 85-95% of laryngeal malignancies.[19]

### STAGING OF LARYNGEAL NEOPLASMS

Primary Tumor (T)

TX Primary tumor cannot be assessed

T0 No evidence of primary

Tis Carcinoma in situ

### SUPRAGLOTTIS

- T1 Tumor limited to one subsite of supraglottis with normal vocal cord mobility

- T2 Tumor involving more than one adjacent subsite of supraglottis or glottis or region outside the supraglottis (e.g., mucosa of base of tongue, vallecula, medial wall of pyriform sinus) without fixation of the cords.
- T3 Tumor limited to larynx with vocal cord fixation and or involves any of the following: postcricoid area, pre-epiglottic space, paraglottic space, and/or inner cortex of thyroid cartilage
- **T4a Moderately advanced local disease** Tumor invades through the thyroid cartilage and or invades tissues beyond the larynx (e.g., trachea, soft tissues of neck and strap muscles, extrinsic muscles of tongue, , thyroid, or esophagus)
- **T4b Very advanced local disease:** Tumor invades prevertebral space, encases carotid artery, or invades mediastinal structures

**GLOTTIS**

- **T1a** Tumor limited to one vocal cord +/- Anterior Commissure with normal mobility.
- **T1b** Tumor involves both vocal cords +/- Anterior Commissure with normal mobility.
- **T2** Tumor extends to supraglottis and/or subglottis, and/or with impaired vocal cord mobility
- **T3** Tumor limited to the larynx with vocal cord fixation and/or invasion of paraglottic space, and/or inner cortex of the thyroid cartilage
- **T4a Moderately advanced local disease**- Tumor invades through the outer cortex of the thyroid cartilage and/or invades tissues beyond the larynx (e.g., trachea, soft tissues of neck including deep extrinsic muscles of tongue, strap muscles, thyroid, or esophagus)

- **T4b Very advanced local disease-** Tumor invades prevertebral space, encases carotid artery, or invades mediastinal structures

**SUBGLOTTIS**

- **T1** Tumor limited to the subglottis.
- **T2** Tumor extends to vocal cord(s) with normal or impaired mobility.
- **T3** Tumor limited to larynx with vocal cord fixation.
- **T4a Moderately advanced local disease-** Tumor invades cricoid or thyroid cartilage and/or invades tissues beyond the larynx (e.g., trachea, soft tissues of neck and strap muscles, extrinsic muscles of tongue, thyroid, or esophagus)
- **T4b Very advanced local disease-** Tumor invades prevertebral space, encases carotid artery, or invades mediastinal structures

**REGIONAL LYMPH NODES**

- **$N_X$→** Regional lymph nodes cannot be assessed.
- **$N_0$→** No regional lymph node metastasis.
- **N1→** Metastasis in a single ipsilateral lymph node, **≤ 3 cm** in greatest dimension.
- **N2a→** Metastasis in a single ipsilateral lymph node, **≥3 cm** but **≤ 6 cm** in greatest dimension.
- **N2b→** Metastasis in multiple ipsilateral lymph nodes, **≤ 6 cm** in greatest dimension.
- **N2c→** Metastasis in bilateral or contralateral lymph nodes, **≤ 6 cm** in greatest dimension.
- **N3a→** Metastasis in a lymph node, **> 6 cm** in greatest dimension. **3b** – extracapsular spread

**DISTANT METASTASIS (M)**

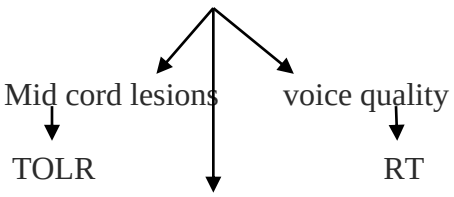
- M0 No distant metastasis
- M1 Distant metastasis.[19]

## GUIDELINES IN TREATMENT OF CARCINOMA LARYNX

The goal of treatment is to remove the tumor and prevent recurrence while maintaining laryngeal function. The ideal treatment varies for carcinoma larynx depending on the stage of disease. Location of primary tumor (ie, glottic, supraglottic or subglottic) is also an important consideration when selecting therapy.

Early stage laryngeal carcinomas (stage I-II) are ideally treated with either radiation or surgical techniques (either endoscopic or open) that preserve laryngeal function. For carcinoma in situ or early stage invasive glottic or supraglottic cancer, endoscopic surgical excision or radiation therapy are both equally effective, with similar functional outcomes.[19]

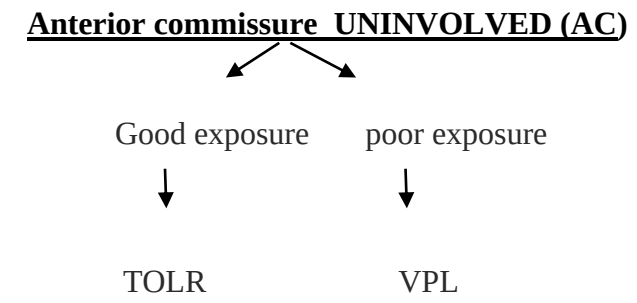
### T1 GLOTTIC CANCER

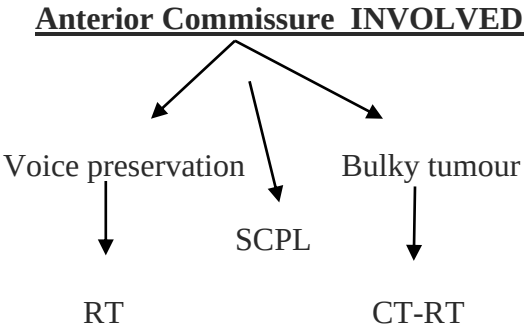



young, verrucous growth, prior RT, bad exposure on suspension laryngoscopy

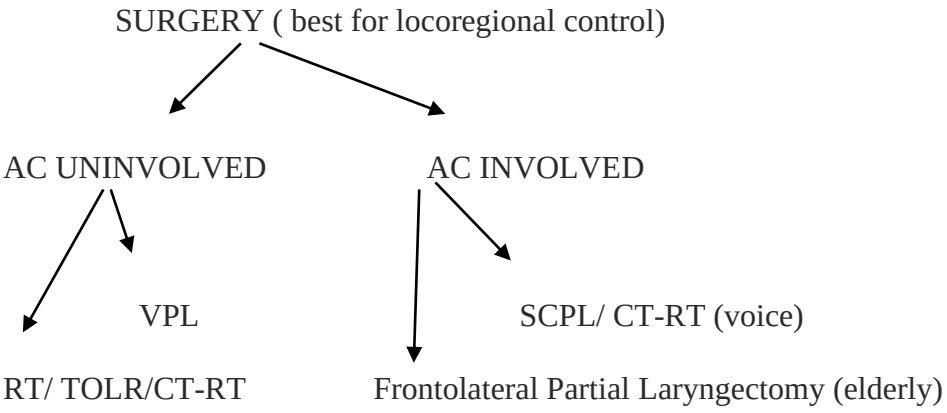
VERTICAL PARTIAL LARYNGECTOMY

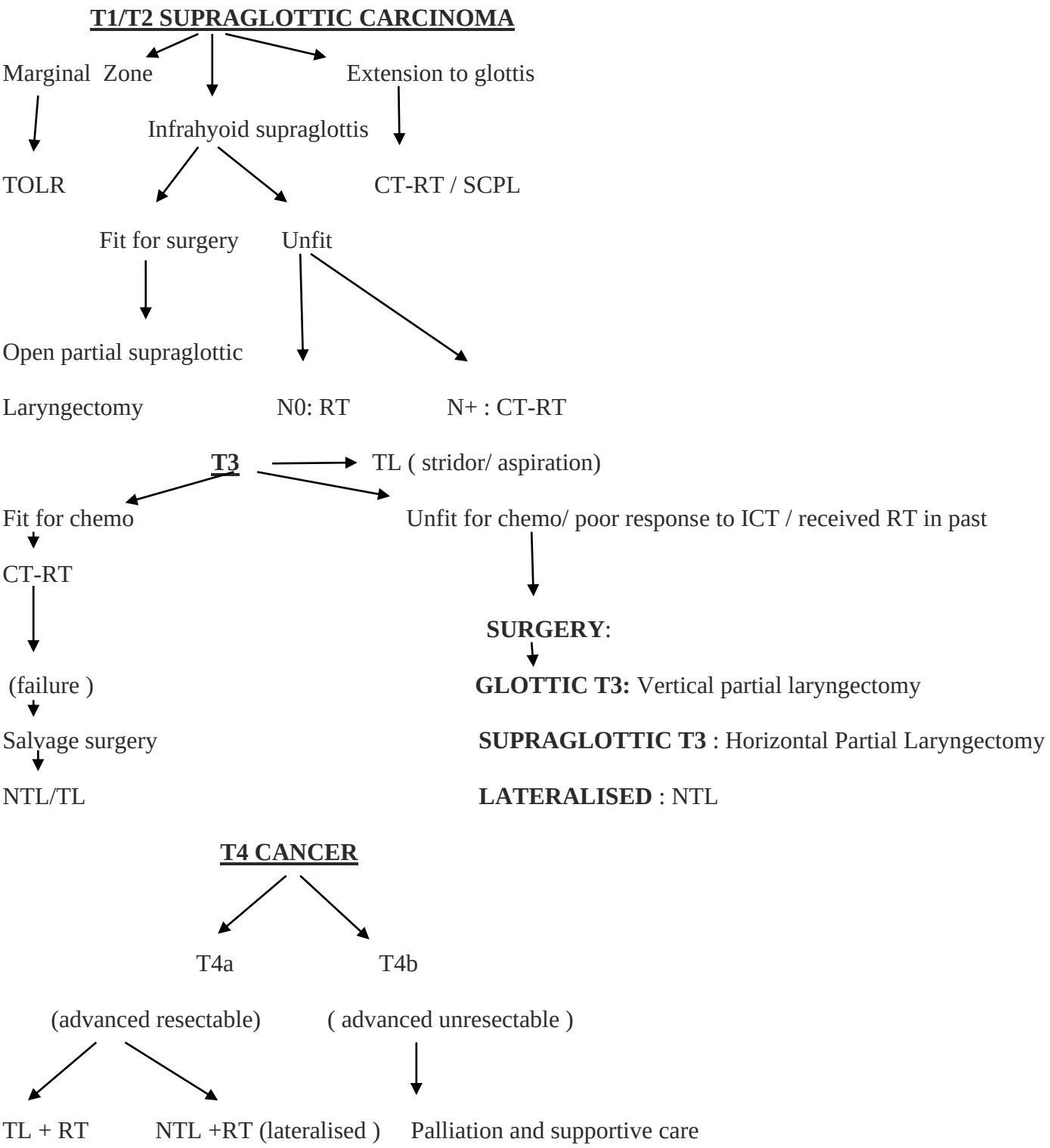
## T2 GLOTTIC CANCER WITH MOBILE VOCAL CORD

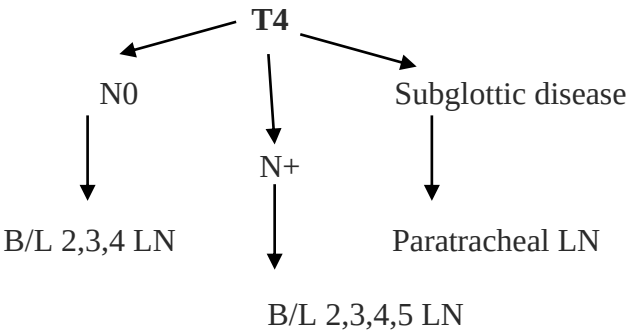



## T2 GLOTTIC CANCER WITH IMPAIRED CORD MOBILITY: (B/L arytenoids )




T1/T2 SUPRAGLOTTIC CARCINOMA
Marginal Zone
Infrahyoid supraglottis
Extension to glottis
TOLR
CT-RT / SCPL
Fit for surgery
Unfit
Open partial supraglottic
Laryngectomy
N0: RT
N+ : CT-RT
T3
TL ( stridor/ aspiration)
Fit for chemo
Unfit for chemo/ poor response to ICT / received RT in past
CT-RT
SURGERY:
(failure )
GLOTTIC T3: Vertical partial laryngectomy
Salvage surgery
SUPRAGLOTTIC T3 : Horizontal Partial Laryngectomy
NTL/TL
LATERALISED : NTL
T4 CANCER
T4a
T4b
(advanced resectable)
( advanced unresectable )
TL + RT
NTL +RT (lateralised )
Palliation and supportive care




- If margins unsatisfactory / extracapsular nodal extension : Surgery + CT-RT

## CARCINOMA HYPOPHARYNX

Hypopharynx, a triangular space extends from the level of the hyoid bone (C4) above to the lower border of the cricoid cartilage below (C6). It is interposed between the oropharynx superiorly and the upper esophagus inferiorly with the larynx located anteriorly. Subsites of hypopharynx include pyriform sinus, post cricoid region and posterior pharyngeal wall.

Hypopharynx cancers present late and it is a submucosal disease with lymph node metastases being very common. Therefore hypopharyngeal cancers have got poor prognosis. Concurrent CTRT is the treatment of choice for T1-T2 with N+ disease. Surgery followed by radiation is the treatment for T4a and large volume T3 with advanced nodal disease which consists - Near total or total laryngectomy with partial pharyngectomy, neck dissection with nodal clearance and surgical reconstruction with myocutaneous flap, gastric pull up or microvascular tissue transfer.[19]

## CARCINOMA MAXILLA

Carcinoma maxilla is the most common ( 55%) among the paranasal sinus tumors with incidence 0.5- 1/ 100,000 /year. It is more common in nickel and wood industrial workers. Boundaries of maxillary sinus are:

- Anteriorly by Cheek, skin

- Posteriorly by pterygopalatine fossa, infratemporal fossa, middle cranial fossa
- Medially by nasal cavity
- Laterally by cheek, skin
- Superiorly by orbit
- Inferiorly by palate.[20]

## STAGING OF CARCINOMA MAXILLA

TX- Primary tumor cannot be assessed

Tis - Carcinoma in situ

TI - Tumor limited to maxillary sinus mucosa with no erosion or destruction of bone.

T2 - Tumor causing bone erosion or destruction including extension into the hard palate and/or middle nasal meatus, except extension to posterior wall of maxillary sinus and pterygoid plates.

T3 - Tumor involves any of the following: posterior wall of maxillary sinus, subcutaneous tissues, floor or medial wall of orbit, pterygoid fossa, ethmoid sinuses.

T4a- Moderately advanced local disease. Tumor involves anterior orbital contents, skin of cheek, pterygoid plates, infratemporal fossa, cribriform plate, sphenoid or frontal sinuses

T4b- Very advanced local disease. Tumor involves any of the following: orbital apex, dura, brain, middle cranial fossa, cranial nerves other than maxillary branch of trigeminal nerve (V2), nasopharynx, or clivus.

### Regional Lymph Node (N)

NX - Regional lymph nodes cannot be assessed

NO - No regional lymph node metástasis

NI - Metastasis in a single ipsilateral lymph node, 3 cm or smaller in greatest dimension and ENE(-)

N2a - Metastasis in a single ipsilateral node larger than 3 cm but not larger than 6 cm in greatest dimension and ENE(-)

N2b - Metástasis in múltiple ipsilateral nodes, none larger than 6 cm in greatest dimensión and ENE(-)

N2c - Metastasis in bilateral or contralateral lymph nodes, none larger than 6 cm in greatest dimensión and ENE(-).[20]

N3a – Metastasis in lymph node larger than 6cm and ENE (-), N3b- Any lymph node with clinically over ENE +.

## TREATMENT:

Treatment depends on extent of tumours and extent of bone need to be removed.

Types of surgery includes maxillectomy and craniofacial resection followed by RT.

1. Partial maxillectomy is partial removal of upper jaw which includes:
    - Medial maxillectomy is the removal of lateral nasal wall & ethmoid sinuses, medial wall of maxilla, lacrimal bone, lamina, medial orbital floor
    - Palatal resection with adjacent alveolus done for tumour of oral cavity with palate involvement.
2. Total maxillectomy is the total resection of upper jaw.
3. Extended maxillectomy is when resection extends beyond upper jaw.
4. Cranio facial resection is done when tumor involves skull base.[20]

## DYSPHAGIA

Dysphagia is a term used to describe difficulty with swallowing solids, liquids or both. It implies impairment of one or more of the phases of swallowing. Dysphagia usually arises as a complication of another health condition. It can be divided into oropharyngeal (high) dysphagia and oesophageal (low) dysphagia.[5,21]

## ASPIRATION

Aspiration is the entry of food or liquid into the airway below the true vocal folds. It may be due to incompetent or inadequate airway protection, ill-timed or uncoordinated events during swallowing. Silent aspiration is defined as foreign material entering the trachea or lungs without an outward sign of coughing or attempts at expulsion. Penetration is defined as entry of food or liquid into the larynx initiating a cough reflex. Spill over is defined as entry of food or liquid into the laryngeal inlet. Figure shows Penetration-aspiration score that has been used in patients treated for head and neck cancer.[5,21,22]

| Score | Classification | Description |
|---|---|---|
| 1 | None | No entry of material into the larynx or trachea |
| 2 | Penetration | Entry of material into the larynx with clearing |
| 3 | Penetration | Entry of material into the larynx without clearing |
| 4 | Penetration | Material contacts the true vocal folds with clearing |
| 5 | Penetration | Material contacts the true vocal folds without clearing the larynx |
| 6 | Aspiration | Material enters the trachea and is sponta-neously cleared into the larynx or pharynx |
| 7 | Aspiration | Material enters the trachea and is not cleared following attempts |
| 8 | Aspiration | Material enters the trachea with no attempt to clear |

**Figure 8: Penetration- aspiration score**

Patients treated for Head and Neck cancer often suffer significant dysphagia and aspiration. Longer oral and pharyngeal transit times, oral and pharyngeal food residue, shorter cricopharyngeal opening durations, and poor swallow efficiencies are common. Swallowing function is significantly impaired with higher tumour stage, and compared to patients with laryngeal lesions, those with oral or pharyngeal lesions have worse swallow function. Incidence of aspiration is highest in Head and neck cancer patients (76%) than patients with neurogenic, medical, gastrointestinal diseases. These effects are long-standing, 44% of patients had aspiration at 5 years and beyond their original treatment. Chemoradiotherapy is the choice of treatment for locally advanced tumors of the oropharynx, larynx and hypopharynx. Despite the encouraging results in locoregional control and survival, significant functional impairment is documented.[5,23]

Common problems include: reduced tongue strength and control, decreased tongue base movement towards the posterior pharyngeal wall, decreased laryngeal elevation, reduced posterior tilt epiglottis, delayed pharyngeal swallow, residual food material in vallecula and pyriform sinuses and penetration into the laryngeal vestibule and major aspiration. Studies have found that, 30% of Head and neck Cancer patients treated by chemoradiotherapy developed aspiration pneumonia, despite on nasogastric tube feeds. The radiation dose given to the superior and middle pharyngeal constrictors, longitudinal muscles and palatopharyngeal fold are significantly related to swallowing outcomes. Intensity-modulated radiotherapy (IMRT) is designed to reduce doses to the major salivary glands, pharyngeal constrictors, masticator muscles and mandible. It is not possible to spare key structures like the tongue base and the soft palate due to tumour site and therefore swallowing function is always compromised. The pharyngeal phase of deglutition depends on precise interaction of these muscles with base of tongue movement, pharyngeal muscle contraction and hyolaryngeal excursion. Nasogastric tube or gastrostomy dependence has been noted for 13–33% at long-term follow-up after chemoradiation. These problems also occur following surgery.[5,23]

Functional endoscopic evaluation of swallowing (FEES) is very helpful in the post-treatment HNC patient to document bolus flow during swallow, laryngeal penetration and aspiration and pre- and post-swallow residue in the vallecullae, piriform fossa and postcricoid area. It is easily performed in the outpatient clinic and intensive care unit. A functional evaluation such as pharyngeal squeeze manoeuvre, forced breath hold, maintenance of glottic closure and dryness during swallow can be made and a range of fluid and food can be given.[5,23,24]

## ASSESSMENT OF DYSPHAGIA AND ASPIRATION

### DIRECT PHARYNGO-OESOPHAGOSCOPY

Examination helps to visualize and biopsy the lesions in pharynx and upper oesophagus under general anesthesia. It helps to perform biopsy and stage all cases of Upper aerodigestive tract tumour. It allows inspection of the postcricoid area, which is not seen well during flexible endoscopic assessment of upper gastrointestinal tract. It helps in examining pharyngeal pouches and to facilitate their treatment. A major drawback of this assessment technique is the need for a general anaesthesia, and it is not a dynamic and functional assessment.[5]

### TRANSNASAL OESOPHAGOSCOPY

Transnasal oesophagoscopy (TNO) uses a narrow flexible endoscope to assess the oesophagus under local anaesthesia in the clinic setting to assess and diagnose oesophageal pathology. Around 40% of patients with swallowing problems can have concurrent oesophageal pathology, and major clinical advantage of this investigation is the lack of sedation-related morbidity and mortality and it is also more cost- effective.[5]

### MANOMETRY

This is the measurement of oesophageal pressures at rest and during swallowing to diagnose motility

disorders. A catheter with pressure transducer along its length is placed in the oesophagus and a multichannel system records the contraction amplitude, duration, coordination and velocity of each peristaltic wave. It is helpful in patients with atypical chest pain and unexplained causes of dysphagia. Conditions with abnormal manometric findings include achalasia, diffuse oesophageal spasm and scleroderma.[5]

## CONTRAST SWALLOW

Barium swallow includes both static and dynamic assessment of swallow. Patient is given a cup of liquid barium to swallow and bolus is followed fluoroscopically till the stomach. Improved visualization of mucosal detail can be obtained by using effervescent granules of barium producing an air contrast study. It is useful to diagnose intrinsic disease (diverticulae, stricture or web, tumour and dysmotility) and extrinsic disease (compression from thyroid or cervical osteophytes). It has poor sensitivity for other pharyngeal disease with failure rate of 40%. Use of barium is contraindicated when there is risk of aspiration since it can cause pneumonitis. In these situations a low molecular weight, non-ionic, water- soluble contrast medium must be used which causes less irritaton and minimal complications.[5]

## VIDEOFLUOROSCOPY (VF)

VF is the dynamic assessment of swallowing function and is considered as the gold standard for the evaluation of swallowing mechanism. Passage of measured volumes and viscosities of foods is observed in both the lateral and anteroposterior plane and a recorded study is performed. It is a comprehensive test for all phases of swallowing but particularly useful for oral and pharyngeal phases, to assess and interpret bolus preparation and propulsion. When aspiration is identified, measurement on scales can be done on penetration–aspiration scale. Manoeuvres can be tested to reduce aspiration, including swallowing during breath-holding, with or without a chin tuck, and with or without a head turn towards the affected side. VF is

especially useful in patients with neurological disease, and in patients after treatment for Head and neck cancer.[5,25]

### DYNAMIC MAGNETIC RESONANCE IMAGING

Magnetic resonance imaging (MRI) overcomes the limitations of videofluoroscopy in assessing without radiation exposure. Swallowing is assessed in the terms of symmetry and amplitude of movements of uvula and soft palate, faucial pillars, tongue, epiglottis and cricopharyngeous and images from sagittal, coronal and axial planes. In sagittal plane posterior movement of tongue and its compression on velum, elevation of hyoid, elevation of larynx, action of epiglottis and, in the coronal view the symmetrical movements of the faucial pillars and pharyngeal constrictor muscles and in axial plane three anatomical landmarks were targeted based on their role in swallowing, viz. velum, epiglottis and cricopharyngeous can be studied. Asymmetrical movements of faucial pillars and cricopharyngeous muscle can be appreciated in the dynamic MRI. Therefore, Dynamic MRI is helpful in understanding swallowing physiology and its disorders.[26]

## FIBRE-OPTIC ENDOSCOPIC EVALUATION OF SWALLOWING

### HISTORY

FEES was first described in 1988 when otolaryngologists had just started to use fiberoptic laryngoscopes in their practice. Prior to fiberoptic technology, indirect laryngoscopy was performed with a mirror or more invasive direct laryngoscopy instruments. The first fiberoptic laryngoscope is generally credited to Sawashima and Hirose in1968. It transformed the practice of laryngoscopy by allowing a transnasal approach with the patient conscious during the procedure and providing a view of vocal folds during natural speech. Today, in some parts of world, FEES is the primary procedure done on patients with suspected pharyngeal dysphagia.[27]

## COMPARISON OF FEES TO VIDEOFLUOROSCOPY

Studies have been done using simultaneous fluoroscopy and endoscopy equipment while the patient swallowed various foods or liquids. Thus, the same bolus was compared, and the same swallow was compared. Multiple raters were used to judge presence or absence of the bolus findings or they were asked to rate severity of residue or to score penetration or aspiration on the PAS (Penetration/ Aspiration) Scale. These studies found that agreement for presence or absence of findings was very high but that FEES consistently yielded a worse scores in terms of increasing severity of the findings. PAS scores were higher or worse when the swallow was rated from FEES. Residue was found to be more severe, and residue was seen in more locations. FEES is more sensitive to bolus findings, and in detecting the presence of a bolus. Therefore, it is superior and a fibre-optic endoscopic examination of the Upper aerodigestive tract must be performed in all cases of dysphagia. It is useful in identifying aspiration and secretion and for visual biofeedback for patients when trying compensatory procedures to aid swallowing and reduce aspiration incidence. This test may be performed at the bedside and is best if a digital recording can be made. Various consistencies of food material given, can be dyed with food colouring to enhance visibility. Bolus flow during swallow, laryngeal penetration and aspiration, and post-swallow residue can be documented. Endolaryngeal sensation along with FEES can also be assessed.[5,27,28,29]

A fibre-optic endoscopic evaluation of swallowing (FEES) allows a direct view of nasolaryngopharyngeal anatomy and physiology, assessment of the swallowing function and any compensatory interventions to facilitate swallowing performance. The equipment is portable so the test may be performed at the bedside particularly in intensive care unit. The endoscopic view can give specific information on transit of secretions as an indication of aspiration, the impact of fatigue and laryngopharyngeal sensation.[5,30]

Presence or absence of induction of swallowing reflex during the pharyngeal phase can be determined by swallowing provocation test with FEES.[31] Sensation may be measured quantitatively using FEES with the sensory testing (FEESST), which requires additional equipment to deliver air pulses of differing intensity,

duration and frequency through an additional port in the endoscope. The patient can view their swallowing simultaneously, which is particularly useful for teaching swallowing manoeuvres.[5,32]

## PROCEDURE

Patients are not required to fast prior to a FEES. They should be positioned in their usual eating/drinking position. First, the nostrils are examined using tip of the scope, to assess which side provides the wider access. Topical anaesthesia or a decongestant is applied to the nares only, for patients who have difficulty tolerating the procedure. The nasendoscope is coated in a water-based lubricant to ease its passage through the nasal passage. Four different views allow observation of anatomy and physiology during swallowing as follows:

• Nasal passage for elevation of the dorsal side of the velum.

• Nasopharynx for velopharyngeal competency, nasal reflux and lateral and posterior pharyngeal walls. Oropharynx for base of tongue, epiglottis and larynx.

• Hypopharynx for pyriform fossae, vocal folds and upper trachea.[5]

A functional evaluation is conducted before giving any food or liquid. Later, various consistencies of fluid and food may be given, without requiring the addition of radio-opaque contrast. Food colouring is added to enhance visibility. For patients with severe dysphagia, the swallow trial may just consist of an ice chip as described by Langmore. Similar to VFSS, compensatory strategies may be introduced and their effectiveness evaluated. Images can be recorded digitally, for later analysis and interpretation. Specific patient safety procedures should be ready for management of epistaxis or laryngospasm. Guidelines on sterilization and infection control must be followed.[3,5,27,30]

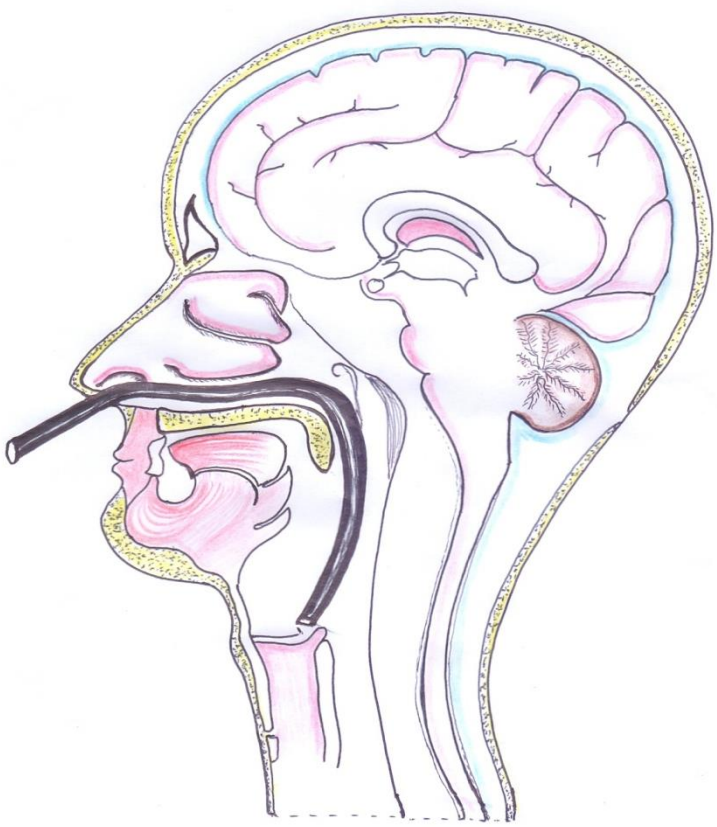


**Figure 9: Endoscopic evaluation of swallowing.**

## ADVANTAGES OF FEES

1. It is easier to perform with minimal discomfort to patient and has possibility for bedside or office examination.
2. Cost effective
3. No radiation exposure.
4. Illumination and magnification provides reliable assessment. It helps to evaluate swallowing by patient, in terms of complete swallowing, residual food material in oral cavity and pharynx, spill over into larynx and aspiration.[3,5]

## CONTRAINDICATIONS AND RISKS

FEES is a safe procedure, but it may be unsuitable for those patients who are drowsy or are not

cooperative. Caution is needed in those patients with a history of bronchospasm or laryngospasm, vasovagal response, cardiac instability, severe epistaxis or a physical obstruction to the passing of the scope. Adverse reactions to the topical anaesthetic are rare, but clinicians should take an adequate care, adhere to recommended doses and have resuscitation measures available.[5]

**ANALYSIS**

Interpretation of a FEES includes a description of bolus flow, reactions to a misdirected bolus, presence of airway invasion, residue and variations from the normal anatomy and physiology. Specific measurements relating to initiation of swallow can be taken. Presence of post-swallow residue and airway invasion must be recorded.[5]

**LIMITATIONS**

The limitations of FEES include:

1. Oral stage of swallowing cannot be evaluated.

2. There is loss of view known as 'whiteout' during swallow due to pharyngeal constriction around the endoscope lens.

3. Quantitative measures of structure displacement such as hyoid elevation are not possible.

4. Ability to estimate amount of aspirated material is limited.[5]

## USE OF FEES TO ASSESS AND MANAGE PATIENTS WITH HEAD AND NECK CANCER

The goal of cancer surgery is to remove all the tumor to achieve tumor-free margins to cure the patient. As medical science and the skills of the surgeon have increased over the years, surgery has become more extensive, resulting in larger surgical deficits, requiring more reconstructive solutions to approximate, as

best as possible, normal anatomic and physiologic relationships. Patient is not considered cured if the resultant surgical deficit does not allow resumption of oral feeding. After appropriate diagnostic testing and implementation of therapeutic interventions, the vast majority of head and neck cancer patients are able to take feeds orally postoperatively.

Fiberoptic endoscopic evaluation of swallowing (FEES) is most sensitive to pharyngeal phase dysphagias, but the clinician performing FEES must be aware of the patient's entire oropharyngeal phase of swallow. This is especially true with head and neck cancer patients, because of surgical resections involve both the oral cavity and pharynx. Examination of oral cavity and oropharynx prior to FEES, combined with direct visualization of the patient as bolus is taken into the mouth, and in conjunction with endoscopic image of the bolus (when and how it enters oropharynx and is cleared) is important in the appropriate diagnosis of the oral and pharyngeal stage dysphagias and implementing appropriate rehabilitative strategies. Relevant information is obtained, starting from the moment the bolus is presented orally, by observing the patient's oral swallow attempt; then by observing the patient and the monitor showing the oropharyngeal swallow. In this manner, a good assessment and diagnosis of both the oral and pharyngeal stage swallowing disorders can be done, and recommendations for rehabilitation and bolus consistencies can be made based on objective criteria.[33]

## Head and Neck Cancer Surgery and Reconstruction

Swallowing is the most complex coordination of voluntary and involuntary muscle action intermixed with respiration and speaking. Surgical resection alters this system, making dysphagia one of the most common symptoms in patients with head and neck cancer. These dysphagic patient's quality of life may become severely compromised, resulting in a reclusive behavior and withdrawal from social life. Dysphagia can result from the tumor itself due to incoordination of swallowing mechanism, physical obstruction, neurologic changes, or pain as well as from the combination of the treatment modalities used for its cure

including surgery for resection of the cancer, external-beam radiation therapy (EBRT), and chemotherapy.[5,33]

Surgical resection of oral, pharyngeal, laryngeal, or esophageal areas result in varying degrees of dysphagia, with the consequences of surgery on swallowing ranging from minor to life threatening. The actual functional deficits depend on the extent of resection and on the reconstructive procedure. The surgical resection, subsequent reconstruction, and appropriate dysphagia diagnostics and rehabilitation will allow for some type of swallowing success, which can range from small amounts of oral feeding with specific amounts and consistencies to supplement tube feedings to the resumption of a normal oral diet. Patient motivation and individualized dysphagia rehabilitation determines the rate of swallowing recovery.

Once adequate time is given for postoperative healing and reduction of edema, FEES is used as a diagnostic and rehabilitative monitoring tool with the goal of improving oral feeding. Some head and neck cancer patients recover their swallowing skills quickly, whereas others take longer. FEES, by being easily repeatable and patient friendly, is a valuable tool for determining when to initiate oral feeding, what consistency of food to begin with, and when to advance an oral diet.[23,24,33]

Many patients are scared of starting or advancing their diets, and many complain of stasis of food in their throat due to altered anatomic and physiologic relationships. FEES is used as a biofeedback tool to show visually that a particular food bolus consistency can be swallowed successfully. Head and neck cancer patients constitute a heterogenous population and surgical resections result in predictable patterns of dysphagia and aspiration risk. Common dysphagia symptoms include drooling and bolus loss anteriorly, incomplete bolus clearance from oral cavity, difficulty with mastication, numbness, decreased temperature and pain sensation, delayed initiation of the swallow as a result of poor oral control and transport of bolus, and increased pooling of secretions in pharynx because of a weak pharyngeal swallow marked by inappropriate residue in vallecula, pyriform sinuses, or laryngeal vestibule.[33]

The goals of any diagnostic swallowing assessment is to diagnose the cause of swallowing difficulty and to formulate therapeutic strategies for a successful swallowing using different bolus consistencies and volumes, head positioning, or swallow steps and laryngeal adduction manuevers. FEES can be done at the bedside as well as in the clinic using regular food, and has no time constraints because there is no radiation exposure and the endoscope can remain in place for 20 to 30 minutes at a time. The clinician and patient can experiment with different bolus consistencies, different positioning, and use various swallowing steps and manuevers to determine the optimal strategy for successful swallowing. As a result of the often rapidly improving postoperative period resulting in improved sensation and decreased edema, FEES is done repeatedly in a short time to monitor changes in dysphagia and aspiration status and to advance the patient's diet safely.[33]

## DYSPHAGIA REHABILITATION

The ultimate goal of dysphagia rehabilitation is to return the patient's swallowing ability to as near normal as possible. Dysphagia rehabilitation following resections of oral, pharyngeal, and laryngeal structures focuses on individually designed compensatory skills to allow the patient to take food orally without compromising health. It may be necessary to replace or supplement oral feeding with either nasogastric or gastric feeding tubes. Most of the time, these will be temporary measures to allow for adequate nutrition during the healing process, during EBRT, or during chemotherapy to minimize the risk of aspiration and to maintain adequate nutrition. As the patient improves, tube feedings can be altered according to the amount of oral intake, with the goal of removing the tube and relying only on oral feeds. It is advantageous for the speech-language pathologist to work closely with a dietitian as well as head and neck surgeon during this transition period to ensure proper nutritional maintenance and patient compliance.[33,34]

## ORAL CANCER

Oral cancers can cause both oral- and pharyngeal-stage dysphagia problems. The most likely causes are delayed bolus transit, retention in the anterior floor of mouth, pocketing in the right or left sulcus, decreased sensation and poor oral preparatory skills. Aspiration results if there is decreased oral sensation and postoperative edema causing weak and uncoordinated mastication and bolus preparation, thereby allowing the food bolus to spill abnormally into pharynx without triggering the swallow reflex. Oral-stage problems can arise as a result of poor lingual containment of the food bolus, resulting in abnormal spillage over base of the tongue and into pharynx before initiating the swallow reflex.[33]

**Figure 10: Carcinoma left Buccal Mucosa.**

## LABIAL RESECTIONS

Labial resections result in decreased strength and imprecise lip closure around a straw, cup, or spoon. The

result is bolus loss anteriorly and inadequate bolus volume to initiate triggering of swallow reflex. FEES may be used to assess liquid bolus delivery when using a straw, cup, or spoon and success of retention of the bolus in oral cavity or any presence of abnormal spillage of bolus food material into the pharynx, to formulate an individualized oral diet plan.[33]

## ANTERIOR TONGUE AND FLOOR-OF-MOUTH RESECTIONS

Patients with resection of anterior tongue and floor of mouth will have problems predominantly with the oral preparatory and oral stages of swallowing function. Aspiration is not a characteristic finding in these patients except in patients where suprahyoid muscles are disrupted, thereby impairing the ability of the larynx to elevate, or if decreased oral sensation does not allow adequate bolus manipulation or clearing from oral cavity. Anterior tongue resections can lead to decreased lingual-palatal contact affecting bolus formation and anterior-posterior bolus propulsion. Anterior floor of mouth resections result in an anterior defect that traps and collects food. The combination of an anterior tongue and floor of mouth resection results in, an inability to clear bolus food material with the tongue tip because of the surgical defect.[35]

Unlike fluoroscopy, fibreoptic endoscope can remain in position and view the entire pharynx continuously after a swallow has been completed. It also helps to document the time taken for a successful swallow of the residual bolus. Movements of base of tongue and process of swallowing from chewing to bolus preparation and initiation of the swallow reflex can be seen and documented. This may be better documented by using soft and coloured food material like icecream and porridge.[33]

## LATERAL TONGUE RESECTIONS

Lateral tongue resections involving less than half of oral tongue will not cause long term problems. Once edema resolves and healing takes place, normal eating can be started. Oral dysphagia will depend on the extent of surgery. If more than two thirds of tongue is surgically resected, compensatory techniques with

suitable bolus consistency can lead to successful oral intake. In post operative patients of partial or hemiglossectomies, FEES is an ideal tool for both diagnostic and ongoing therapeutic interventions. Spillage can be seen clearly, and if the amount or depth of bolus penetration puts the patient at risk for aspiration, modifications in bolus volume and individualized swallowing training can be implemented. If an inappropriate amount of residue is noted as a result of inadequate bolus propulsion, the patient can be made to perform a forceful throat clearing maneuver after each swallow to remove any residual bolus from the upper airway that potentially could be aspirated. Visual biofeedback provided by FEES is extremely helpful in allowing the patient to modify or add steps following the swallow, to help prevent aspiration.[33,36]

**Figure 11 : Intraoperative image of Hemiglossectomy**

## TOTAL GLOSSECTOMY

Total glossectomy will result in a significant aspiration risk due to the impairment of oral preparatory and the oral stages of the swallowing and failure to trigger the swallowing reflex. When a total glossectomy is required, great difficulty is encountered for oral feeding in the postoperative period. Trials with different compensatory techniques and food consistencies then can be tried. If the patient develops an aspiration pneumonia, oral feeding trials must be stopped and airway protected till optimal healing occurs and the patient's medical condition is stable. Later, oral feeding trials can be restarted.[33,36]

## BASE-OF-TONGUE RESECTIONS

The tongue base provides the primary driving force for bolus to pass through pharynx. When the tongue base is altered surgically, there will be difficulty in generating the propulsive force necessary for good bolus clearance in pharynx resulting in abnormal spillage from oral cavity. Inappropriate amounts of residue frequently remain in the vallecula and pyriform fossae. This residue may enter the laryngeal vestibule after the swallow and result in aspiration. FEES enables endoscopic view of the base of tongue and biofeedback during rehabilitation. Clinician can direct the patient to perform compensatory maneuvers in a more efficient manner and can manipulate bolus volume and consistency for swallowing success.[33,37]

## COMPOSITE RESECTION

Composite resections results in decreased lingual and mandibular range of motion and control and decreased sensation. This can affect the oral and pharyngeal stages of swallowing. Unlike fluoroscopy, FEES is ideally suited to examine soft-tissue changes, such as resections, reconstructive procedures, and edema, that impact on swallowing success. FEES allows close inspection before the swallow (to determine how secretions are being handled and the range of motion of affected structures during spontaneous swallowing), during the swallow (to assess physiologic changes resulting from the surgery), and after the

swallow (to identify the pattern of bolus residue, if any, that is amenable to therapeutic interventions). In addition, it may be used routinely in the postoperative recovery period to determine when and with what bolus types swallowing can be attempted. Frequent assessments with FEES permit the earliest possible timing for appropriate resumption of oral feeding and provide objective feedback regarding recovery.[33]

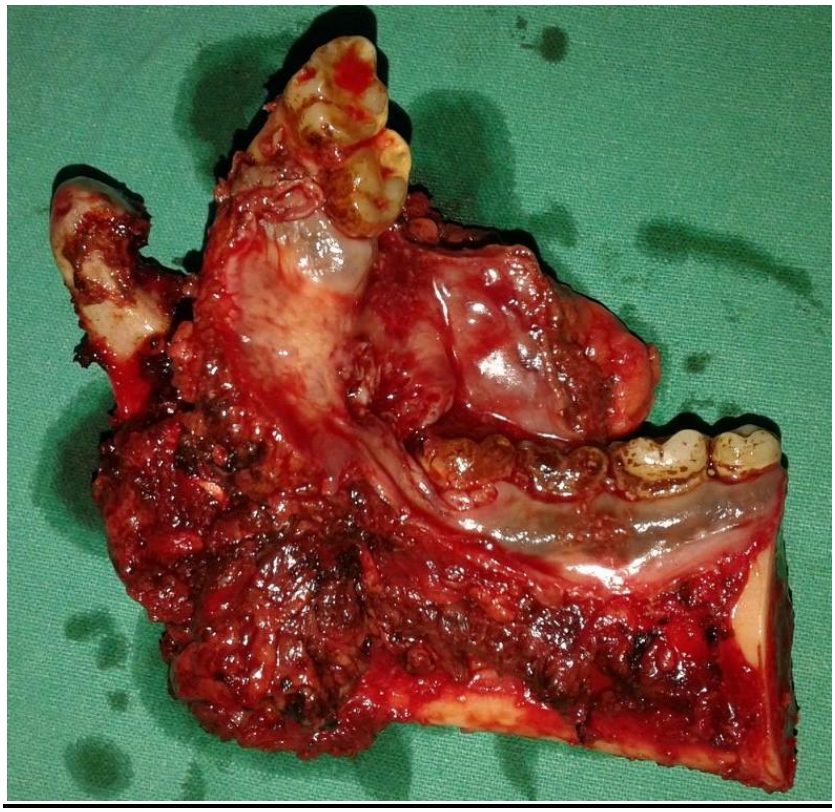


**Figure 12: Specimen of Composite resection.**

## MANDIBULECTOMY

When cancer has invaded bone, a composite resection (i.e., glossectomy, mandibulectomy, and radical neck dissection) is performed for an en bloc resection. Oral preparatory and oral phases of swallowing are affected due to surgical changes in tongue musculature and floor of mouth and functional deficit is generally directly proportional to the extent of surgical resection. When the anterior mandibular arch is resected, the genioglossus muscle, which comprises the bulk of tongue and suprahyoid laryngeal support,

loses its insertion, resulting in drooling, and impairs hyoid elevation and laryngeal excursion during the swallow. If the mandible is cut, the inferior alveolar nerve, may be severed, resulting in ipsilateral anesthesia of mandibular dentition and alveolar ridge, labial alveolar mucosa and gingiva, lower lip, and tactile sensation of the tongue resulting in bolus loss anteriorly and pocketing of food bolus in the ipsilateral buccal sulcus. FEES is used to assess oropharyngeal functioning before, during, and after the swallow with different bolus consistencies for a successful swallow.[33,38]

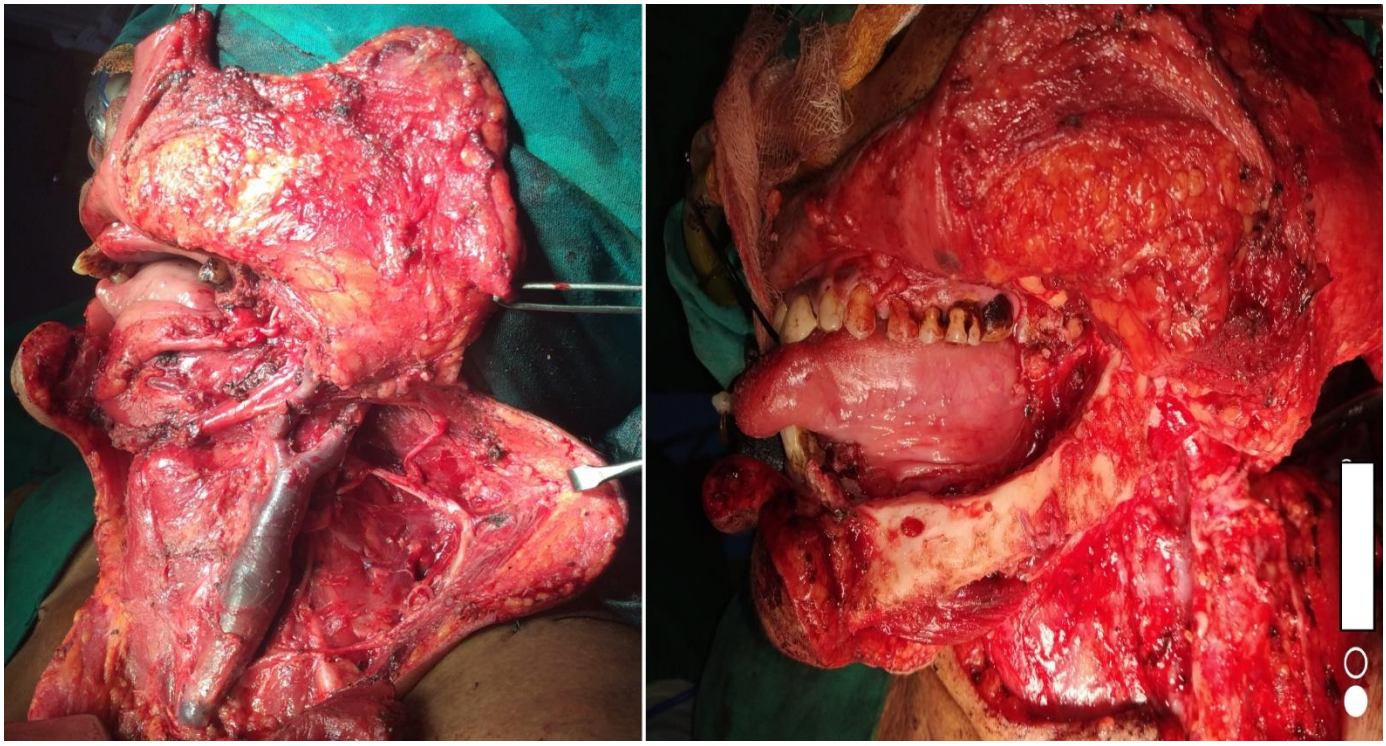


**Figure 13: a) Hemimandibulectomy b) Marginal mandibulectomy**

## HARD- AND SOFT-PALATE RESECTIONS

Palatal defects result in abnormalities in the oral phases of swallowing. Hardpalate defects are managed by using an obturator, which prevents nasal regurgitation of food via the surgically created oronasal fistula. Soft-palate defects are more difficult to resolve, because soft palate is a dynamic muscular structure and

resection results in velopharyngeal insufficiency. Both hard and soft-palate defects and the obturator itself cause decreased sensation, which may impair oral function, resulting in oropharyngeal dysphagia. Using FEES, an excellent view of any fistulas and velopharyngeal insufficiency is achieved. Both oronasal fistulas of the hard palate and velopharyngeal insufficiency can result in nasal reflux of food. The larger the surgical defect, the greater the potential for nasal reflux. Treatment involves fabrication of a palatal prosthesis to cover up the surgical defect, so that food will not enter the nasal cavity. Therapeutic techniques involve limiting bolus volume and head positioning to reduce the potential for nasal reflux.[33,39]

**Figure 14: Intraoperative image of Hard palate resection.**

## PHARYNX, LARYNX, AND ESOPHAGUS

When the hypopharynx is involved with tumor, resection can involve pharynx and the larynx. Reconstruction is undertaken by regional myocutaneous flap or radial forearm free flap. Similarly, if the tumor is extensive involving the esophagus, a total laryngopharyngoesophagectomy is performed with

gastric pull up, jejunal free flap, or colonic interposition. Aspiration cannot occur in the usual manner after these procedures since there is complete separation of respiratory and alimentary tracts. Dysphagia can result due to fistula or anastomosis leak. The patient presents with feeling of fullness at the base of tongue, and oral regurgitation occurs if an upright posture is not maintained during eating. Maintaining appropriate bolus consistency, rate of eating, and an upright posture both during and an hour after eating are critical for successful oral intake. Neither fluoroscopy nor FEES is especially helpful with dysphagia management for this patient population.[33]

## TOTAL LARYNGECTOMY

Incidence of dysphagia following total laryngectomy is highly variable, from 10 to 58% and aspiration is eliminated by the surgical separation of the respiratory and digestive tracts. Hypopharyngeal stenosis is a relatively common finding following total laryngectomy and dilatation is the therapeutic solution. In the pharynx, FEES is used to examine postoperative changes like bolus clearance and residue resulting from decreased tone or the presence of pseudovalleculae in total laryngectomy patients. Therapeutic interventions, such as bolus consistency modification, head positioning, or drinking a liquid bolus after a puree or solid bolus to aid in pharyngeal clearance and can be investigated with biofeedback.[33,40]

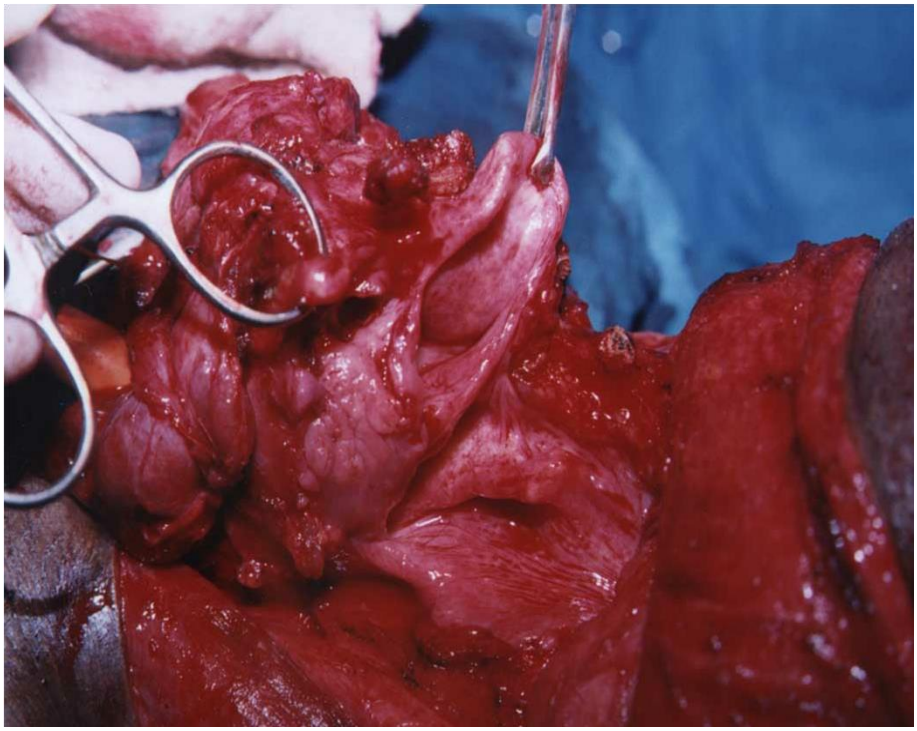


**Figure 15: Intra-operative image of Total Laryngectomy.**

## VERTICAL PARTIAL LARYNGECTOMY

A partial laryngectomy is performed in T2 glottic malignancies to save at least one true vocal fold for preservation of voice. Partial laryngectomy involves excision, in the vertical plane, of the ventricular fold, and true vocal fold unilaterally, sparing the epiglottis. Specific oncologic requirements also may necessitate resections involving the hyoid bone, arytenoid cartilage, superior laryngeal nerve, thyroid cartilage, or base of tongue, with concomitant increase in dysphagia based on the extent of laryngeal resection and the type of neoglottic reconstruction used.

Vertical partial laryngectomy results in voice changes, such as hoarseness and breathiness, because the resection usually involves one arytenoid cartilage and one true vocal fold, with reconstruction of the neoglottis using mucosa to adduct with the remaining true vocal fold. The primary protective valve of the airway is compromised resulting in high risk for aspiration during the immediate postoperative period. The FEES procedure is extremely useful for assessing the functioning of larynx postoperatively, making

diagnoses of dysphagia, and providing documentation of swallowing success with different bolus consistencies. It also can be used with sensory testing and as a biofeedback tool during therapy by focusing on laryngeal adduction maneuvers. Ability for the patient to see how well the airway closes and then learn to execute this maneuver prior to swallowing enhances correct implementation of therapeutic interventions and promotes faster swallowing success.[33,41]

## SUPRAGLOTTIC LARYNGECTOMY

Supraglottic laryngectomy is done in the horizontal plane for patients with cancer of the epiglottis or ventricular vocal fold without extension across or into the ventricle or anterior commissure. Supraglottic laryngectomy involves resection of two of the three protective laryngeal airway mechanisms ( the epiglottis, aryepiglottic folds and false vocal folds, but not the true vocal folds and arytenoid cartilages). Swallowing function is more difficult since the hyoid bone ( ipsilateral 2/3$^{rd}$) is resected. Supraglottic laryngectomy is organ-sparing surgery that places the patient at high risk for aspiration both before the swallow because of inadequate protection of the airway and following the swallow because of reduced pharyngeal clearing secondary to changes in the infrahyoid muscles affecting laryngeal movement and pharyngeal shortening (i.e., their hyoid insertions have been surgically severed). Swallowing function may recover in 2 weeks, with an overall failure rate of 8 to 20%.[33,42,43]

## SWALLOWING THERAPY

Swallowing therapy may be provided to the dysphagic patient in acute care if it is anticipated that the patient's spontaneous recovery will be slow or when it is required to improve specified aspects of swallowing physiology. Swallowing therapy is designed to change the physiology of patient's swallow and generally includes muscle exercises directed at the specific locus of the patient's physiologic abnormality.

# SWALLOW MANEUVERS

## SUPRAGLOTTIC SWALLOW

This maneuver is done for patients with reduced or late vocal closure and delayed pharyngeal swallow The supraglottic swallow is a technique that has the goal of adducting the true vocal folds, to protect the airway during swallowing. The technique can also be used by patients to enhance weak or incomplete vocal fold adduction secondary to tumor involvement, surgical resection, or neurologic insult to the superior laryngeal nerve and or recurrent laryngeal nerves. The supraglottic swallow comprises the five steps as delineated that below. The supraglottic swallow may be taught with or without visual biofeedback provided by endoscopy which allows faster and more successful achievement of the steps necessary to perform the technique correctly. The endoscope is positioned such that the patient has a clear view of his or her pharynx and supraglottic larynx on the monitor. Patient is instructed that the purpose of the supraglottic swallow is to achieve true vocal fold closure for several seconds before the swallow and to maintain this closure during swallowing.

1. Patient is instructed to adduct the true vocal folds by humming and then holding his or her breath and tensing the neck followed by abrupt cut off.
2. The bolus is swallowed while the breath is held and the neck is tensed. (If an air leak or vocalization is noted, maintenance of true vocal fold adduction has not been achieved.)
3. Immediately after the swallow, a throat-clearing maneuver is performed (This forces any residual bolus present in the pharynx into the oral cavity).
4. The patient is instructed to adduct the true vocal folds and hold his or her breath and tense the neck again immediately after the throat clearance maneuver. It is essential not to inhale during steps 3 and 4.
5. The remaining bolus is swallowed while the breath is held and the neck is tensed. It takes 1 to 3 days for the patient to adopt to the supraglottic swallow steps. The patient must be counseled that during this training period, the five steps should be followed strictly. After 2 to 4 weeks of practice, the technique becomes

habitual, and the patient does not have to perform all the steps to achieve a successful swallow. In two to three months postoperatively, a normal appearing swallow occurs, and the patient usually can swallow successfully without consciously performing the supraglottic swallow steps.[33,44]

**SUPER-SUPRAGLOTTIC SWALLOW**

This maneuver is done for patients with reduced closure of airway entrance. This maneuver tilts arytenoid forward, and pulls false vocal folds in closing airway entrance before and during swallow. Patient is instructed to follow the instructions as mentioned above, but has to bear down while holding breath.

**EFFORTFUL SWALLOW**

This maneuver is done for patients with decreased posterior movement of the tongue base. It helps in increasing posterior tongue-base movement and in generating pressure. Patient is made to swallow hard with squeezing of all the muscles of tongue.

**MENDELSOHN MANEUVER**

This maneuver is done for patients with reduced laryngeal movement and discoordinated swallow. Laryngeal movement opens up the upper esophageal sphincter and prolonged laryngeal elevation prolongs the upper esophageal sphincter opening. This normalizes the coordination of pharyngeal swallow events.[44]

Patient's perception of the swallowing function is poor following surgery on tongue which leads to poor quality of life. Decreased tongue movement, dryness of mouth, a delayed oral transit time, reduced hyoid bone elevation, penetration of food into larynx, fixity of epiglottis, residual food in the pharynx, and risk of aspiration are the major problems in swallowing, in patients with tongue cancer. Studies have shown after surgery for tongue cancer post operative incidence of aspiration is about 5% and incidence of severe

pharyngeal residue is 40%.[37,38]

Laryngectomized patients may experience problems like stricture, leakage from voice prosthesis, laryngeal reflux, pseudodiverticulum, fistula formation and reduced neopharyngeal propulsion. Each of these difficulties may result in reduced ingestion of food, weight loss and morbidity.

Incidence of aspiration was about 5% in post operative evaluation of swallowing function in head and neck cancer patients. A Dutch study done in 2011 showed that surgery for head and neck cancers results in both anatomic or neurologic insults which lead to site-specific patterns of dysphagia. It also showed that larger resections cause more dysphagia and resection of vital structures like tongue or larynx have the greatest impact on swallowing due to poor bolus formation, impairment of bolus transit and inadequate airway protection. Damage to the tongue base, pharyngeal constrictors, the larynx, and autonomic neural plexus was also noted following radiotherapy which resulted in severe dysphagia.[23]

Fibreoptic endoscopic evaluation of swallowing (FEES) provides equally potential results as that of videofluoroscopy for assessment of dysphagia. FEES can be easily performed on sick and immobile patients unlike videofluoroscopy. FEES also gives a clear inspection of the voice prosthesis in laryngectomised patients. It is a dependable investigation to identify aspiration, is safe and inexpensive bedside examination with no radiation exposure, minimal discomfort to the patient, and can be repeated multiple times when indicated. As a result FEES has received significant importance in acute dysphagia assessment, specifically in the acute stroke and head and cancer patients. It is an ideal tool that is readily accessible to treating physicians and swallowing therapists and is helpful in recommending dietary modifications for these patients with accuracy and safety.

Data suggests that investigating patients' perception of swallowing impairment and swallowing-related QOL is not sufficient to discriminate safe and unsafe swallowing in OPHL patients, although a correlation

between swallowing related QOL and objective signs of dysphagia is present in these patients.[42]

A study investigated the post-laryngectomy swallow and presence and degree of residue as observed on videofluoroscopy and FEES. In addition, videofluoroscopy and FEES are assessed for reliability and inter-instrument agreement. 30 laryngectomy subjects underwent dysphagia evaluation using simultaneous videofluoroscopy and FEES. There was a finding of residue in 78% of videofluoroscopy ratings, and 83% of FEES ratings.[45]

Post swallow residue, both in the vallecula and the pyriform fossae, is significantly correlated with penetration/aspiration on FEES. The effectiveness of residue clearance also correlates with penetration/aspiration on FEES and contributes to strengthen the correlation between residue and aspiration. The effectiveness of residue clearing changes according to the consistency and location in the pharynx. These findings help in understanding the complex association between pharyngeal residue, swallowing efficiency, and aspiration in dysphagia patients.[46]

# MATERIALS AND METHODS

# IV. MATERIALS AND METHODS

## TYPE OF STUDY

- This is a Descriptive Observational study.

## SOURCE OF DATA:

- 73 patients treated for head and neck cancer involving upper aerodigestive tract treated by surgery followed by radiotherapy in the Department of Otorhinolaryngology and Head and Neck Surgery in R.L. Jalappa Hospital And Research Centre, Tamaka, Kolar from December 2017 till June 2019 were included in this study.

## SAMPLE SIZE

- 73 patients treated for various head and neck cancers involving upper aerodigestive tract treated by surgery followed by radiotherapy.
- Sample size was obtained based on a study done by Dwivedi RC in 2008[38] with 95% confidence interval considering absolute error 5% .

  $n=Z_{\alpha}^{2}SD^{2}/ (d)^{2}$ where $Z_{\alpha}$= 1.96, SD+ 21/5 d= Absolute error 5%

  Confidence interval = 95%
- Chi square test

## METHODS OF COLLECTION OF DATA

- 73 patients treated for head and neck cancer involving upper aerodigestive tract treated by surgery followed by radiotherapy in Department of Otorhinolaryngology and Head and Neck

surgery in R.L. Jalappa Hospital And Research Centre, Tamaka, Kolar from December 2017 – June 2019 were included in this study.

- An informed written consent from all the patients, after proper counselling regarding the procedure being performed and the research being done was obtained.
- A complete detailed history regarding the stage and site of head and neck cancer and the nature and details of treatment was taken.
- Physical examination, head and neck examination including examination of oral cavity and oropharynx, indirect laryngoscopy and palpation of neck was done. Investigations like X ray chest, hemoglobin estimation and total and differential leucocyte count was done.
- Nasal cavity was packed with 4% xylocaine with vasoconstrictor for 10-15 minutes and xylocaine viscus was used if patient had gag reflex. A 3 mm PENTAX FB-10V fibreoptic laryngopharyngoscope was passed through the nasal cavity and advanced behind the soft palate. Solid, semisolid and liquid food in form of small bolus was given while performing the above endoscopy trans-nasally and the pharyngeal phase of swallowing was assessed to document the structural deficit or dysfunction in oral cavity, pharynx and larynx. In our observation semisolid diet was best suited for assessment as mastication and second phase of deglutition were easier for the patient and aspiration was minimal.

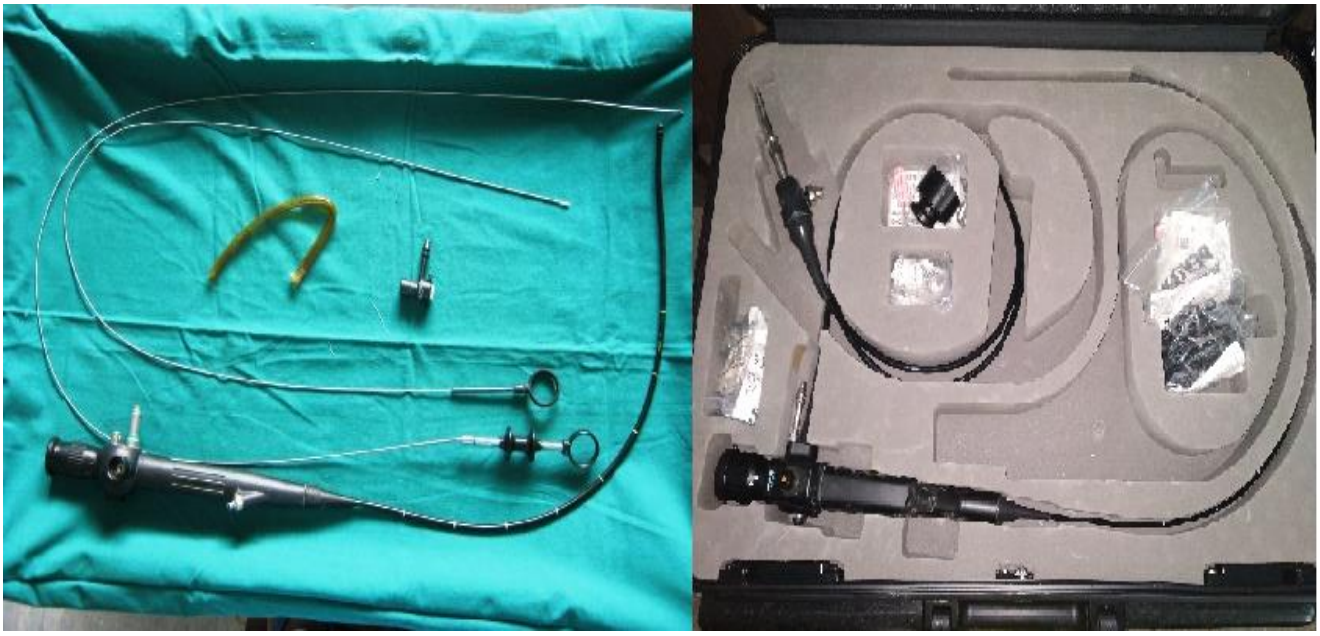


**Figure 16: 3 mm PENTAX FB-10V fibreoptic laryngopharyngoscope used the study.**

- Nasopharynx was visualized for velopharyngeal insufficiency and nasal regurgitation. Oropharynx and hypopharynx was examined to identify problems in swallowing like restricted tongue movement, second and third repeat swallow, delayed bolus transit, inability to form a proper bolus, adynamic segments, fibrotic bands in the pharyngeal wall, pooling in pyriform fossa and larynx was visualized for spill over, minor degrees of aspiration or regurgitation was documented. Edema, ulceration and dryness was also documented.

- Patients were trained in diet modification, swallowing therapy and intervention like tracheostomy was done based on severity of dysphagia.

- A repeat fibreoptic laryngopharyngoscopy was done 6 weeks and 12 weeks after completion of treatment to evaluate whether there was any improvement in swallowing.

**Figure 17: FEES under progress.**

## INCLUSION CRITERIA

- 73 patients between 30 to 70 years of age treated for head and neck malignancies involving upper aerodigestive tract with surgery followed by radiotherapy in the department of Otorhinolaryngology and head and neck surgery in R.L. Jalappa Hospital And Research Centre, Tamaka, Kolar.

## EXCLUSION CRITERIA

- Patients with recurrent tumour.
- Patients with history of previous neck dissection.
- Patients with neck contracture.
- Patients with kyphoscoliosis.

- Patients with hypothyroidism or goitre.

Patients with dysphagia for more than 1 week due to any cause before being included in the study.

**STATISTICAL ANALYSIS:**

Data was entered into Microsoft excel data sheet and was analysed using SPSS 22 version software. Categorical data was made in the form of Frequencies and proportions. **Fischer's exact test** was used as a test of significance for qualitative data. Continuous data were showed as mean and standard deviation.

**Graphical representation of data:** MS Excel and MS Word were used to obtain various types of graphs such as bar diagram.

**p value** (Probability that the result is true) of <0.05 was statistically significant after assuming all the rules of statistical tests.

**Statistical software:** MS Excel**,** SPSS version 22 **(**IBM SPSS Statistics, Somers NY, USA) was used to analyze data.

# OBSERVATION AND RESULTS

## V. RESULTS

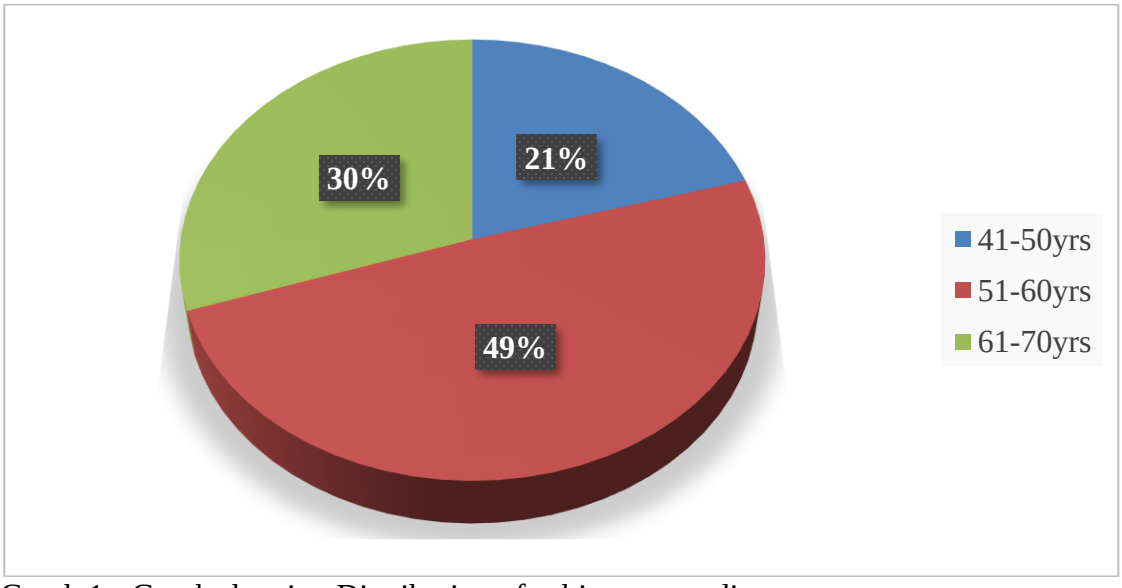
- Our study done in 73 patients treated for head and neck cancer involving upper aerodigestive tract treated by surgery followed by radiotherapy or concurrent chemoradiation from a period of December 2017 to June 2019.

- A fibreoptic laryngopharyngoscopy was done in the above patients treated for head and neck malignancies under topical anesthesia.

## AGE DISTRIBUTION

| Age group | Frequency | Percent |
|---|---|---|
| 41-50yrs | 15 | 20.5 |
| 51-60yrs | 36 | 49.3 |
| 61-70yrs | 22 | 30.1 |
| Total | 73 | 100.0 |

Table 1:- Distribution of subjects according to age group




Graph 1:- Graph showing Distribution of subjects according to age group

In this study 21% patients were in the age group of 41 – 50 years, 30% patients in the age group 61 – 70 years and 49% patients in the age group of 51- 60 years as shown n table: 1.

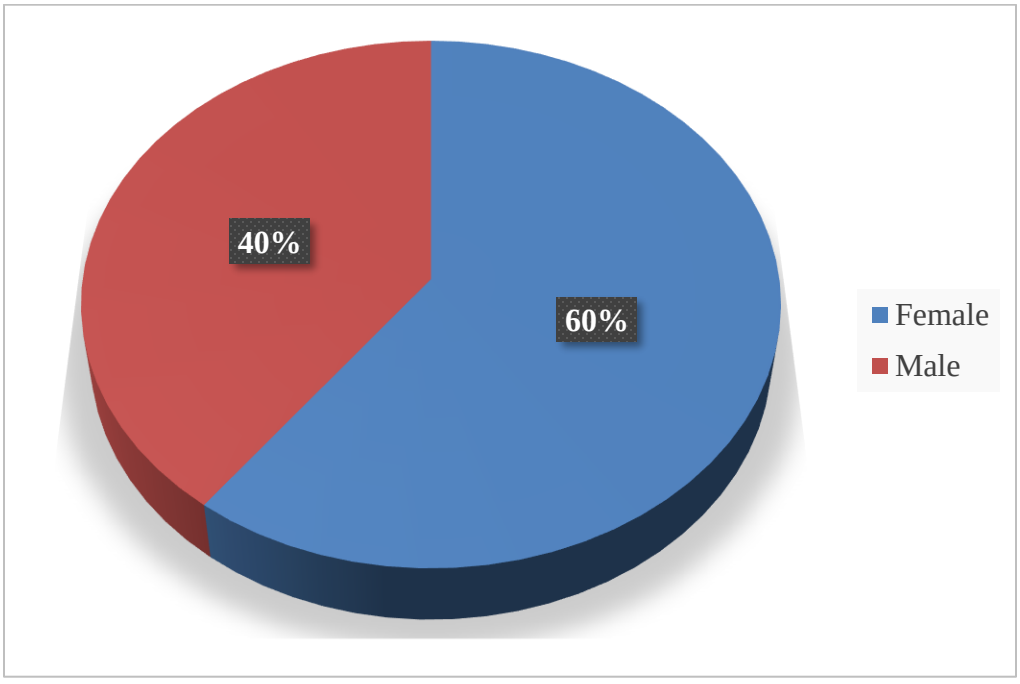
## SEX DISTRIBUTION

Among the study group, 44 patients (60.3% ) were females and 29 patients (39.7% ) were males as shown in table: 2.

Table 2:- Distribution of subjects according to sex

| **Sex** | Frequency | Percent |
|---|---|---|
| **Female** | 44 | 60.3 |
| **Male** | 29 | 39.7 |
| **Total** | 73 | 100.0 |

Graph 2:- Graph showing Distribution of subjects according to sex



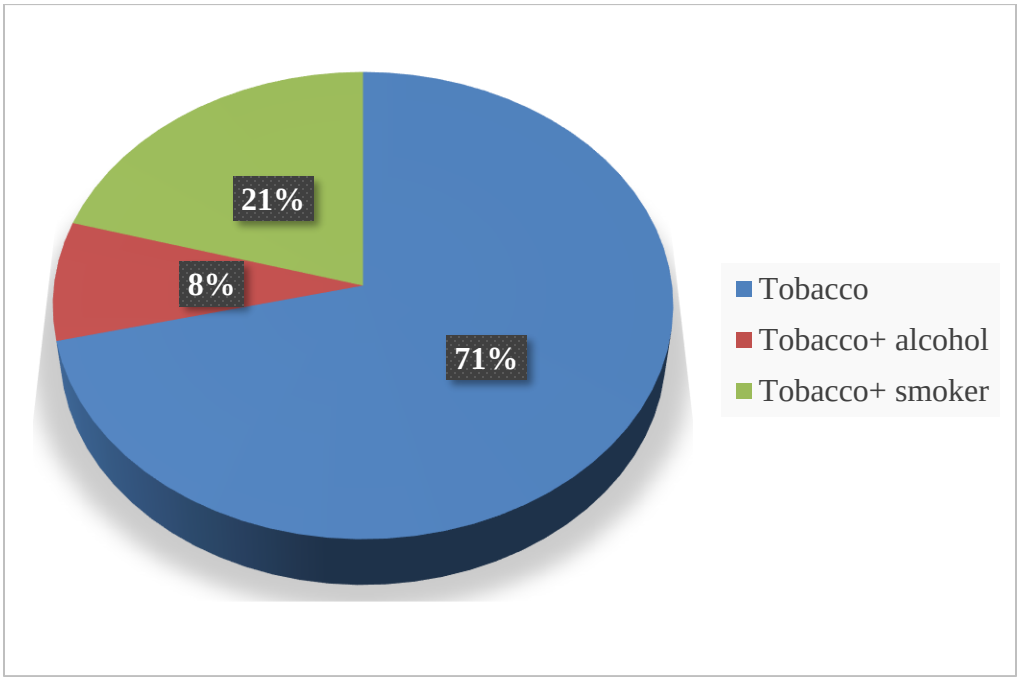
## ADDICTIONS

In our study, 52 patients ( 71.2%) had addiction for tobacco chewing, 6 patients ( 8.2% ) had tobacco and alcohol addiction and 15 patients ( 20.5%) had tobacco and smoking habit as shown in table: 3.

Table 3:- Distribution of subjects according to habit

| | Frequency | Percent |
|---|---|---|
| Tobacco | 52 | 71.2 |
| Tobacco+ alcohol | 6 | 8.2 |
| Tobacco+ smoker | 15 | 20.5 |
| Total | 73 | 100.0 |

Graph 3:- Graph showing Distribution of subjects according to habit



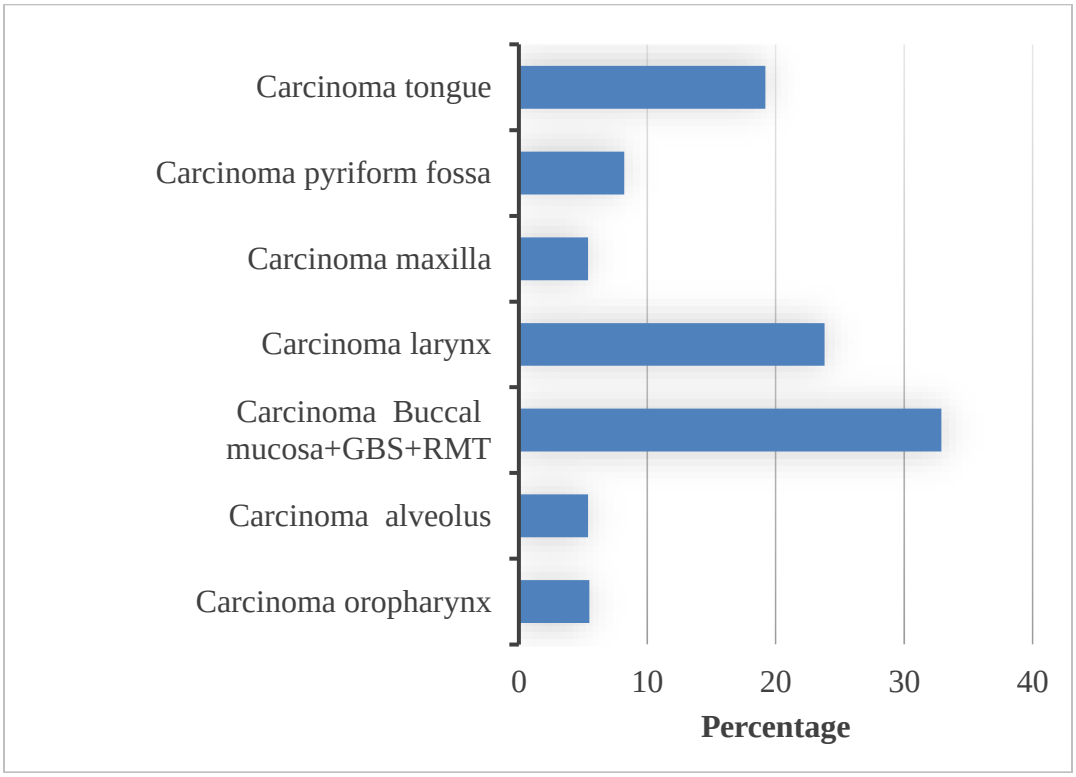
## PATIENT DISTRIBUTION ACCORDING TO DIAGNOSIS AND STAGING

In our study, 10 patients (13.6% ) were diagnosed with carcinoma buccal mucosa out of whom 4 patients were staged T3 and 6 patients were staged T4. 13 patients ( 17.8%) were diagnosed with carcinoma lower gingivobuccal sulcus out of whom 6 patients were staged T3 and 7 patients were staged T4 and 1 patient was diagnosed with carcinoma retromolar trigone staged T3. 17 patients ( 23.2%) were diagnosed with carcinoma larynx out of whom 4 patients were staged T3 and 13 were T4. 6 patients were diagnosed with carcinoma pyriform fossa out of whom 3 were staged T4 and 3 were staged T3. 14 patients (19.2% ) were diagnosed with carcinoma tongue out of whom 5 were staged T2, 3 were T4 and 6 were T3. 4 patients ( 5.4%) were diagnosed with carcinoma maxilla and were staged T3. 4 patients (5.5% ) were diagnosed with carcinoma oropharynx staged T3. 4 patients (5.4%) were diagnosed with carcinoma upper alveolus staged T4.

Table 4:- Distribution of subjects according to diagnosis

| **DIAGNOSIS** | Frequency | Percent |
|---|---|---|
| Carcinoma Oropharynx | 4 | 5.5 |
| Carcinoma Upper alveolus | 4 | 5.4 |
| Carcinoma Buccal mucosa + GBS+ RMT | 24 | 32.9 |
| Carcinoma Larynx | 17 | 23.8 |
| Carcinoma Maxilla | 4 | 5.4 |
| Carcinoma Pyriform fossa | 6 | 8.2 |
| Carcinoma Tongue | 14 | 19.2 |
| Total | 73 | 100.0 |

Graph 4:- Graph showing Distribution of subjects according to diagnosis

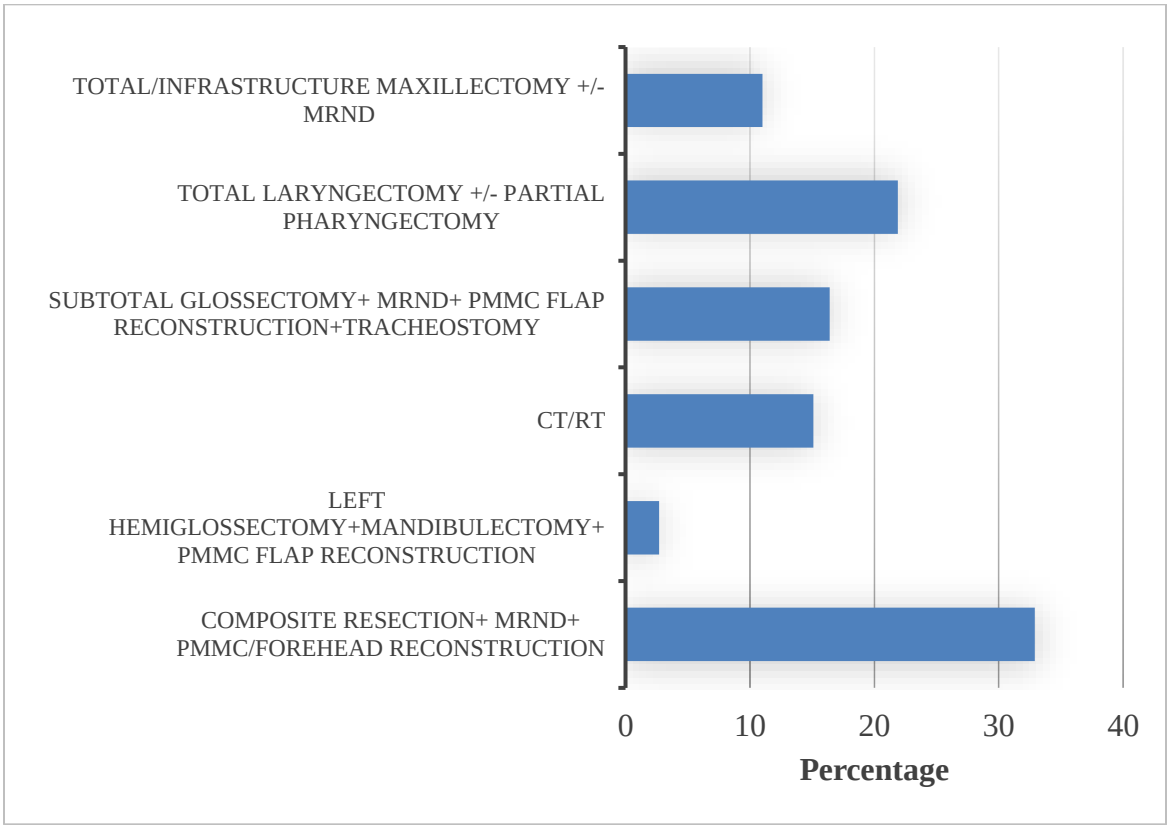



## MANAGEMENT

Table 5:- Distribution of subjects according to management

| MANAGEMENT | Frequency | Percent |
|---|---|---|
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 24 | 32.9 |
| LEFT HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 2 | 2.7 |
| CT/RT | 11 | 15.1 |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 12 | 16.4 |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 16 | 21.9 |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 8 | 11.0 |
| Total | 73 | 100.0 |

Graph 5:- Graph showing Distribution of subjects according to management




## MANAGEMENT

### COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION

In our study, 24 patients ( 32.9%) with oral cancer underwent composite resection ( 21 hemi-mandibulectomy and 3 marginal mandibulectomy). Among these patients, 17 underwent PMMC flap reconstruction, 6 forehead flap reconstructions and 1 masseter flap reconstruction. 19 patients received post operative radiotherapy and 5 post operative chemoradiation. Post treatment, 7 patients complained difficulty in swallowing, 8 patients complained difficulty in opening mouth, 3 patients complained difficulty to push the bolus and 1 patient complained stasis of food in oral cavity and oropharynx.

Functional endoscopic evaluation of swallowing in all the patients done at 6 weeks post treatment showed that, 17 patients ( 70.8%) required repeated second and third swallow to clear the bolus, and were started on swallowing exercises and diet modifications specific to each patient. A repeat assessment at 12 weeks showed only 5 patients had persistent repeated swallow. 17 patients ( 70.8%) had severe edema and ulceration, were started on anti edema medications and improved over a period of 6 weeks. 14 patients (58.3% ) had dryness of mucosa which persisted in 4 patients when a repeat assessment was done at 12 weeks.

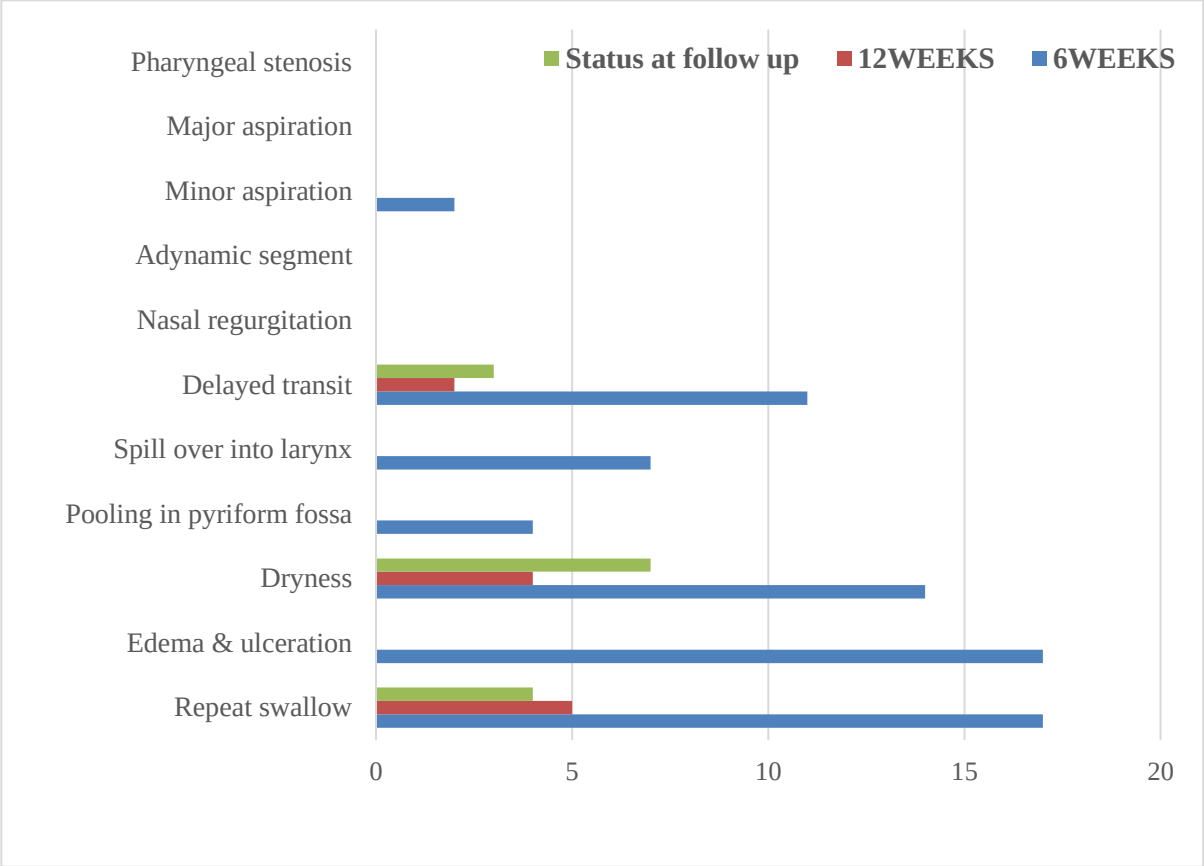
4 patients had pooling in pyriform fossa and improved over a period of 6 weeks when started upon swallowing therapy and diet modifications. 7 patients had spill over into larynx, were started with swallowing exercises ( range of motion exercises for lip, tongue and jaw, head tilt and back with suprglottic swallow) and diet modifications and patients improved over a period of 6 weeks and none had persistent problem. 11 patients ( 45.8% ) had delayed transit and 2 patients persisted with the problem when evaluated at 12 weeks. 2 patients (8.3% ) had minor aspiration who were continued with Ryles tube feeds, started with swallowing therapy ( range of motion exercises for lip, tongue and jaw, head tilt and back with supraglottic swallow) and diet modifications and patients improved over a period of 6 weeks and none had persistent problem.

At the time of last follow up, 4 patients had repeated swallow, 7 patients had persistent dryness and 3 patients had delayed transit of food in oral cavity and oropharynx.

**Figure 18: Postoperative axial flap reconstruction (PMMC) giving rise to denervated adynamic segment- delayed transit, stasis of food, inadequate initiation of swallow.**

| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| Repeat swallow | 17 | 70.8% | 5 | 20.8% | 4 | 16.7% |
| Edema& ulceration | 17 | 70.8% | 0 | .0% | 0 | .0% |
| Dryness | 14 | 58.3% | 4 | 16.7% | 7 | 29.2% |
| Pooling in pyriform fossa | 4 | 16.7% | 0 | .0% | 0 | .0% |
| Spill over into larynx | 7 | 29.2% | 0 | .0% | 0 | .0% |
| Delayed transit | 11 | 45.8% | 2 | 8.3% | 3 | 12.5% |
| Nasal regurgitation | 0 | .0% | 0 | .0% | 0 | .0% |
| Adynamic segment | 0 | .0% | 0 | .0% | 0 | .0% |
| Minor aspiration | 2 | 8.3% | 0 | .0% | 0 | .0% |
| Major aspiration | 0 | .0% | 0 | .0% | 0 | .0% |
| Pharyngeal stenosis | 0 | .0% | 0 | .0% | 0 | .0% |

Table 6:- Distribution of subjects who underwent composite resection according to the swallowing problems.




Graph 6:- Distribution of subjects who underwent **COMPOSITE RESECTION** according to the swallowing problems.

## TOTAL LARYNGECTOMY

In our study, 16 patients ( 21.9%) underwent total laryngectomy. Among these patients, 7 patients received post operative radiotherapy and 9 patients received post operative chemoradiation. Post treatment, 5 patients complained difficulty in swallowing and 8 patient complained stasis of food in oral cavity and oropharynx.

Functional endoscopic evaluation of swallowing done at 6 weeks post treatment showed that, 12 patients ( 75.0%) required repeated second and third swallow to clear the bolus, and were started on swallowing therapy and diet modifications specific to each patient. A repeat assessment at 12 weeks showed only 4 patients had persistent repeated swallow. 8 patients ( 50.0%) had severe edema and

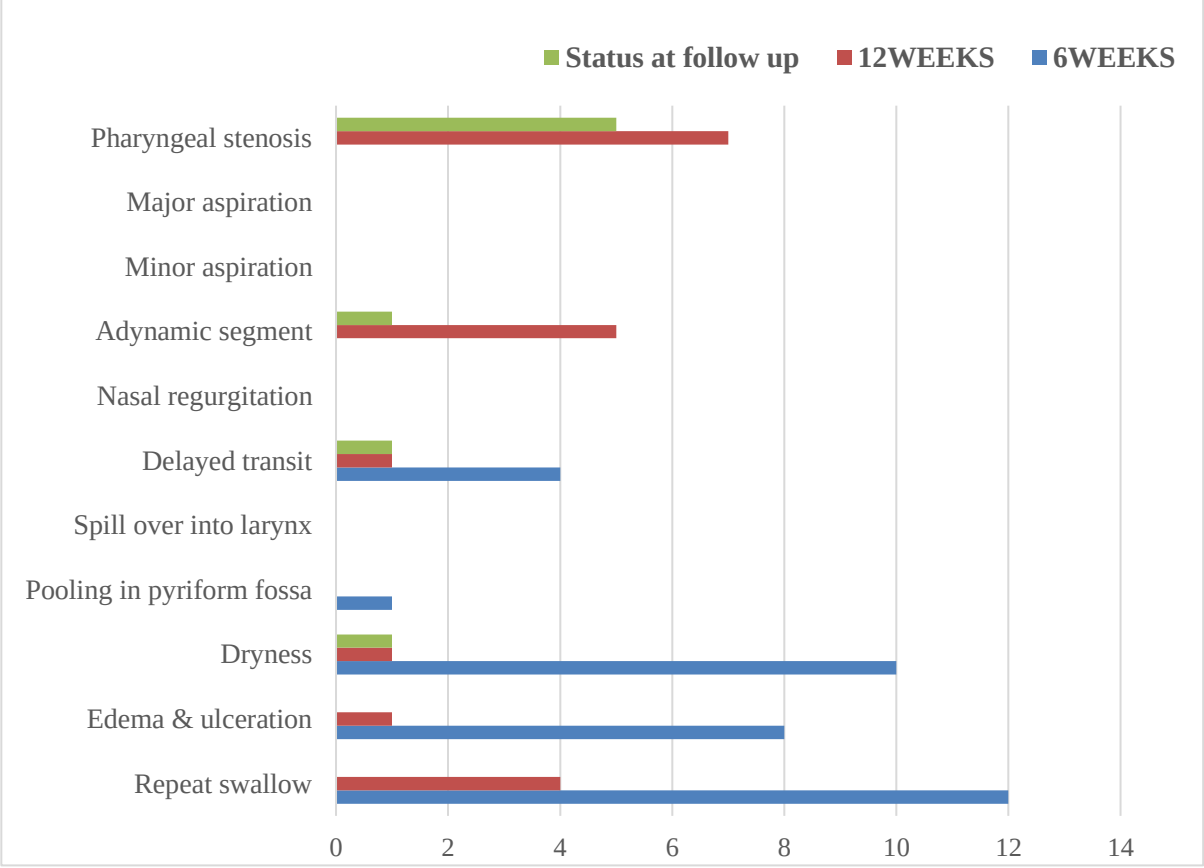
ulceration, were started on anti edema medications and 1 patient had persistent edema in a repeat assessment at 12 weeks. 10 patients (62.5% ) had dryness of mucosa which persisted in 1 patient. 1 patient (6.3% ) had pooling in pyriform fossa and improved over a period of 6 weeks when given swallowing therapy and diet modifications. 4 patients ( 25% ) had delayed transit and 1 patient persisted with the problem at 12 weeks later. 7 patients (43.8% ) had pharyngeal stenosis and 2 patients who had severe stenosis underwent serial dilatations.

At the time of last follow up, 1 patient had persistent dryness and delayed transit of food in oral cavity and oropharynx. 5 patients were found to have developed pharyngeal stenosis, who will be planned for dilatation.

**Figure 19: a) Post operative image of Total Laryngectomy and b) Tracheo oesophageal puncture prosthesis.**

| TOTAL LARYNGECTOMY | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| Repeat swallow | 12 | 75.0% | 4 | 25.0% | 0 | .0% |
| Edema& ulceration | 8 | 50.0% | 1 | 6.3% | 0 | .0% |
| Dryness | 10 | 62.5% | 1 | 6.3% | 1 | 6.3% |
| Pooling in pyriform fossa | 1 | 6.3% | 0 | .0% | 0 | .0% |
| Spill over into larynx | 0 | .0% | 0 | .0% | 0 | .0% |
| Delayed transit | 4 | 25.0% | 1 | 6.3% | 1 | 6.3% |
| Nasal regurgitation | 0 | .0% | 0 | .0% | 0 | .0% |
| Adynamic segment | 0 | .0% | 5 | 31.3% | 1 | 6.3% |
| Minor aspiration | 0 | .0% | 0 | .0% | 0 | .0% |
| Major aspiration | 0 | .0% | 0 | .0% | 0 | .0% |
| Pharyngeal stenosis | 0 | 0% | 7 | 43.8% | 5 | 31.3% |

Table 7:- Distribution of subjects who underwent **TOTAL LARYNGECTOMY** according to the swallowing problems



Graph 7:- Distribution of subjects who underwent **TOTAL LARYNGECTOMY** according to the swallowing problems

## TOTAL/INFRASTRUCTURE MAXILLECTOMY

In our study, 8 patients ( 11%) underwent maxillectomy and 6 patients received post operative radiotherapy and 2 patients received post operative chemoradiation. Post treatment, 4 patients complained nasal regurgitation and 3 patients complained inability to push the bolus in oral cavity and oropharynx.

Functional endoscopic evaluation of swallowing at 6 weeks post treatment showed that, 5 patients ( 62.5%) required repeated second and third swallow to clear the bolus, and were started on swallowing therapy and diet modifications specific to each patient. A repeat assessment at 12 weeks showed 2 patients had persistent repeated swallow. 6 patients ( 75%) had severe edema and ulceration, were started on anti edema medications and persisted in 1 patient. 4 patients (50% ) had dryness of mucosa which persisted in 1 patient. 1 patient (12.5% ) had pooling in pyriform fossa and improved after swallowing therapy and diet modifications. 7 patients ( 87.5% ) had delayed transit and 2 patients persisted with the problem seen in the evaluation at 12 weeks. 4 patients ( 50%) had nasal regurgitation and 2 patients had persistent problem when a repeat evaluation was done after 6 weeks.

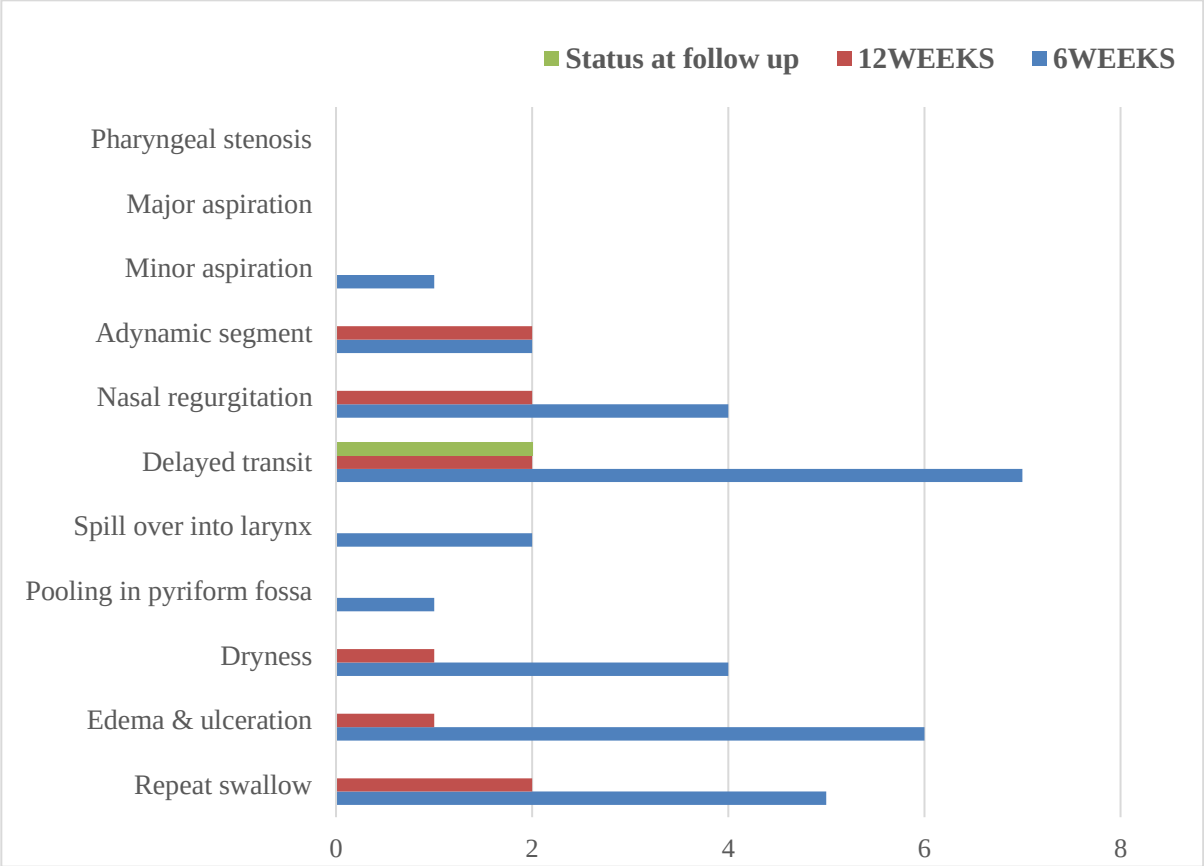
2 patients (25% ) had adynamic segment involving soft palate. 1 patient ( 12.5%) had minor aspiration and was started with Ryles tube feeds and swallowing therapy ( head back, head tilt and effortfull swallow). Patient improved over a period of 6 weeks.

All patients were given obturator and 4 patients were started on chin tuck method of swallowing exercise and 4 patients on head back, head tilt and effortfull swallow exercises with diet modifications specific to each patient. At the time of last follow up, 2 patient had persistent delayed transit of food in oral cavity and oropharynx.

**Figure 20: Pre operative and intraoperative image of Infrastructure Maxillectomy.**

| TOTAL/INFRASTRUCTURE MAXILLECTOMY | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| Repeat swallow | 5 | 62.5% | 2 | 25.0% | 0 | .0% |
| Edema& ulceration | 6 | 75.0% | 1 | 12.5% | 0 | .0% |
| Dryness | 4 | 50.0% | 1 | 12.5% | 0 | .0% |
| Pooling in pyriform fossa | 1 | 12.5% | 0 | .0% | 0 | .0% |
| Spill over into larynx | 2 | 25.0% | 0 | .0% | 0 | .0% |
| Delayed transit | 7 | 87.5% | 2 | 25.0% | 2 | 25.0% |
| Nasal regurgitation | 4 | 50.0% | 2 | 25.0% | 0 | .0% |
| Adynamic segment | 2 | 25.0% | 2 | 25.0% | 0 | .0% |
| Minor aspiration | 1 | 12.5% | 0 | .0% | 0 | .0% |
| Major aspiration | 0 | .0% | 0 | .0% | 0 | .0% |
| Pharyngeal stenosis | 0 | .0% | 0 | .0% | 0 | .0% |

Table 8:- Distribution of subjects who underwent **MAXILLECTOMY** according to the swallowing problems




Graph 8:- Distribution of subjects who underwent **MAXILLECTOMY** according to the swallowing problems.

## CONCURRENT CHEMORADIATION

In our study, 11 patients ( 15.1%) were treated with concurrent chemoradiation for carcinoma pyriform fossa ( 3 patients staged T3), carcinoma glottis ( 1 patient staged T3 ), carcinoma supraglottis ( 3 patients staged T3 ) and carcinoma oropharynx ( staged T3).

Post treatment, 7 patients ( 3- carcinoma pyriform fossa, 2 carcinoma glottis, 1 carcinoma oropharynx and 1 carcinoma glottis) complained difficulty in swallowing, 1 patient had symptoms of aspiration, 1 patient complained difficulty to push the bolus and 2 patients complained stasis of food in oral cavity and oropharynx.

Functional endoscopic evaluation of swallowing at 6 weeks post treatment showed, 8 patients (72.7%) required repeated second and third swallow to clear the bolus, and were started on swallowing therapy ( head back, head tilt and effortfull swallow) and diet modifications specific to each patient. A repeat assessment at 12 weeks showed only 4 patients (36.4%) had persistent repeated swallow. 9 patients (81.8%) had severe edema and ulceration and improved over a period of 6 weeks. 8 patients (72.7% ) had dryness of mucosa which persisted in 3 patients at 12 weeks. 9 patients (81.8%) had pooling in pyriform fossa and improved over a period of 6 weeks when started upon swallowing therapy (mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow) and diet modifications.

4 patients had (36.4%) spill over into larynx were on swallowing therapy (Mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow) and diet modifications and none had persistent problem. 5 patients ( 45.5% ) had delayed transit and 2 patients persisted with the problem. 3 patients (27.3% ) had minor aspiration who were continued with Ryles tube feeds, started with swallowing therapy (Mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow) and diet modifications and patients improved over a period of 6 weeks.

2 patients had major aspiration (1 carcinoma supraglottis and 1 carcinoma pyriform fossa). Both patients underwent tracheostomy, Ryles tube feedings, started on swallowing therapy (mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow) and antibiotics. This led to prolonged hospitalization and improved over a period of 4 – 6 weeks.

At the time of last follow up, 1 patient had persistent dryness, 2 patients had pooling in pyriform fossa and spill over into larynx, 1 patient had persistent delayed transit of food in oral cavity and oropharynx and 1 patient had fibrotic adynamic segment in hypopharynx.

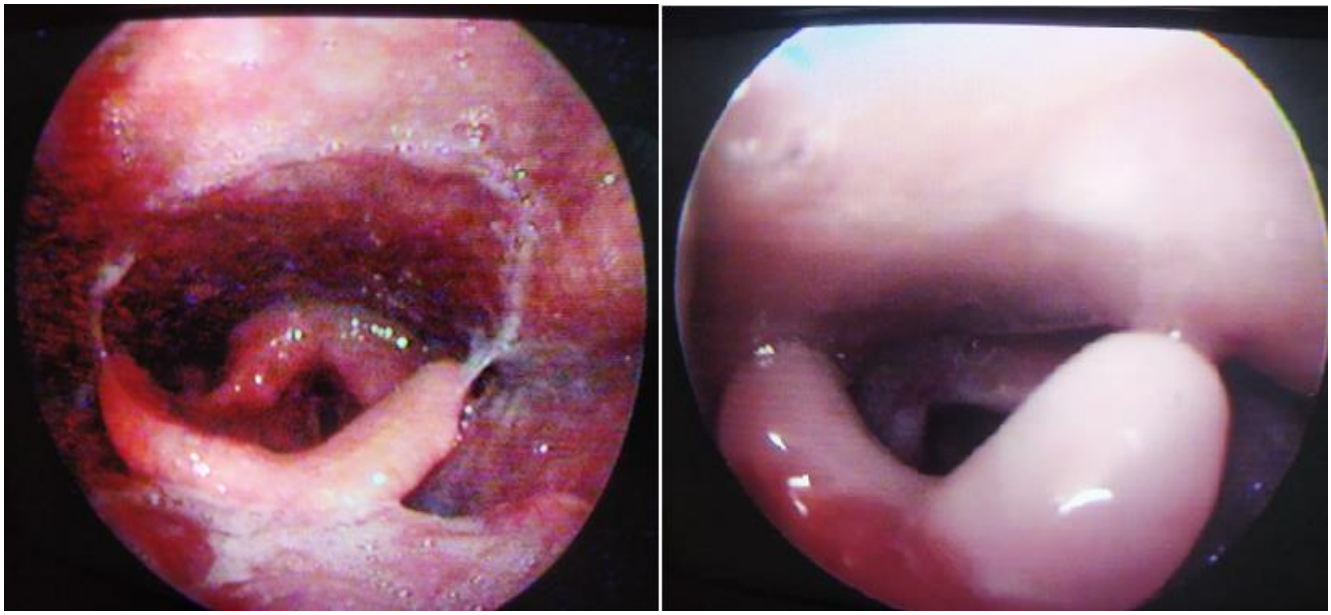
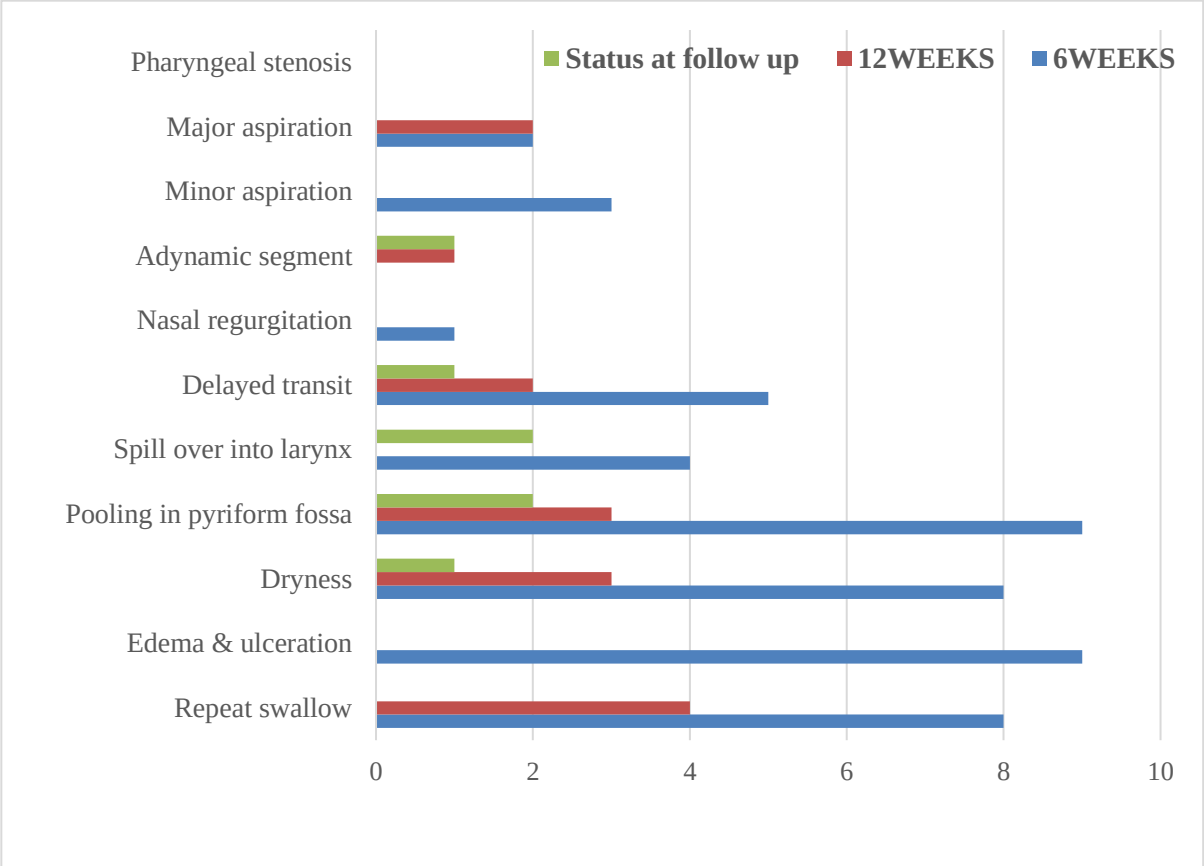


**Figure 21: Edema and Ulceration in patients who underwent CT/RT.**

| CT/RT | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| Repeat swallow | 8 | 72.7% | 4 | 36.4% | 0 | .0% |
| Edema& ulceration | 9 | 81.8% | 0 | .0% | 0 | .0% |
| Dryness | 8 | 72.7% | 3 | 27.3% | 1 | 9.1% |
| Pooling in pyriform fossa | 9 | 81.8% | 3 | 27.3% | 2 | 18.2% |
| Spill over into larynx | 4 | 36.4% | 0 | .0% | 2 | 18.2% |
| Delayed transit | 5 | 45.5% | 2 | 18.2% | 1 | 9.1% |
| Nasal regurgitation | 1 | 9.1% | 0 | .0% | 0 | .0% |
| Adynamic segment | 0 | .0% | 1 | 9.1% | 1 | 9.1% |
| Minor aspiration | 3 | 27.3% | 0 | .0% | 0 | .0% |
| Major aspiration | 2 | 18.2% | 2 | 18.2% | 0 | .0% |

Table 9:- Distribution of subjects who received **CT/RT** according to the swallowing problems




Graph 9:- Distribution of subjects who received **CT/RT** according to the swallowing problems

## HEMIGLOSSECTOMY/ SUBTOTAL GLOSSECTOMY

Among the 14 patients diagnosed with carcinoma tongue, 12 patients underwent subtotal glossectomy with tracheostomy and 2 patients underwent hemiglossectomy. 12 patients received post operative chemoradiation and 2 patients received post op radiotherapy alone. Among the patients who completed the treatment, 4 patients complained fixity of tongue, 3 patients had difficulty in pushing the bolus, 1 patient had difficulty in swallowing.

After functional evaluation of swallowing, both the patients who underwent hemiglossectomy, had edema, ulceration and required repeated second and third swallow to clear the bolus and 1 patient

persisted with the problem when a repeat evaluation was done at 12 weeks. 1 patient had pooling in pyriform fossa and delayed transit of bolus in oral cavity and oropharynx which persisted at 12 weeks. At the time of last follow up, both patients had delayed transit of food material.

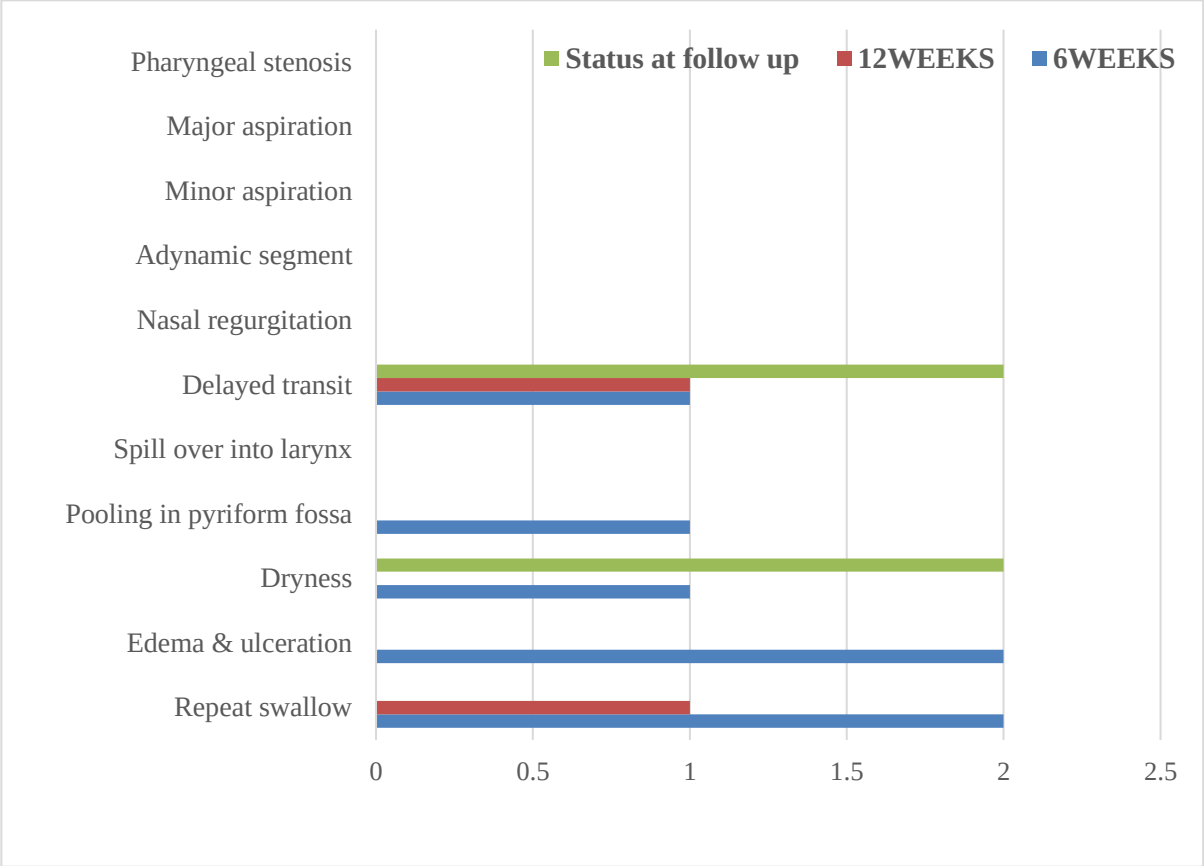
Functional evaluation of swallowing in patients who underwent subtotal glossectomy showed, 9 patients (75%) required second and third swallow to clear the bolus, were started on swallowing therapy ( head back, supraglottic swallow) for 2 – 4 weeks and 5 patients had persistent second swallow in a repeat evaluation at 12 weeks. 9 patients (75%) had edema and ulceration were started on anti edema medications and 3 patients persisted with the problem when evaluated after 6 weeks. 9 patients had pooling of saliva, 6 patients had spill over, 7 patients had delayed transit, all patients were started on head back, supraglottic swallow therapy and diet modification specific to each patient for a period of 2 – 4 weeks. Repeat evaluation at 12 weeks showed 1 patient with spill over, 3 patients with delayed transit and 1 patient had pharyngeal stenosis.

6 patients had symptoms of aspiration and on respiratory system examination and auscultation showed basal crepitations. On endoscopic evaluation of swallowing, 2 patients were found to have major aspiration, were on cuffed tracheostomy tube and Ryles tube feeding, also started on antibiotics and swallowing therapy (head back, supraglottic swallow). This prolonged their hospitalisation by 4- 6 weeks and among them 2 patients had aspiration pneumonia and 1 patient succumbed to it.

**Figure 22: Pre operative and postoperative image of Subtotal glossectomy with radial forearm free flap reconstruction.**

| HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| Repeat swallow | 2 | 100.0% | 1 | 50.0% | 0 | .0% |
| Edema& ulceration | 2 | 100.0% | 0 | .0% | 0 | .0% |
| Dryness | 1 | 50.0% | 0 | .0% | 2 | 100.0% |
| Pooling in pyriform fossa | 1 | 50.0% | 0 | .0% | 0 | .0% |
| Spill over into larynx | 0 | .0% | 0 | .0% | 0 | .0% |
| Delayed transit | 1 | 50.0% | 1 | 50.0% | 2 | 100.0% |
| Nasal regurgitation | 0 | .0% | 0 | .0% | 0 | .0% |
| Adynamic segment | 0 | .0% | 0 | .0% | 0 | .0% |
| Minor aspiration | 0 | .0% | 0 | .0% | 0 | .0% |
| Major aspiration | 0 | .0% | 0 | .0% | 0 | .0% |

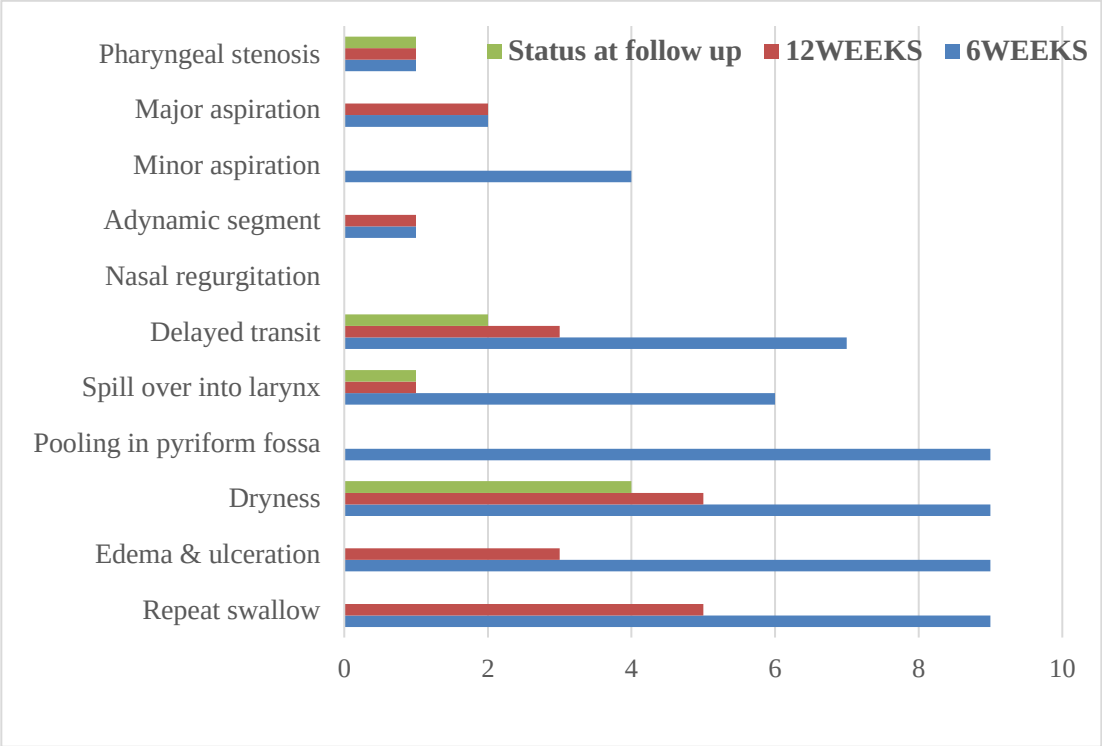
Table 10a:- Distribution of subjects who underwent **HEMIGLOSSECTOMY+ MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION** according to the swallowing problems.




Graph 10a:- Distribution of subjects who underwent **HEMIGLOSSECTOMY+ MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION** according to the swallowing problems.

| **SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY** | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| Repeat swallow | 9 | 75.0% | 5 | 41.7% | 0 | .0% |
| Edema& ulceration | 9 | 75.0% | 3 | 25.0% | 0 | .0% |
| Dryness | 9 | 75.0% | 5 | 41.7% | 4 | 33.3% |
| Pooling in pyriform fossa | 9 | 75.0% | 0 | .0% | 0 | .0% |
| Spill over into larynx | 6 | 50.0% | 1 | 8.3% | 1 | 8.3% |
| Delayed transit | 7 | 58.3% | 3 | 25.0% | 2 | 16.7% |
| Nasal regurgitation | 0 | .0% | 0 | .0% | 0 | .0% |
| Adynamic segment | 1 | 8.3% | 1 | 8.3% | 0 | .0% |
| Minor aspiration | 4 | 33.3% | 0 | .0% | 0 | .0% |
| Major aspiration | 2 | 16.7% | 2 | 16.7% | 0 | .0% |
| Pharyngeal stenosis | 1 | 8.3% | 1 | 8.3% | 1 | 8.3% |

Table 10b:- Distribution of subjects who received **SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY** according to the swallowing problems.



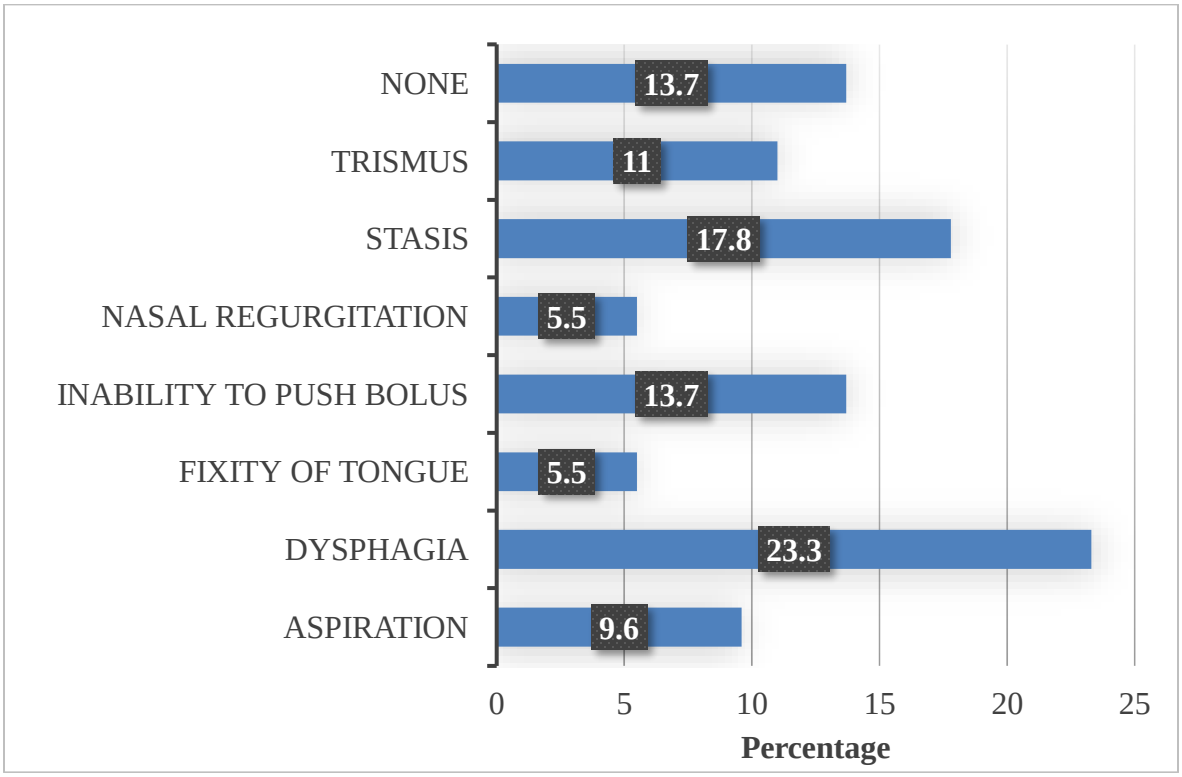

Graph 10b:- Distribution of subjects who received **SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY** according to the swallowing problems.

## POST OP CHIEF COMPLAINTS

Table 11:- Distribution of subjects according to post op chief complaint

| POST OP CHIEF COMPLAINT | Frequency | Percent |
|---|---|---|
| ASPIRATION | 7 | 9.6 |
| DYSPHAGIA | 17 | 23.3 |
| FIXITY OF TONGUE | 4 | 5.5 |
| INABILITY TO PUSH BOLUS | 10 | 13.7 |
| NASAL REGURGITATION | 4 | 5.5 |
| STASIS | 13 | 17.8 |
| TRISMUS | 8 | 11.0 |
| NONE | 10 | 13.7 |

Graph 11:- Graph showing Distribution of subjects according to post op chief complaint



## PROBLEM SPECIFIC ANALYSIS

## REPEATED SWALLOW (n=53):

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 53 patients (72.6%) required repeated second and third swallow to clear bolus from oral cavity and oropharynx.

Among these patients 17 patients (70.8%) had undergone composite resection + MRND+ PMMC/ forehead flap reconstruction and 4 patients persisted with the problem at 12 weeks, 2 patients had undergone hemiglossectomy and 1 patient persisted with the problem at 12 weeks, 9 patients had undergone subtotal glossectomy (75%) and 5 patients persisted with the problem, 12 (75%) were total laryngectomy patients and 4 patients persisted the problem at 12 weeks, 5 (62.5%) were maxillectomy patients and 2 patients persisted with the problem when a repeat evaluation was done at 12 weeks, and 8 patients had received concurrent chemoradiation for carcinoma glottis, pyriform fossa and oropharynx and 4 patients persisted with the problem when a repeat evaluation was done at 12 weeks,.

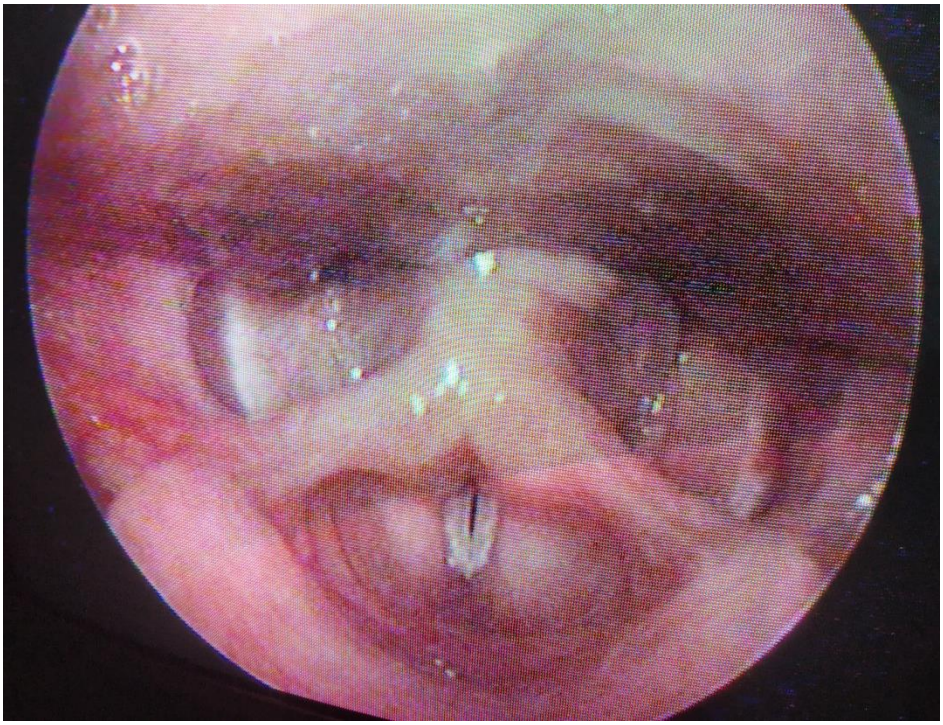
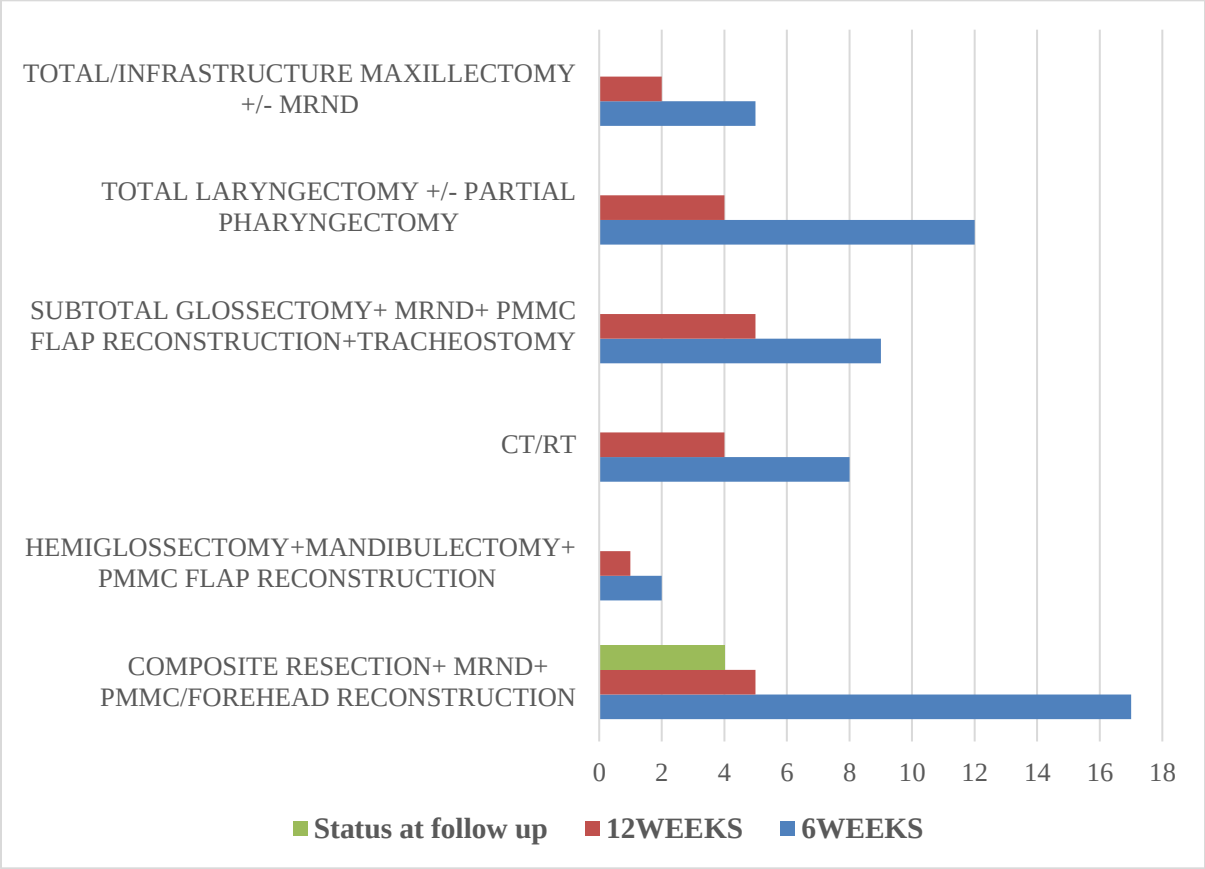


**Figure 23: Glottic closure during swallowing in a competent larynx.**

| REPEAT SWALLOW (n=53) | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 17 | 70.8% | 5 | 20.8% | 4 | 16.7% |
| HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 2 | 100.0% | 1 | 50.0% | 0 | .0% |
| CT/RT | 8 | 72.7% | 4 | 36.4% | 0 | .0% |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 9 | 75.0% | 5 | 41.7% | 0 | .0% |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 12 | 75.0% | 4 | 25.0% | 0 | .0% |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 5 | 62.5% | 2 | 25.0% | 0 | .0% |

Table 12:- table showing Distribution of subjects having **REPEATED SWALLOW** according to the surgery performed.




Graph 12:- figure showing Distribution of subjects having **REPEAT SWALLOW** according to the surgery performed.

## POOLING IN PYRIFORM FOSSA (n=25)

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 25 patients (34.24%) had pooling in pyriform fossa.

Among these patients 4 patients (16.7%) had undergone composite resection with reconstruction, 1 patient had undergone hemiglossectomy, 9 patients had undergone subtotal glossectomy (75.0%) and none had persistent problem, 1 patient (6.3%) had undergone total laryngectomy, 1 patient had undergone maxillectomy and none persisted with the problem when a repeat evaluation was done at 12 weeks. 9 patients (81.8%) had received concurrent chemoradiation for carcinoma glottis, pyriform

fossa and oropharynx and 3 patients persisted with the problem at 12 weeks.

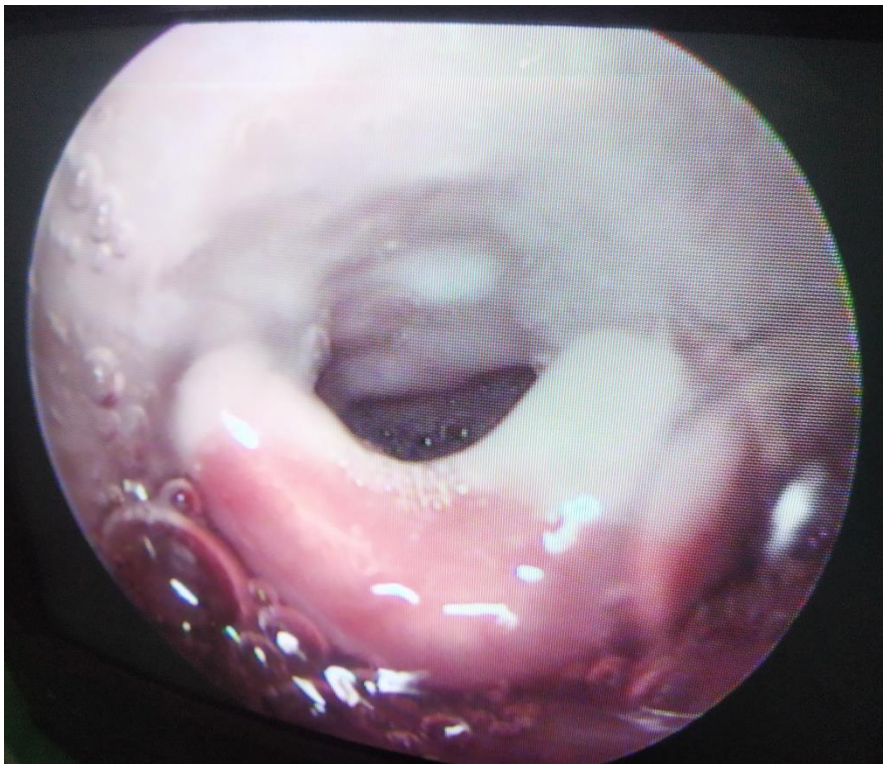
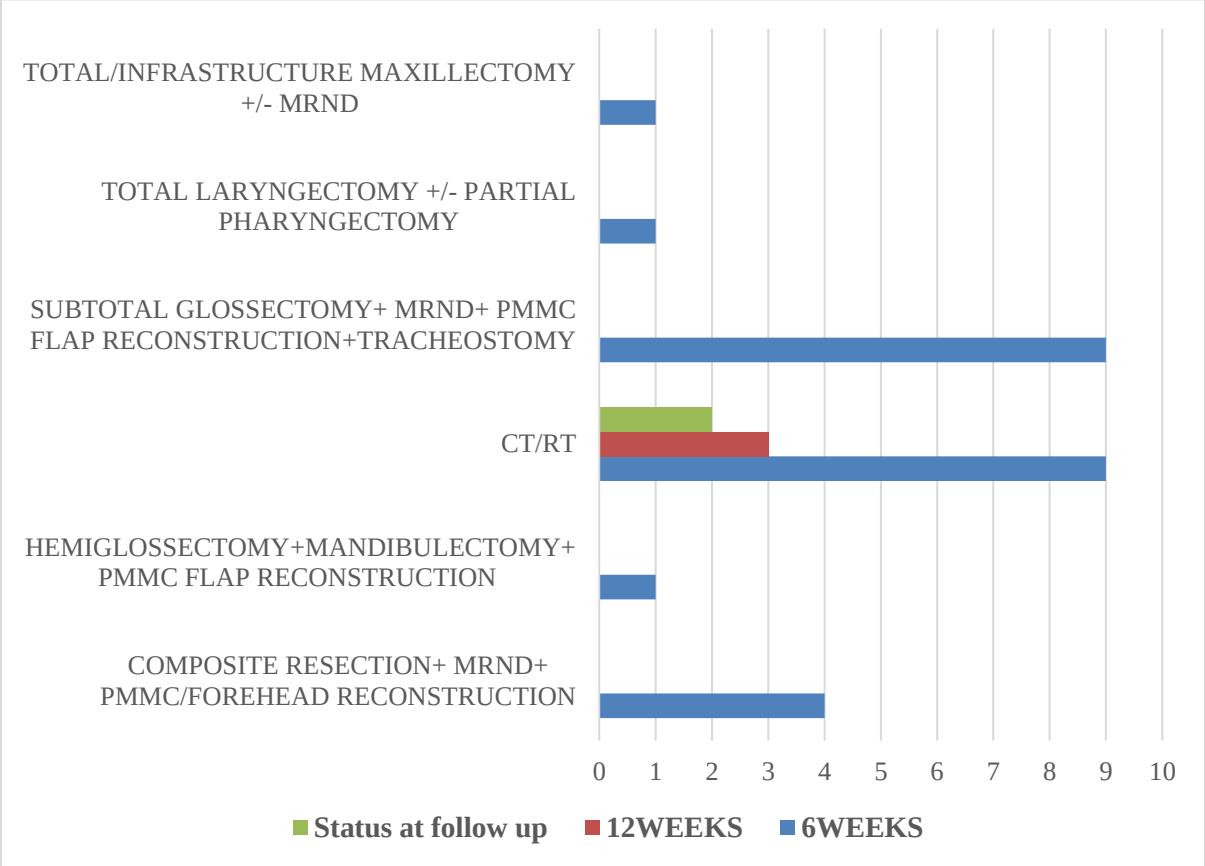


**Figure 24: Pooling of saliva in Pyriform fossa.**

| **POOLING IN PYRIFORM FOSSA (n=25)** | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 4 | 16.7% | 0 | .0% | 0 | .0% |
| HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 1 | 50.0% | 0 | .0% | 0 | .0% |
| CT/RT | 9 | 81.8% | 3 | 27.3% | 2 | 18.2% |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 9 | 75.0% | 0 | .0% | 0 | .0% |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 1 | 6.3% | 0 | .0% | 0 | .0% |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 1 | 12.5% | 0 | .0% | 0 | .0% |

Table 13:- table showing Distribution of subjects having **POOLING IN PYRIFORM FOSSA** according to the surgery performed.




Graph 13:- figure showing Distribution of subjects having **POOLING IN PYRIFORM FOSSA** according to the surgery performed.

## SPILL OVER INTO LARYNX (n=19)

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 19 patients (26%) had spill over into larynx. Among these patients 7 patients (29.2%) had undergone composite resection and reconstruction, 2 patients had undergone maxillectomy and 4 patients received concurrent chemoradiation for carcinoma glottis, pyriform fossa and oropharynx and none persisted

with the problem when a repeat evaluation was done at 12 weeks. 6 patients had undergone subtotal glossectomy and 1 persisted with the problem at 12 weeks,

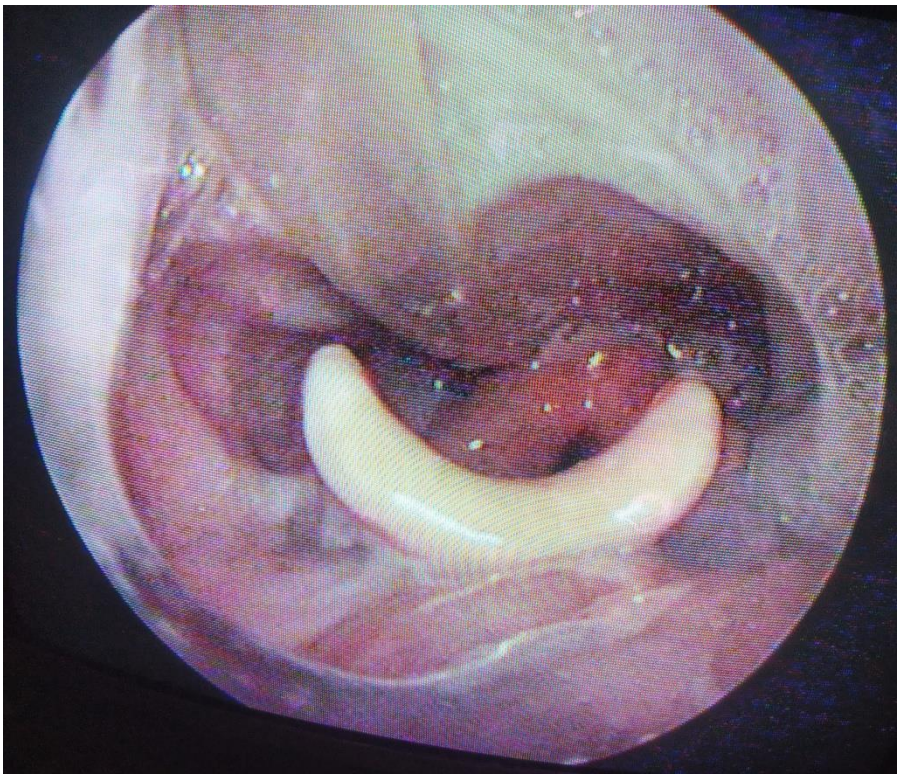
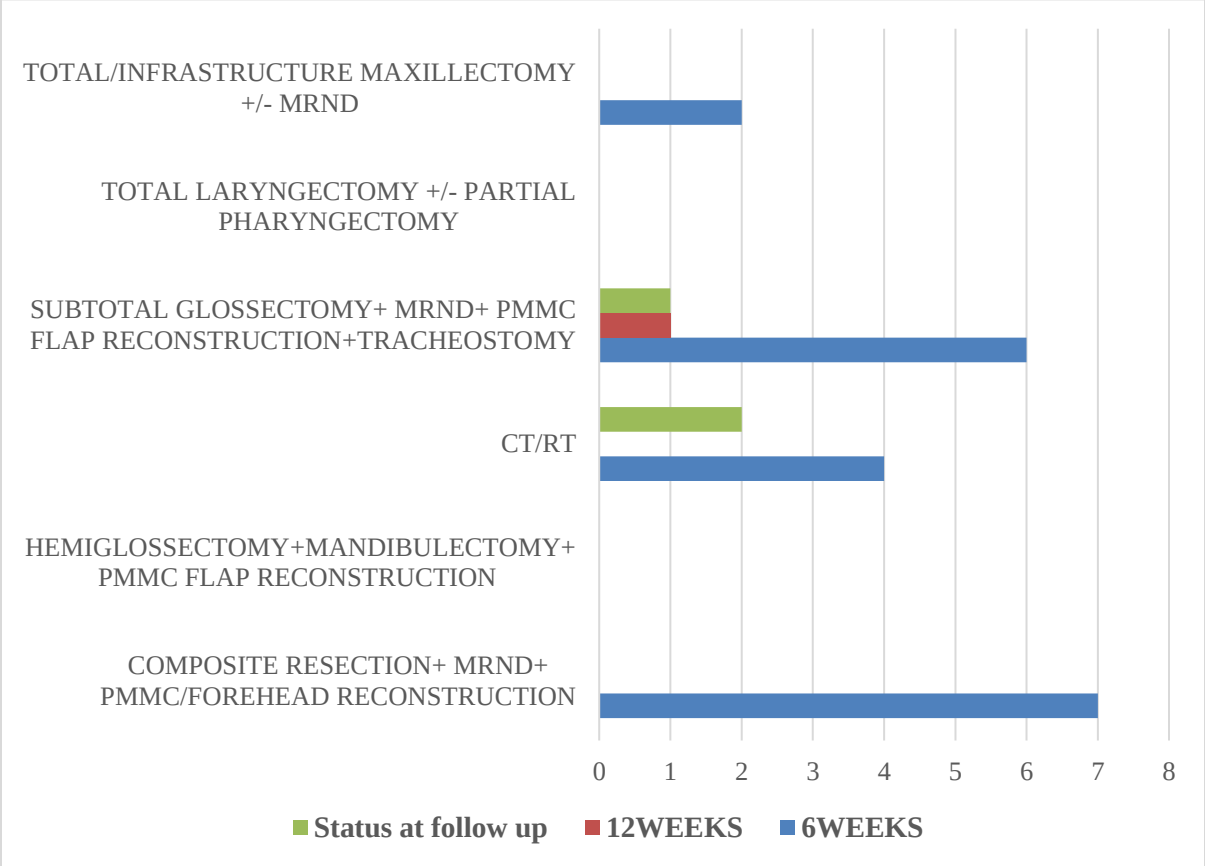


**Figure 25: Spill over into Larynx.**

| **SPILL OVER INTO LARYNX (n=19)** | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 7 | 29.2% | 0 | .0% | 0 | .0% |
| HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 0 | .0% | 0 | .0% | 0 | .0% |
| CT/RT | 4 | 36.4% | 0 | .0% | 2 | 18.2% |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 6 | 50.0% | 1 | 8.3% | 1 | 8.3% |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 0 | .0% | 0 | .0% | 0 | .0% |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 2 | 25.0% | 0 | .0% | 0 | .0% |

Table 14:- table showing Distribution of subjects having **SPILL OVER INTO LARYNX** according to the surgery performed.




Graph 14:- figure showing Distribution of subjects having **SPILL OVER INTO LARYNX** according to the surgery performed.

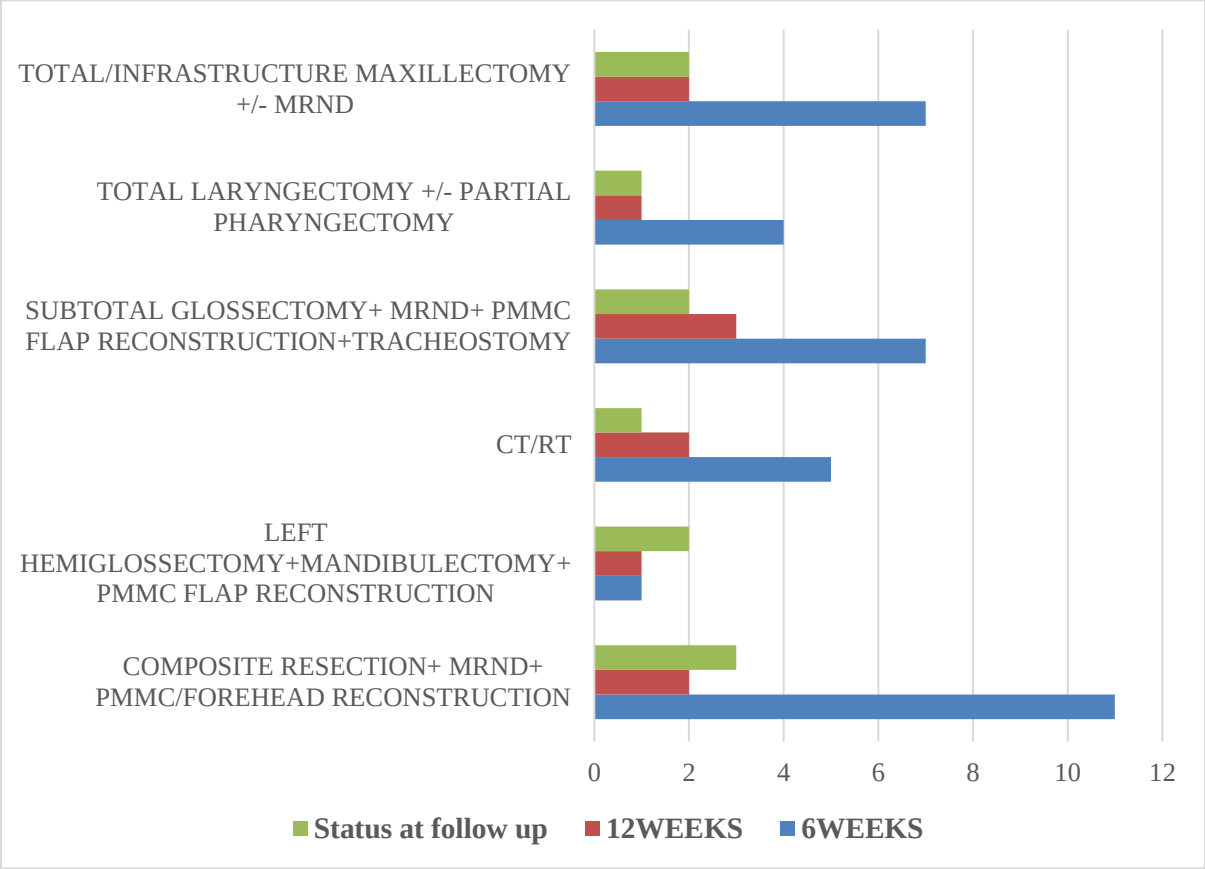
## DELAYED TRANSIT (n=35)

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 35 patients (47.9%) had delayed transit of food bolus in oral cavity and oropharynx. Among these patients 11 patients (45.8%) had undergone composite resection with reconstruction and 2 had persistent problem at 12 weeks, 1 patient with hemiglossectomy and had persistent problem, 7 patients had undergone subtotal glossectomy (58.3%) and 3 persisted with the problem at 12 weeks, 4 patients (25%)

had undergone total laryngectomy and 1 persisted with the problem, 7 patient had undergone maxillectomy (87.5%) and 2 persisted with the problem, and 5 patients received concurrent chemoradiation for carcinoma glottis, supraglottis, pyriform fossa and oropharynx and 2 patients persisted with the problem when a repeat evaluation was done at 12 weeks.

| **DELAYED TRANSIT (n=35)** | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 11 | 45.8% | 2 | 8.3% | 3 | 12.5% |
| LEFT HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 1 | 50.0% | 1 | 50.0% | 2 | 100.0% |
| CT/RT | 5 | 45.5% | 2 | 18.2% | 1 | 9.1% |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 7 | 58.3% | 3 | 25.0% | 2 | 16.7% |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 4 | 25.0% | 1 | 6.3% | 1 | 6.3% |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 7 | 87.5% | 2 | 25.0% | 2 | 25.0% |

Table 15:- table showing Distribution of subjects having **DELAYED TRANSIT** according to the surgery performed.




Graph 15:- Graph showing Distribution of subjects having **DELAYED TRANSIT** according to the surgery performed.

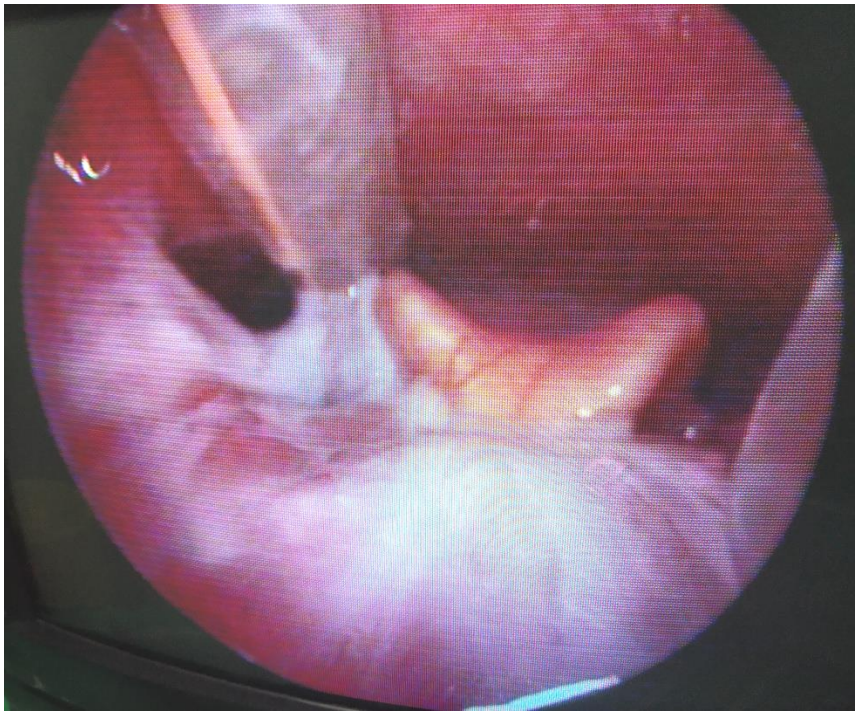
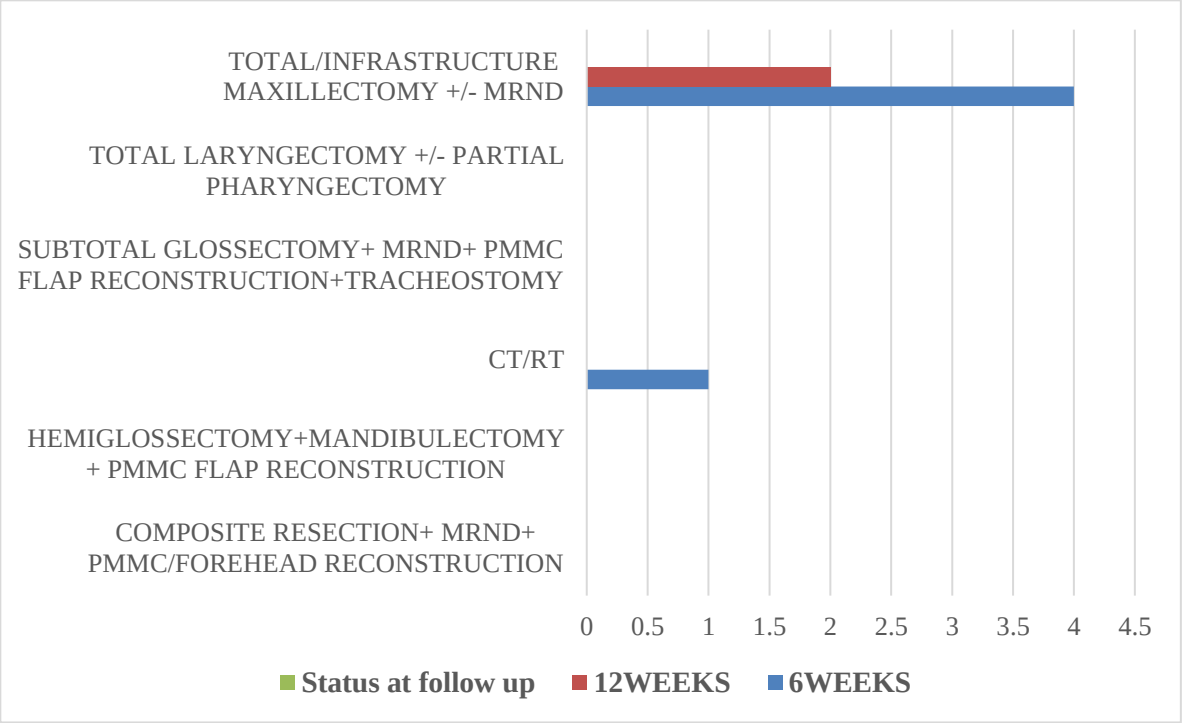


**Figure 26: Delayed transit – Remnants in vallecula**

## NASAL REGURGITATION (n=5)

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 5 patients (6.84%) had nasal regurgitation of food bolus. Among these patients 4 patients had undergone maxillectomy (50.0%) and 2 persisted with the problem when a repeat evaluation was done at 12 weeks, and 1 patient had received concurrent chemoradiation for carcinoma oropharynx and none persisted with the problem when a repeat evaluation was done at 12 weeks.

**Figure 27: Intraoperative image of hard palate resection**




Graph 16:- figure showing Distribution of subjects having **NASAL REGURGITATION** according to the surgery performed.

## MINOR ASPIRATION (n=10)

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 10 patients (13.6%) had minor aspiration. Among these patients 2 patients (8.3%) had undergone composite resection with reconstruction, 4 patients (33.3%) had undergone subtotal glossectomy, 1 patient had undergone maxillectomy, and 3 patients (27.3%) received concurrent chemoradiation for carcinoma glottis, pyriform fossa and oropharynx and none persisted with the problem when a repeat evaluation was done at 12 weeks.

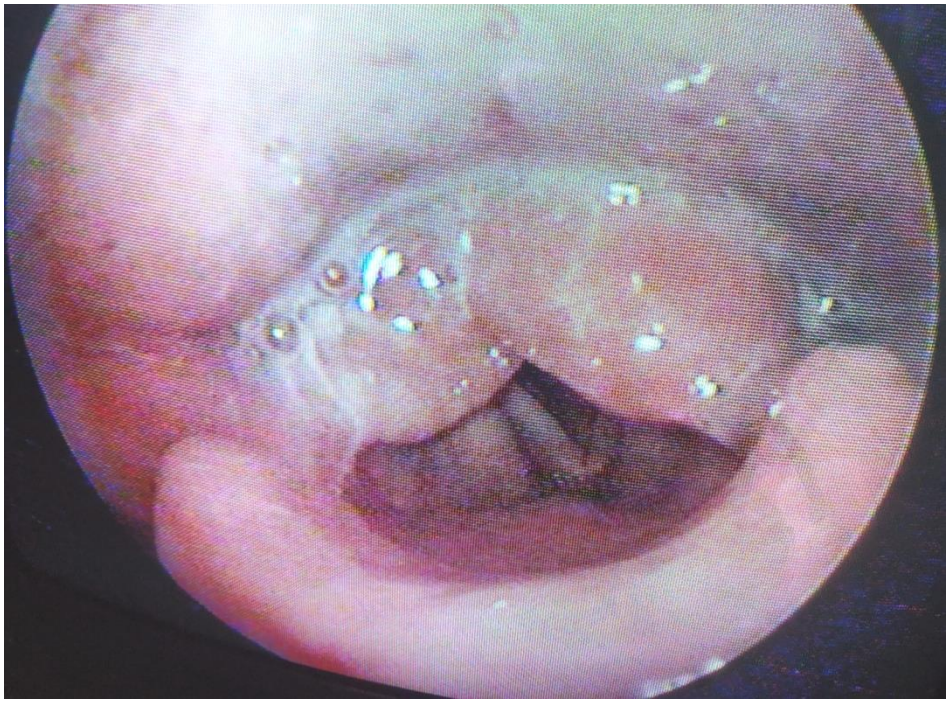
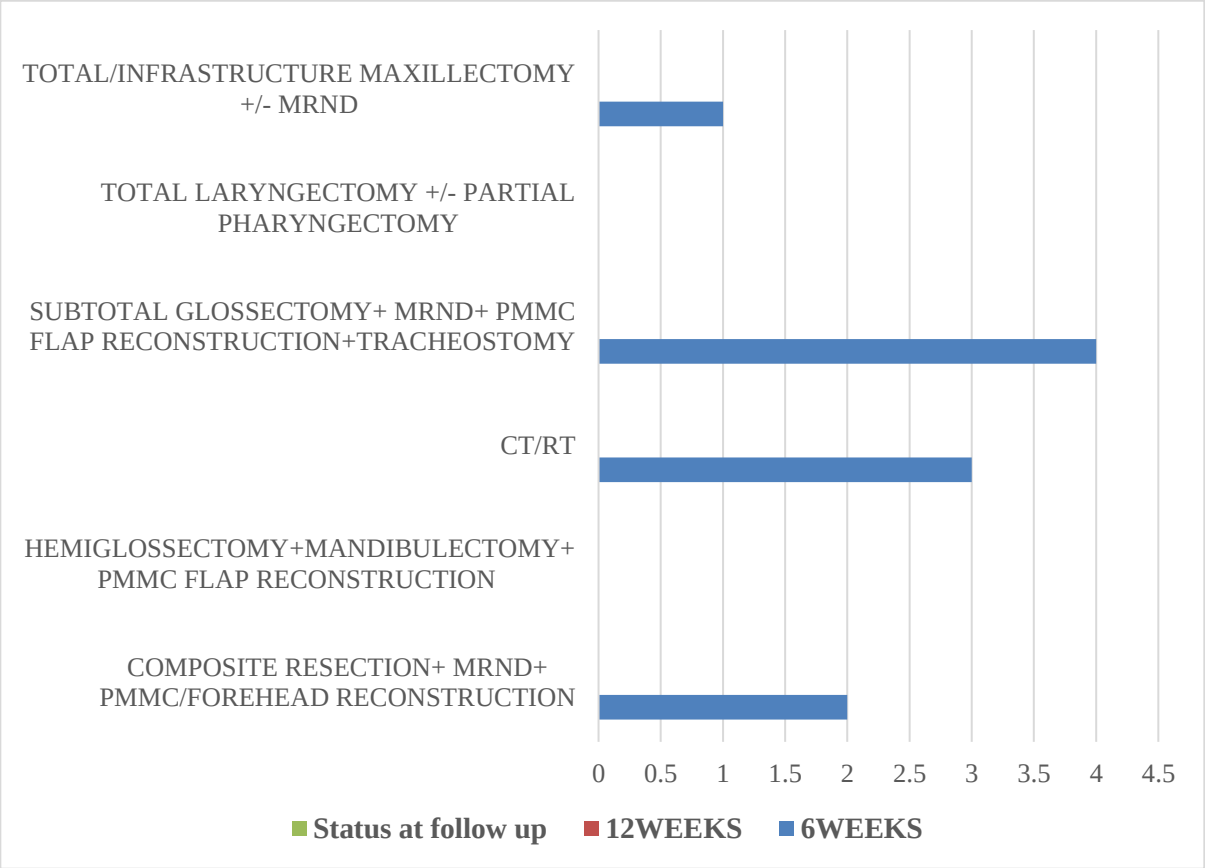


**Figure 28: Minor Aspiration**

| MINOR ASPIRATION (n=10) | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 2 | 8.3% | 0 | .0% | 0 | .0% |
| HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 0 | .0% | 0 | .0% | 0 | .0% |
| CT/RT | 3 | 27.3% | 0 | .0% | 0 | .0% |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 4 | 33.3% | 0 | .0% | 0 | .0% |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 0 | .0% | 0 | .0% | 0 | .0% |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 1 | 12.5% | 0 | .0% | 0 | .0% |

Table 17:- table showing Distribution of subjects having **MINOR ASPIRATION** according to the surgery performed.




Graph 17:- figure showing Distribution of subjects having **MINOR ASPIRATION** according to the surgery performed.

## MAJOR ASPIRATION (n=4)

On functional endoscopic evaluation of swallowing done 6 weeks after completion of treatment, 4 patients (5.4%) had major aspiration. Among these patients, 2 patients (16.7%) had undergone subtotal glossectomy. This prolonged their hospitalisation by 4- 6 weeks and among them 2 patients had aspiration pneumonia and 1 patient succumbed to it. 2 patients had received concurrent chemoradiation for carcinoma supraglottis and pyriform fossa, and both persisted with the problem when a repeat evaluation was done at 12 weeks.

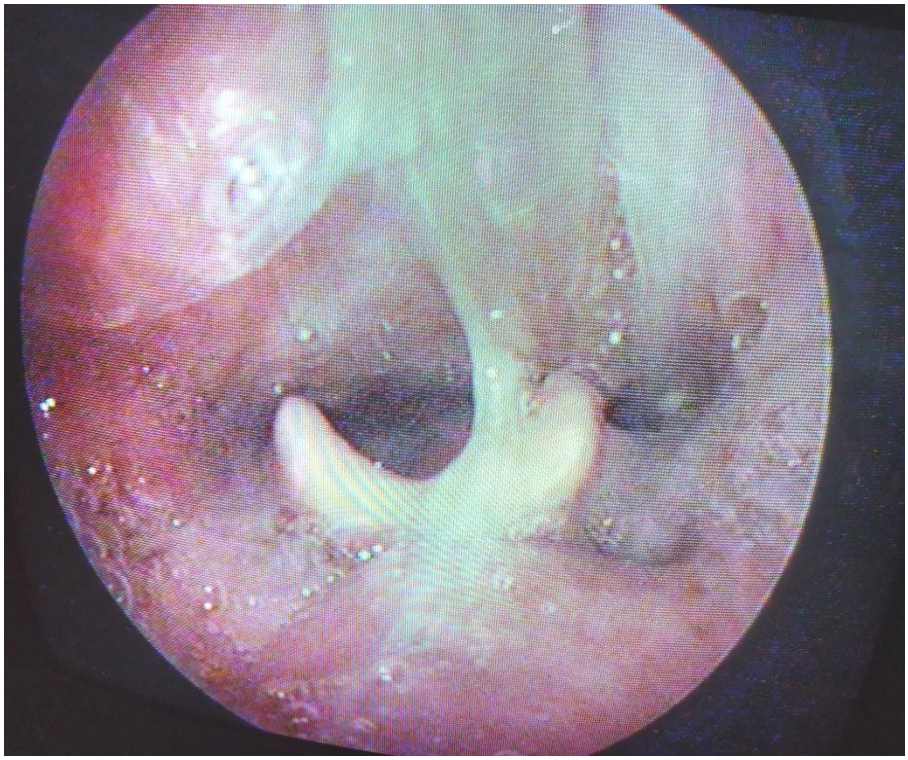
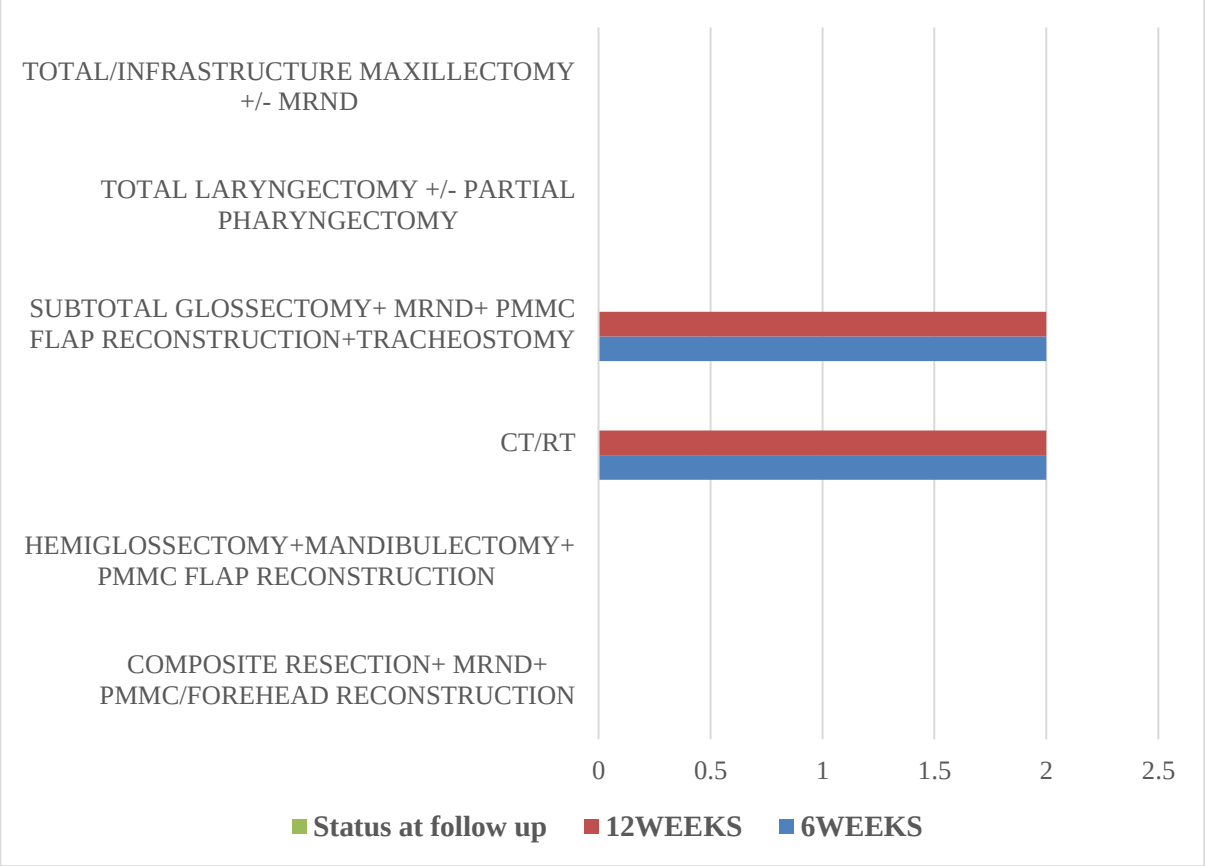


**Figure 29: Major Aspiration.**

| MAJOR ASPIRATION (n=4) | 6WEEKS | | 12WEEKS | | Status at follow up | |
|---|---|---|---|---|---|---|
| | Count | % | Count | % | Count | % |
| COMPOSITE RESECTION+ MRND+ PMMC/FOREHEAD RECONSTRUCTION | 0 | .0% | 0 | .0% | 0 | .0% |
| HEMIGLOSSECTOMY+MANDIBULECTOMY+ PMMC FLAP RECONSTRUCTION | 0 | .0% | 0 | .0% | 0 | .0% |
| CT/RT | 2 | 18.2% | 2 | 18.2% | 0 | .0% |
| SUBTOTAL GLOSSECTOMY+ MRND+ PMMC FLAP RECONSTRUCTION+TRACHEOSTOMY | 2 | 16.7% | 2 | 16.7% | 0 | .0% |
| TOTAL LARYNGECTOMY +/- PARTIAL PHARYNGECTOMY | 0 | .0% | 0 | .0% | 0 | .0% |
| TOTAL/INFRASTRUCTURE MAXILLECTOMY +/- MRND | 0 | .0% | 0 | .0% | 0 | .0% |

Table 18:- table showing Distribution of subjects having **MAJOR ASPIRATION** according to the surgery performed.




Graph 18:- figure showing Distribution of subjects having **MAJOR ASPIRATION** according to the surgery performed.

## PHARYNGEAL STENOSIS (n=8)

On functional endoscopic evaluation of swallowing done at 12 weeks, 8 patients (%) had pharyngeal stenosis. Among these patients 1 patient had undergone subtotal glossectomy and 7 patient (%) had undergone total laryngectomy with or without partial pharyngectomy. 2 patients had severe dysphagia and underwent serial dilatation procedures.

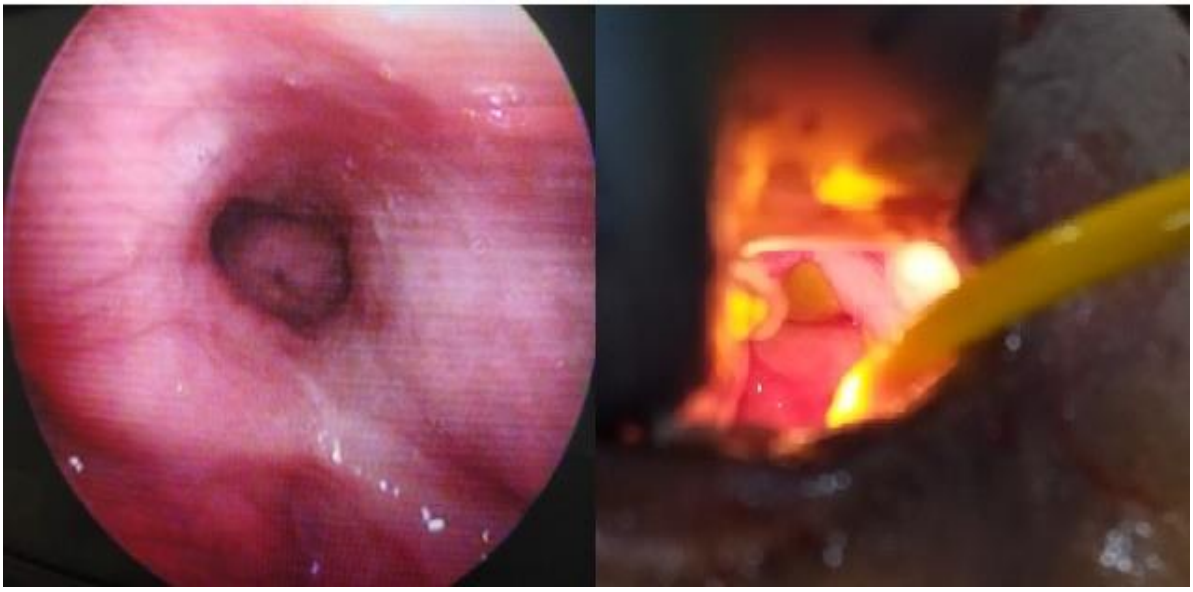


**Figure 30: Pre operative and intra operative image of Pharyngeal stenosis and Balloon dilatation.**

Table 19:- Distribution of subjects according to Outcome of intervention

| | Frequency | Percent |
|---|---|---|
| Continued exercises | 5 | 6.8 |
| Death | 1 | 1.4 |
| Improvement | 63 | 86.30 |
| Planned for dilatation | 4 | 5.5 |
| Total | 73 | 100.0 |

Figure 19:- Graph showing Distribution of subjects according to Outcome of intervention

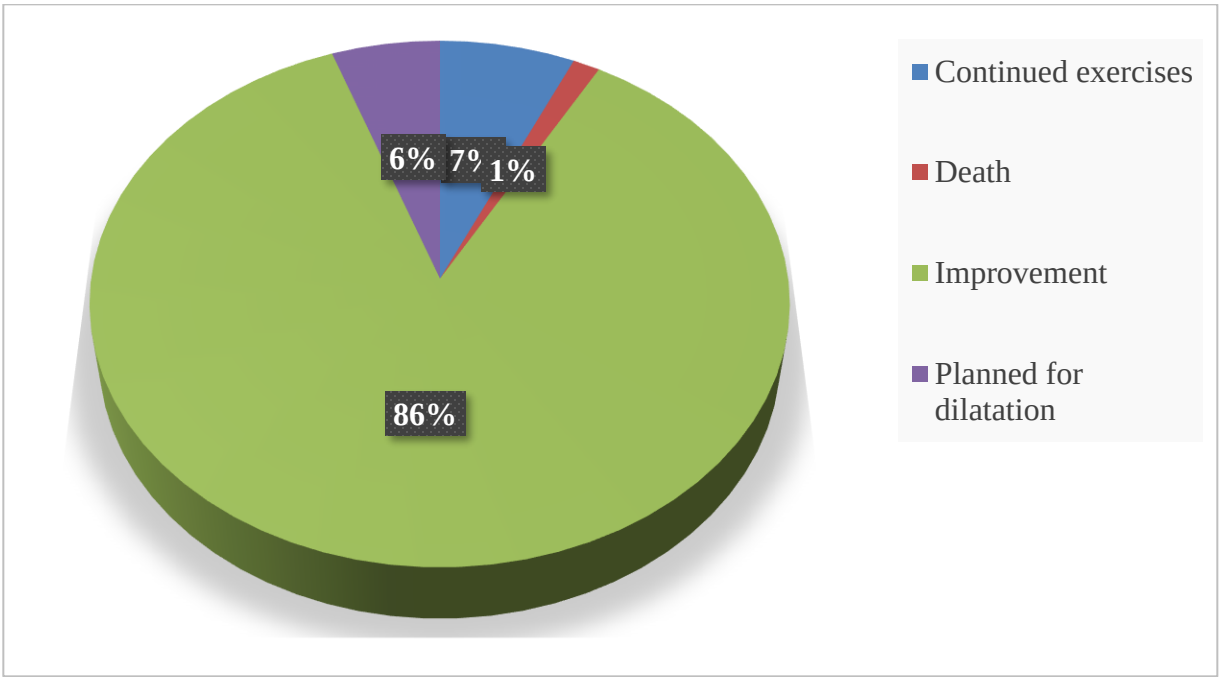



Table 20:- Distribution of subjects according to status at last follow up

| | Frequency | Percent |
|---|---|---|
| 2nd swallow present | 5 | 6.8 |
| Death | 1 | 1.4 |
| Delayed transit | 7 | 9.6 |
| Dryness present | 11 | 15.1 |
| Dryness present+delayed transit | 4 | 5.5 |
| Fibrotic segment | 2 | 2.7 |
| Pharyngeal stenosis | 6 | 8.2 |
| Pneumonia | 1 | 1.4 |
| Pooling present | 2 | 2.7 |
| Spill over into larynx | 3 | 4.1 |
| NIL | 31 | 42.5 |
| Total | 73 | 100.0 |

Graph 20:- Graph showing Distribution of subjects according to status at last follow up

# VI. DISCUSSION

Head and neck malignancy is the most common group of malignancies in India. It constitutes 25-30% of all cancers. There is high prevalence of head and neck cancer in Kolar region (30% of all cancers). 80% of patients present with locally advanced disease and therefore undergo multimodality treatment resulting in structural and functional deficit in the upper aerodigestive tract in the form of restriction of movement, loss of bone and muscle, fibrosis, adynamic segments, denervated areas and stenosis. One or more of the above mentioned factors can lead to compromise in nutrition due to dysphagia and predisposed to complications like cachexia and aspiration. Therefore early and objective identification of the site and cause for dysphagia and supportive care, swallowing therapy or diet modification will help in better recovery of patient.[1,2]

In our study, majority of patients were between 50- 70 years of age. This is similar to other studies which have shown that majority of patients in India present at an advanced stage, resulting in a greater challenge for the treatment. According to studies done in USA, head and neck cancer is 2-3 fold more common among men compared to women in United States. In our study, 44 patients (60.3% ) were females and 29 patients (39.7% ) were males. The high prevalence among female patients is due to the addiction to tobacco quid from early age among women in this region particularly in farmers and manual labourers. According to the Global Adult Tobacco Survey, the consumption rate of tobacco among adults in India is 34.6%. It is higher in males (47.9%) compared to females (20.7%). It is more prevalent in the rural areas (38.4%) where two thirds of the nation's population resides. In our study, 52 patients ( 71.2%) had addiction for tobacco chewing, 6 patients ( 8.2% ) had tobacco and alcohol addiction and 15 patients ( 20.5%) had tobacco and smoking habit. Among head and neck cancers, oral

cancers are the most common and constitute 40-70%. Inability to seek timely medical attention and socioeconomic factors are main factors contributing to approximately 60% of cases presenting in an advanced stage (Stage III, IV).

Similar to other studies, in our study also oral cancer was the most common accounting to 38% and majority of them presented in advanced staged cancer, 43.8% staged T3 and 49.3% staged T4. 10 patients (13.6% ) were diagnosed with carcinoma buccal mucosa out of whom 4 patients were staged T3 and 6 patients were staged T4. 13 patients ( 17.8%) were diagnosed with carcinoma lower gingivobuccal sulcus out of whom 6 patients were staged T3 and 7 patients were staged T4 and 1 patient was diagnosed with carcinoma retromolar trigone staged T3. 17 patients ( 23.2%) were diagnosed with carcinoma larynx out of whom 4 patients were staged T3 and 13 were T4. 6 patients were diagnosed with carcinoma pyriform fossa out of whom 3 were staged T4 and 3 were staged T3. 14 patients (19.2% ) were diagnosed with carcinoma tongue out of whom 5 were staged T2, 3 were T4 and 6 were T3. 8 patients ( 10.8%) were diagnosed with carcinoma maxilla and were staged T4. 4 patients (5.5% ) were diagnosed with carcinoma oropharynx staged T3.[1,2]

The primary treatment modalities for locally advanced Head and neck Cancer include surgery followed by radiotherapy, with a recently increasing role for chemotherapy and molecularly targeted therapies. All treatment modalities may result in acute and long-term swallowing dysfunction. According to various studies in literature, 50-75% of patients treated for head and neck cancer complain difficulty in swallowing.[38]

Dysphagia is a debilitating, depressing, and potentially life-threatening complication in cancer patients that is under-reported. Surgical interventions for Head and neck cancer result in anatomic or neurologic insults with site-specific patterns of dysphagia. Transection of muscles and nerves, loss of sensation, and scar tissue may all affect functioning of tissues vital for

swallowing. The swallowing deficits that occur after surgical resections vary with the site of the tumor, the size of the tumor, the extent of surgical resection, and type of reconstruction. Larger the resection, the more swallowing function will be impaired. However, resection of structures vital to bolus formation, bolus transit, and airway protection such as the tongue, tongue base, and the larynx will have the greatest impact on swallowing function. Resection of the anterior floor of mouth has been found to have a limited impact on swallowing function, except when the geniohyoid or mylohyoid muscles are involved. Surgery disrupting the continuity of the mandibular arch without reconstruction has a profound negative impact on swallowing function. Resection of tumors involving the palate and maxillary sinus often creates defects that need reconstruction to restore oral function.[23]

In our study, 24 patients ( 32.9%) with oral cancer underwent composite resection. Majority of patients (70% ) underwent PMMC flap reconstruction. Functional endoscopic evaluation of swallowing in all the patients done at 6 weeks post treatment showed that, 17 patients ( 70.8%) required repeated swallow to clear the bolus, were started on swallowing therapy and diet modifications specific to each patient and 5 patients had persistent repeat swallow. 7 patients (29.2%) had spill over into larynx and 2 patients (8.3% ) had minor aspiration, were continued with Ryles tube feeds, started with swallowing therapy ( range of motion exercises for lip, tongue and jaw, head tilt and back with supraglottic swallow) and diet modifications and all improved over a period of 6 weeks. 11 patients ( 45.8% ) had delayed transit and 2 patients persisted with the problem after an evaluation 6 weeks later. Studies have mentioned overall incidence of dysphagia after composite resection of oral cancer to be 49%. 34% of patients required repeated swallow to clear the bolus from oral cavity and oropharynx and xerostomia in 18.4%. The main reasons for dysphagia after composite resection for oral cancer include denervation, restricted mobility of tongue and floor of mouth, reduced pliability of the PMMC

flap, poor initiation of swallow due to loss of bulk and restricted mobility and in some cases inability to make a tight seal of the oral commissure. Post operative radiation resulted in mucositis, ulceration and fibrosis thereby increasing the dysphagia and minor aspirations.[34]

Among the 14 patients diagnosed with carcinoma tongue, 12 patients underwent subtotal glossectomy with tracheostomy and 2 patients underwent hemiglossectomy. On functional evaluation of swallowing, both patients who underwent hemiglossectomy required repeated swallow to clear the bolus and 1 patient had pooling in pyriform fossa and delayed transit of bolus and persisted with the problem when a repeat evaluation was done after a period of 6 weeks.

Among who underwent subtotal glossectomy, 9 patients (75.0%) required repeated swallowing due to incomplete clearance from the oral cavity and pooling in pyriform fossa, 6 patients had spill over into larynx (50%), 7 patients had delayed transit (58.3%), all patients were started on head back, supraglottic swallow therapy and diet modification specific to each patient for a period of 2 – 4 weeks. After a repeat evaluation done after 6 weeks, 1 patient persisted with spill over, 3 patients with delayed transit and 1 patient had pharyngeal stenosis. In majority of our glossectomy patients, epiglottic mobility was not significantly impaired. 2 patients were found to have major aspiration, were on cuffed tracheostomy tube and Ryles tube feeding, and required antibiotics and aggressive swallowing therapy ( head back, supraglottic swallow). This prolonged their hospitalization by 4- 6 weeks and among them 2 patients had aspiration pneumonia and 1 patient succumbed to it.

A study done in Spain showed prevalence of dysphagia was higher in patients with total glossectomy due to the vital role of the tongue in the swallowing.[34] Similar to our findings, other studies have also shown that aspiration in patients after such oral structures excision is a major swallowing problem also resulting in aspiration pneumonia.[35] A study done in Poland has

shown that in the early postoperative period, absence of epiglottic movement was accompanied by aspiration and made swallowing incompetent in a majority of cases. A correlation of movement between the epiglottis and the extent of oral tissue excision has been found. Epiglottic mobility was evaluated as normal in 72% of the patients after a partial or subtotal glossectomy and in 25% people who underwent a total glossectomy. Compensatory mechanisms such as additional swallows and prolonged apnea during deglutition, enabled them to avoid aspiration.[36] Decline in swallowing function and quality of life returns to baseline levels by 1 year post-operation and patients who do not improve will require interventions like cuffed tracheostomy tube and swallowing therapies. Compensatory mechanisms depend on motivation, training and nutrition of the patient. Many of these patients who do not develop compensatory mechanisms may require prolonged nasogastric tube or gastrostomy thereby adding to the morbidity.[47,48]

In our study, 16 patients ( 21.9%) underwent total laryngectomy with or without partial pharyngectomy followed by radiotherapy. Functional endoscopic evaluation of swallowing done at 6 weeks post treatment showed that, 12 patients (75%) required repeated swallow to clear the bolus, 1 patient (6.3% ) had pooling in pyriform fossa, 4 patients ( 25% ) had delayed transit and were started on swallowing therapy (Mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow ) and diet modifications specific to each patient. A repeat assessment after a period of 6 weeks showed improvement and only 4 patients had persistent repeat swallow and 1 patient with delayed transit. 7 patients (43.8% ) had pharyngeal stenosis and 2 patients who had severe stenosis underwent serial dilatations.

This pharyngeal stenosis and persistent dysphagia could be due to the fact that majority of our laryngectomized patients had hypopharyngeal or supraglottic cancer in a locally advanced stage and the bulky disease required resection of a large part of the pharynx thereby affecting

mobility and innervations. In various institutions all over our country, it has been reported that supraglottic cancer is more common than glottis and hypopharyngeal cancer has higher prevalence in India compared to western countries.[2]

Similar to our findings, a study done in London showed that, in contrast with other dysphagic populations, the risk of aspiration is low in this group, occurring only in the event of fistualisation or voice prosthesis leakage. Percentage of positive responses for presence of neopharynx residue was 13%.[45] Another study reported that in laryngectomy patients, pharyngeal constrictor contraction is significantly altered by surgical closure of the pharynx post surgery resulting in delayed bolus transit. Radiotherapy induced fibrosis may further contribute to reduced neopharyngeal propulsion and residue.[40] Eighty-three percent of patients achieved at least partial oral feeding at time of hospital discharge and 87.5 % achieved exclusive oral feeding within 2 months postoperatively. The lesser prevalence of dysphagia among laryngectomized patients in western countries could be due to the fact that glottis cancer is more prevalent there and patients present with early disease and are better nourished.[49]

In our study, 8 patients (11%) underwent maxillectomy. Functional endoscopic evaluation of swallowing in all the patients done at 6 weeks post treatment showed that, 5 patients ( 62.5%) required repeated swallow, 1 patient (12.5% ) had pooling in pyriform fossa, 7 patients (87.5% ) had delayed transit and were started on swallowing therapy and diet modifications specific to each patient. A repeat assessment after a period of 6 weeks showed, 2 patients had persistent repeated swallow and 2 had delayed transit. 4 patients ( 50%) had nasal regurgitation and 2 patients had persistent problem when a repeat evaluation was done after 6 weeks.

2 patients (25% ) had adynamic segment involving soft palate. 1 patient ( 12.5%) had minor aspiration and was started with Ryles tube feeds and swallowing exercises ( head back, head tilt

and extra effort for swallow). Patient improved over a period of 6 weeks when a repeat evaluation was done. All patients were given obturator and 4 patients were started on chin tuck method of swallow exercise and 4 patients on head back, head tilt and effortfull swallow exercises with diet modifications specific to each patient.

Studies have shown that there is higher prevalence of pooling of food in the nasopharynx in patients submitted to regional flap reconstruction or primary closure (53.9 %) when compared to those who received microsurgical flaps. Swallowing difficulties were predominantly related to solid foods (54.5 %) and were associated with more extensive palatal resections. Pharyngeal phase of swallowing was satisfactory in most patients but however, nasal reflux and penetration were present in a few patients.[39] In a study done in University of North Carolina showed that, surgical resection of the maxilla or the soft palate results in a communication between the oral and nasal regions that causes difficulty in swallowing, leakage from the nasal cavity, unintelligible speech, and loss of facial support. Most maxillary and palatal defects required prosthetic obturation.[50]

In a study done in Amrita University Kochi, it was found that masticatory performance ( as assessed by counting post mastication food particles in oral rinse) and deglutition (as assessed by videofluoroscopy) was better in patients with maxillectomy in whom free flap reconstruction was done in addition to maxillectomy obturator prosthesis. Mastication was better when posterior teeth were preserved. Occlusal force and mouth-opening distance was inversely proportional to the extent of hard palate resection.[51]

In our study, 11 patients ( 15.1%) were treated with concurrent chemoradiation for carcinoma pyriform fossa ( 3 patients staged T3), carcinoma glottis ( 1 patient staged T3 ), carcinoma supraglottis ( 3 patients staged T3 ) and carcinoma oropharynx ( 4 patients staged T3).

Functional endoscopic evaluation of swallowing in all the patients done at 6 weeks post

treatment showed, 8 patients (72.7%) required repeated swallow to clear the bolus and there was residue in cricopharynx, 9 patients (81.8%) had pooling in pyriform fossa, 4 patients (36.4%) had spill over into larynx, 5 patients ( 45.5% ) had delayed transit and were started on swallowing therapy ( head back, head tilt and extra effort for swallow, Mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow) and diet modifications specific to each patient. A repeat assessment after a period of 6 weeks showed only 4 patients (36.4%) had persistent repeated swallow, 2 patients ( 18.2% ) had delayed transit. 3 patients (27.3% ) had minor aspiration who were continued with Ryles tube feeds, started with swallowing therapy and diet modifications and patients improved over a period of 6 weeks and none had persistent problem.

2 patients had major aspiration, among them 1 was carcinoma supraglottis and 1 patient of carcinoma pyriform fossa. Both patients required long term tracheostomy, Ryles tube feedings, started on aggressive swallowing therapy (Mendelsohn maneuver, shaker exercises and supraglottic and super supra glottic swallow) and antibiotics. This led to prolonged hospitalization and improved over a period of 4 – 6 weeks.

According to a study done in Wayne State University USA, radiation therapy has also shown adverse effects on swallowing ability because of reactive locoregional tissue fibrosis and mucositis, pharyngeal and laryngeal dysmotility, and xerostomia may impair masticatory functioning, bolus manipulation and lubrication, airway protection, and reflex initiation during eating activities. In this study eleven patients (79%) had moderate to severe premature spillage into the valleculae, six patients (43%) suffered from moderate to severe postcricoid retention, six patients (43%) exhibited moderate to severe laryngeal penetration, six patients (43%) moderately to severely aspirated throughout the examination, and five patients (36%) struggled with the need to cough or clear their throats

to varying degrees during swallow attempts.[52] Other studies have also shown that swallow functions and oral morbidities deteriorate significantly following chemoradiation with incomplete recovery at 3 months post treatment.[53]

In our study, the major cause for dysphagia in oral composite resections and PMMC flap reconstruction was loss of floor of mouth tissue, restricted mobility of tongue, poor initiation of swallow, reduced support to floor of mouth muscles, denervation and presence of a groove ( gutter) between lateral wall of oral cavity and tongue. The major cause of dysphagia in tongue resections was loss of bulk, poor initiation of swallow, loss of support and restriction of remnant of tongue movement, denervation, inability to build a tight seal during swallow thereby causing prolonged transit time, retention of food in oral cavity, inadequate masticatory movements, incoordinated swallow and aspiration. The most severe aspiration in our study was following subtotal glossectomies particularly involving oropharyngeal tongue. Aggressive swallowing therapy and compensatory mechanisms along with protection of airway and proper head positioning benefited these patients over a period of time. The major swallowing problems after concurrent chemoradiation to larynx and hypopharynx were incoordinated swallow, restriction of mobility of epiglottis and larynx, edema, ulceration and fibrosis leading to repeated swallow, pooling in hypopharynx and spill over into larynx and aspiration. The major cause of the pharyngeal stenosis and persistent dysphagia in our laryngectomized patients were because they had hypopharyngeal or supraglottic cancer in a locally advanced stage and the bulky disease required resection of a large part of the pharynx thereby affecting mobility and innervations. This resulted in narrow neo-pharynx and denervation and dilatation is the most frequent therapeutic solution. The major cause of dysphagia in maxillectomy for locally advanced tumors patients is due to surgical resection of the maxilla along with part of the soft palate resulting in a communication between the oral and

nasal regions that causes difficulty in swallowing, nasal regurgitation, unintelligible speech, and loss of facial support and most maxillary and palatal defects required prosthetic obturation. On periodic FEES 86.3% of patients improved, 12.3% of patients required further swallowing therapies and diet modifications and 1 death due to aspiration in post operative carcinoma tongue patient.

Therefore early detection by FEES will help to identify the site and severity of swallowing problem. Timely intervention in the form of diet modification, swallowing therapy, airway protection and motivation will help to reduce morbidity and mortality and improve the quality of life in these patients.

## VII. SUMMARY

Head and neck malignancies are most common group of malignancies (30%) in India. There is high prevalence of head and neck cancer in Kolar region. Treatment protocols and prognosis vary widely and are based on the stage of the disease at the time of diagnosis. Most patients present with locally advanced disease requiring aggressive, multimodality treatments resulting in dysphagia. In our region oral cancer is more prevalent among women due to the addiction to the tobacco quid.

Head and neck cancer patients are often malnourished. As a result of disease or aggressive treatment, there can be structural and functional deficit in the upper aerodigestive tract in the form of restriction of movement, loss of bone and muscle, fibrosis, adynamic segments, denervated areas and stenosis. One or more of the above mentioned factors can lead to compromise in nutrition as well as complications like cachexia and aspiration leading to life threatening pneumonia. Therefore early and objective identification of the site and cause for dysphagia and supportive care, swallowing therapy or diet modification will help in better recovery of patient.

In order to evaluate the site and function of the compromised segment of the aerodigestive tract and exact problem, following investigations can be used: Videofluoroscopy, fibreoptic pharyngolaryngoscopy, telescopy, direct pharyngolaryngo oesophagoscopy, barium swallow and dynamic MRI.

Fibreoptic endoscopic evaluation of swallowing (FEES) is a useful tool for identifying and diagnosing the severity of dysphagia and the site of structural or functional deficit. FEES is now considered the investigation of choice in cases of dysphagia. It allows a direct view of

nasolaryngopharyngeal anatomy and physiology, assessment of the swallowing function and any compensatory interventions to facilitate swallowing performance. The equipment is portable and therefore the test may be performed at the bedside particularly in intensive care unit. This will help to provide diet modification, swallowing therapy or intervention to facilitate swallowing in future. This will decrease the morbidity in these patients.

Swallowing process is continuous with overlapping sequence of events that is divided into three distinct phases: oral (preparatory and transit phase), pharyngeal and oesophageal. Swallowing is the most complex coordination of voluntary and involuntary muscle action intermixed with respiration and speaking. Surgical resection alters this system, making dysphagia one of the most common symptoms in patients with head and neck cancer. The actual functional deficits depend on the extent of resection and on the reconstructive procedure. Common dysphagia symptoms include drooling and bolus loss anteriorly, incomplete bolus clearance from oral cavity, difficulty with mastication, numbness, decreased temperature and pain sensation, delayed initiation of the swallow as a result of poor oral control and transport of bolus, and increased pooling of secretions in pharynx because of a weak pharyngeal swallow marked by residue in oral cavity, vallecula, pyriform sinuses, or laryngeal vestibule and aspiration.

In our study, majority of patients were between 50- 70 years of age. 24 patients ( 32.9%) with oral cancer underwent composite resection. Majority of patients (70% ) underwent PMMC flap reconstruction. Evaluation at 6 weeks showed, 17 patients ( 70.8%) required repeated swallow, 7 patients (29.2%) had spill over into larynx, 11 patients ( 45.8% ) had delayed transit and 2 patients (8.3% ) had minor aspiration. Most of the patients recovered by 12 weeks except 5 patients with persistent repeated swallow and 2 with delayed transit. Post operative radiation resulted in mucositis, ulceration and fibrosis thereby increasing the dysphagia and minor

aspirations.

In our study, 12 patients underwent subtotal glossectomy with tracheostomy. Among them, 9 patients (75.0%) required repeated swallowing due to incomplete clearance from the oral cavity and pooling in pyriform fossa, 6 patients had spill over into larynx (50%), 7 patients had delayed transit (58.3%), all patients were started on swallowing therapy and diet modification specific to each patient for a period of 2 – 4 weeks. At 12 weeks evaluation, 1 patient persisted with spill over, 3 patients with delayed transit and 1 patient had pharyngeal stenosis. 2 patients had major aspiration, were on cuffed tracheostomy tube and Ryles tube feeding, and required antibiotics and aggressive swallowing therapy. This prolonged their hospitalisation by 4- 6 weeks and among them 2 patients had aspiration pneumonia and 1 patient succumbed to it. The most severe aspiration in our study was following subtotal glossectomy involving major part of oropharyngeal tongue. Aggressive swallowing therapy and compensatory mechanisms along with protection of airway and proper head positioning benefited these patients over a period of time.

In our study, 16 patients ( 21.9%) underwent total laryngectomy followed by radiotherapy. Evaluation at 6 weeks showed, 12 patients (75%) required repeated swallow to clear the bolus, 1 patient (6.3% ) had pooling in pyriform fossa, 4 patients ( 25% ) had delayed transit and were started on swallowing therapy and diet modifications specific to each patient. A repeat assessment at 12 weeks showed improvement and only 4 patients had persistent repeated swallow and 1 patient with delayed transit. 7 patients (43.8% ) had pharyngeal stenosis and 2 patients who had severe stenosis underwent serial dilatations.

Among the 8 patients (11%) who underwent maxillectomy, evaluation at 6 weeks showed that, 5 patients ( 62.5%) required repeated swallow, 1 patient (12.5% ) had pooling in pyriform fossa, 7 patients ( 87.5% ) had delayed transit and were started on swallowing therapy and diet

modifications specific to each patient. 4 patients ( 50%) had nasal regurgitation and 2 patients had persistent problem when a repeat evaluation was done after 6 weeks. The major cause of dysphagia in maxillectomy for locally advanced tumors patients is due to surgical resection of the maxilla along with part of the soft palate resulting in a communication between the oral and nasal regions that causes difficulty in swallowing, nasal regurgitation.

In our study, 11 patients ( 15.1%) were treated with concurrent chemoradiation majority for carcinoma pyriform fossa and carcinoma supraglottis. Evaluation at 6 weeks showed, 8 patients (72.7%) required repeated swallow to clear the bolus and there was residue in cricopharynx, 9 patients (81.8%) had pooling in pyriform fossa, 4 patients (36.4%) had spill over into larynx, 5 patients ( 45.5% ) had delayed transit and were started on swallowing therapy and diet modifications specific to each patient. A repeat assessment at 12 weeks showed only 4 patients (36.4%) had persistent repeated swallow, 2 patients ( 18.2% ) had delayed transit. 2 patients had major aspiration, required long term tracheostomy, Ryles tube feedings, started on aggressive swallowing therapy and antibiotics. This led to prolonged hospitalization and improved over a period of 4 – 6 weeks. The major swallowing problems after concurrent chemoradiation to larynx and hypopharynx were incoordinated swallow, restriction of mobility of epiglottis and larynx, edema, ulceration and fibrosis leading to repeated swallow, pooling in hypopharynx and spill over into larynx and aspiration.

On periodic FEES 86.3% of patients improved, 12.3% of patients required further swallowing therapies and diet modifications and 1 death due to aspiration in post operative carcinoma tongue patient. Therefore early detection by FEES will help to identify the site and severity of swallowing problem. Timely intervention in the form of diet modification, swallowing therapy, airway protection and motivation will help to reduce morbidity and mortality and improve the quality of life in these patients.

## VIII. CONCLUSION

1. In our country, majority of patients present with locally advanced tumors requiring aggressive multimodality treatment resulting structural and functional deficits in upper aerodigestive tract. These lead to compromise in nutrition due to dysphagia and predisposed to complications like cachexia and aspiration.
2. Functional endoscopic evaluation of swallowing is a useful tool in detecting these structural and functional deficits with minimum discomfort to the patient and can be done as office procedure in OPD.
3. Major cause for dysphagia in oral composite resections and PMMC flap reconstructions was masticatory dysfunction and delayed and inefficient transit of bolus from oral cavity to pharynx. Some of them had minor aspirations.
4. The major morbidity with regard to swallowing after major head and neck surgeries is with subtotal glossectomies who have incoordinated swallow and major aspirations requiring long term airway protection and interventions.
5. Concurrent chemoradiation in laryngeal and hypopharyngeal cancers also have significant morbidity with regard to swallowing as they have high chances of aspiration and incoordinated swallow requiring long term airway protection and interventions.
6. Maxillectomy followed by obturator did not have major dysphagia except when part of the soft palate was resected leading to nasal regurgitation and incoordinated swallow.
7. Timely intervention in the form of diet modification, swallowing therapy, airway protection and motivation will help to reduce morbidity and mortality and improve the quality of life in these patients.

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# ANNEXURES

# STUDY PROFORMA

**PATIENT DETAILS**

**Name Of The Patient:.....Age:.....Sex.....**

**Occupation..... Hosp No.:.....**

**Date of Enrolment in Study:..... Date of Admission……....**

**Date of last follow up……..**

**CHIEF COMPLAINTS: Yes/No**

- **Presence of ulcer/mass in oral cavity**
- **Presence of swelling in neck**
- **Trismus**
- **Dysphagia**
- **Change in voice**
- **Aspiration symptoms**
- **Difficulty in protrusion of tongue**
- **Dyspnoea**

**PERSONAL HISTORY**

- **Habits –**
- **Tobacco chewing :**
- **Smoking :**
- **Alcohol :**

**EXAMINATION**

**GENERAL PHYSICAL EXAMINATION**

- **Built:**

**Vitals :**

- **Pulse:**
- **BP:**
- **RR:**

**Temperature :**

**LOCAL EXAMINATION**

- **Oral Cavity :**
- **Mouth opening: Adequate/ Trismus /Grade of Trismus (if any):**
- **Oro-dental Hygiene: Poor/ Satisfactory Nicotine stains:Y/ N**
- **Site and side: Buccal mucosa**

  **RetromolarTrigone**

  **Gingivo-buccal Sulcus**

  **Tongue**

  **Hard palate**

  **Floor of mouth**

**LYMPH NODES:**

- **Number:**
- **Level/ s involved:**

**INDIRECT LARYNGOSCOPY:**

**Nose :**

**Ear :**

**SYSTEMIC EXAMINATION:**

- Cardio vascular system:
- Respiratory system:
- Per Abdomen:
- Central nervous system:

- **CLINICAL DIAGNOSIS :**

- **STAGING:**

- **CT SCAN/USG NECK:**

**BIOPSY REPORT:**

- **TREATMENT:**

Type of treatment:

Surgery done:

Operative findings:

Chemotherapy: Number of cycles-

Drug-

Dose-

Duration-

Radiotherapy: Fractions-

Duration-

- **Histopathological report:**

- **POST TREATMENT CHIEF COMPLAINTS:**

**FIBREOPTIC LARYNGOPHARYNGOSCOPY FINDINGS:**

**AFTER 6 WEEKS** **AFTER 12 weeks**

- REPEAT SWALLOW
- EDEMA AND ULCERATION
- DRYNESS
- POOLING IN PYRIFORM FOSSA
- SPILL OVER LARYNX-
- DELAYED BOLUS TRANSIT-
- ASPIRATION: MINOR-
- MAJOR-
- NASAL REGURGITATION
- ANY ADYNAMIC SEGMENT –
- PHARYNGEAL STENOSIS

- **HOSPITALISATION:**
- **INTERVENTION:**
- **OUTCOME OF INTERVENTION:**
- **STATUS AT LAST FOLLOW UP :**

**IMPRESSION:**

## INFORMED CONSENT FORM

I have read or have been read to me and understand the purpose of the study, the procedure, **FIBREOPTIC LARYNGOPHARYNGOSCOPY** that will be used for swallowing assessment. The risks and benefits associated with my involvement in the study and the nature of information that will be collected and disclosed during the study have been explained.

I have the opportunity to ask my questions regarding various aspects of the study and my questions are answered to my satisfaction.

I understand that I remain free to withdraw from the study at any time and this will not change my future care.

I, the undersigned agree to participate in this study and authorize the collection and disclosure of my personal information for dissertation.

Caretaker's name:

Signature/Thumb impression: DATE:

# PATIENT INFORMATION SHEET

**STUDY TITLE**: **FUNCTIONAL ENDOSCOPIC EVALUATION OF SWALLOWING IN PATIENTS TREATED FOR HEAD AND NECK MALIGNANCIES**

**STUDY LOCATION**: R L Jalappa Hospital and Research Centre attached to Sri Devaraj Urs Medical College, Tamaka, Kolar.

**AIM:** To perform an endoscopic evaluation of swallowing using a fibreoptic laryngoscope in patients treated for head and neck cancer and to document the structural deficit and the site, nature and severity of problems in swallowing associated with each structural deficit or dysfunction.

**STUDY DETAILS**:

Patients treated for various head and neck malignancies in R.L.Jalappa Hospital is included in this study. Patients with recurrent tumour, history of previous neck dissection, neck contracture, kyphoscoliosis, hypothyroidism and with neurological cause for dysphagia will be excluded from the study.

Patients in this study will have to undergo routine general examination and a fibreoptic endoscopy will be performed on all patients treated for head and neck cancers to assess swallowing function which has advantage of being less costly, no radiation exposure. Procedure may be associated with risk and complication such as bleeding and injury to adjacent structures which are extremely rare.

Please read the following information and discuss with your family members. You can ask any question regarding the study. If you agree to participate in the study we will collect information (as per proforma ) from you or a person responsible for you or both. Relevant history will be taken. This information collected will be used only for dissertation and publication.

All information collected from you will be kept confidential and will not be disclosed to any outsider. Your identity will not be revealed.

This study has been reviewed by the Institutional Ethics Committee and you are free to contact the member of the Institutional Ethics Committee. There is no compulsion to agree to this study. The care you will get will not change if you don't wish to participate. You are required to sign/ provide thumb impression only if you voluntarily agree to participate in this study.

**WHO TO CONTACT**?

For further information

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