"EVALUATION OF USEFULNESS OF SUPRACLAVICULAR FLAPS WITH RESPECT TO FUNCTIONAL AND AESTHETIC OUTCOME IN RECONSTRUCTING HEAD AND NECK DEFECTS"

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MASTER OF SURGERY

OTORHINOLARYNGOLOGY

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Dr. BHADRAGIRI VAGEESH PADIYAR

LIST OF ABBREVIATIONS

ABBREVIATION	
AJCC	American Joint Committee on Cancer
CT	Computerized Tomography
END	Elective Neck Dissection
EJV	External Jugular Vein
FND	Functional Neck Dissection
HPE	Histopathological Examination
MRND	Modified Radical Neck Dissection
OSCC	Oral Squamous Cell Carcinoma
SND	Selective Neck Dissection
SCC	Squamous Cell Carcinoma
SND	Selective Neck Dissection
SOND	Supra Omohyoid Neck Dissection
USG	Ultrasonography

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ABSTRACT

Background

In India 30% of the cancers arise from head and neck region. There has been a significant increase in the prevalence of oral cancers among populations residing in Kolar district due to rampant use of carcinogens and increase in life expectancy. Surgical resection of tumor and neck dissection forms the mainstay of treatment in addition to adjuvant radiotherapy. The resulting anatomical defect, functional loss, cosmetic disfigurement and the accompanying psychosocial effects can be devastating to the patient.

Most patients with oral cancer who present to our Out Patient Department require a wide excision of the tumour along with neck dissection causing conspicuous defects requiring large reconstructions. Following ablative cancer surgery in the head and neck, many defects can be directly closed if they are small and enough tissue is available locally. For large defects, closure of the wound can be achieved through the use of grafts, local flaps, pedicled flaps, free flaps or combination of these techniques. Reconstructive surgery for head and neck defects remains an evolving challenge and plays a crucial role in improving the quality of life by restoring anatomical defect, achieving functional rehabilitation and aesthetic outcome.

Supraclavicular artery flap represents an extremely versatile and useful option for reconstructing defects after major head and neck cancer surgery.

Objectives:

To surgically resect the malignant tumor (staged T2 and above) from the oral cavity and to reconstruct the defect using the supraclavicular flap and to evaluate the functional and aesthetic outcome following reconstruction.

Methods:

Our study includes 25 patients who presented to R.L Jalappa Hospital and Research centre who were diagnosed and confirmed with oral sqaumous cell carcinoma staged T_2 and above. All patients underwent reconstruction using the supraclavicular artery flap and were followed up every month for atleast 6 months during which they were assessed for the functional and aesthetic outcome using a scoring system. The details of the scoring system as mentioned earlier comprised of 7 attributes. Each attribute was given a score of 10, if the patients experienced that attribute while a score of 0 was given if the patient did not experience that particular attribute.

Results:

7 patients had complete necrosis of the flap. One patient had a local recurrence 2 months following surgery and was lost during follow up. Rests of the 17 patients were followed up following surgery and a scoring system was adopted to evaluate the functional and aesthetic outcome of the supraclavicular flap. We observed that 14 patients had an excellent outcome score (58%), 3 patients had a good outcome score (13%), while 7 patients had a poor outcome score (58%).

Conclusion:

We found the supraclavicular flap to be safe, technically simple, sensate, thin, pliable and reliable regional fasciocutaneous flap in reconstructing intra oral defects following resection of oral malignant lesions. We experienced a good aesthetic and functional outcome in patients included in our study. It is an excellent option in patients with multiple comorbodities and when there is a need to decrease overall complexity of the surgical management.

Keywords – External jugular vein, Oral squammous cell carcinoma, Neck dissection, Supraclavicular flap, Transverse cervical artery.

INTRODUCTION

In India, oral malignancies account for 35% of all malignancies and majority of patients present with locally advanced disease. Surgical resection of tumor and neck dissection forms the mainstay of treatment in addition to adjuvant radiotherapy. The resulting anatomical defect, functional loss, cosmetic disfigurement and the accompanying psychosocial effects can be devastating to the patient.

Reconstructive surgery for head and neck defects remains an evolving challenge and plays a crucial role in improving the quality of life by restoring anatomical defect, achieving functional rehabilitation and aesthetic outcome.

For many years, reconstructive surgeons have used pedicled flaps, such as the pectoralis major myocutaneous, trapezius, latissimus dorsi or deltopectoral flaps for closure. The pedicled flaps are easy to harvest and are very reliable. However, they are not ideal as these flaps are often bulky and can lead to significant donor site morbidity from a functional and aesthetic perspective. When used for skin resurfacing, distant tissue provides a poor color match.

Application of free tissue transfer has expanded the options available to the reconstructive surgeon. However free tissue transfer requires specialized

expertise that may not be readily available in all centres, requires a longer operative time, extensive postoperative monitoring and most patients are not good candidates for free tissue transfer because of their medical comorbodities or lack of recipient vessels for anastomosis.

In addition, traditional flaps do not always meet needs of the specific defects. Ultimate goal of reconstructive surgical procedures after tumor resection in head and neck in not limited to cover the defect, but also to recreate anatomical functional units in three dimensions with similar skin color and texture match as the original skin at the recipient site.

Over the past three decades, our knowledge of the skin vascular anatomy and physiology has led to several advancements in flap harvesting techniques. As a result, several surgeons have rediscovered forgotten flaps like the supraclavicular flap after a period of absence from the literature. To our knowledge few studies have been described the use of this flap in literature for head and neck reconstruction after tumor resection. The supraclavicular flap is a useful fasciocutaneous pedicled flap adding to the armamentarium of head and neck reconstructive surgeon in suitable patients.

REVIEW OF LITERATURE

Head and neck cancer is the 5th most common malignancy worldwide. An upward trend is seen in morbidity and mortality rates of squammous cell carcinoma (SCC) of oral cavity in industrialized areas. Oral cancer is the sixth most common cancer worldwide with high prevalence in South Asia. Oral cancers are most prevalent in Kolar and constitute 29.66% of total cancer incidence in Kolar.[1]

Carcinoma is a Greek word meaning a crab. Its latinised form is 'cancer'. Another term for cancer is malignancy from its Latin roots malignus and genus meaning endangering harm. Cancer is a term used to characterize abnormal growth of cells, which may result in the invasion of normal tissue or the spread to organs.

In historical review, buccal mucosa and alveolar malignancies have been dated back to time before Christ; references have been made to such tumours by **Edwin Smith Papyrus** (2300 B.C.) and by **Ekers Papyrus** (1500 B.C.).

Sir Henry T. Batlin, a surgeon from St. Bartholomew's Hospital, London, in 1885 A.D., performed wide excision of head and neck cancers with

mandible and lymphatics of the upper neck. He, along with **Kocher,** emphasized the advantage of excising metastatic neck nodes.

EMBRYOLOGY

The stomatodeum bounded by brain above and pericardial sac below becomes apparent at 4th week of intra-uterine life. The breakdown of buccopharyngeal membrane causes mouth to become continuous with developing pharynx.[2]

Mesodermal condensation in lateral wall and floor of pharynx gives rise to branchial arches which differentiate to produce cartilaginous bar, branchial musculature and branchial arch artery with each arch receiving an afferent and an efferent nerve supply, post and pre-trematic nerve supply.[2]

The mandibular processes arising from lateral aspects of developing head fuse by 6th week in midline and the maxillary processes arising as buds from mandibular processes, grow forwards and meet with lower end of nasal septum and its contralateral side in the midline. Fusion of maxillary processes separates primitive nasal cavity from primitive oral cavity.[2]

Development of Tongue

The anterior (2/3rd) of tongue arises from mandibular arches from paired eminences and tuberculum impar and posterior (1/3rd) part arises from hypobranchial eminence. This grows forward over second arches to become

continuous with anterior part. Sulcus terminalis lies posterior to site of union of the two parts. Foramen caecum is the small median pit in dorsum of tongue.[2]

Mucosal cover of body of tongue arises from 1st arch tissue and its sensory innervations from lingual branch of mandibular division of trigeminal nerve. The 3rd arch nerve – glossopharyngeal nerve provides sensory innervations to posterior 1/3rd of tongue. Some amount of tissue between the above two parts are supplied by 7th nerve. Gustatory function is by Chorda tympani branch of Facial nerve.[2]

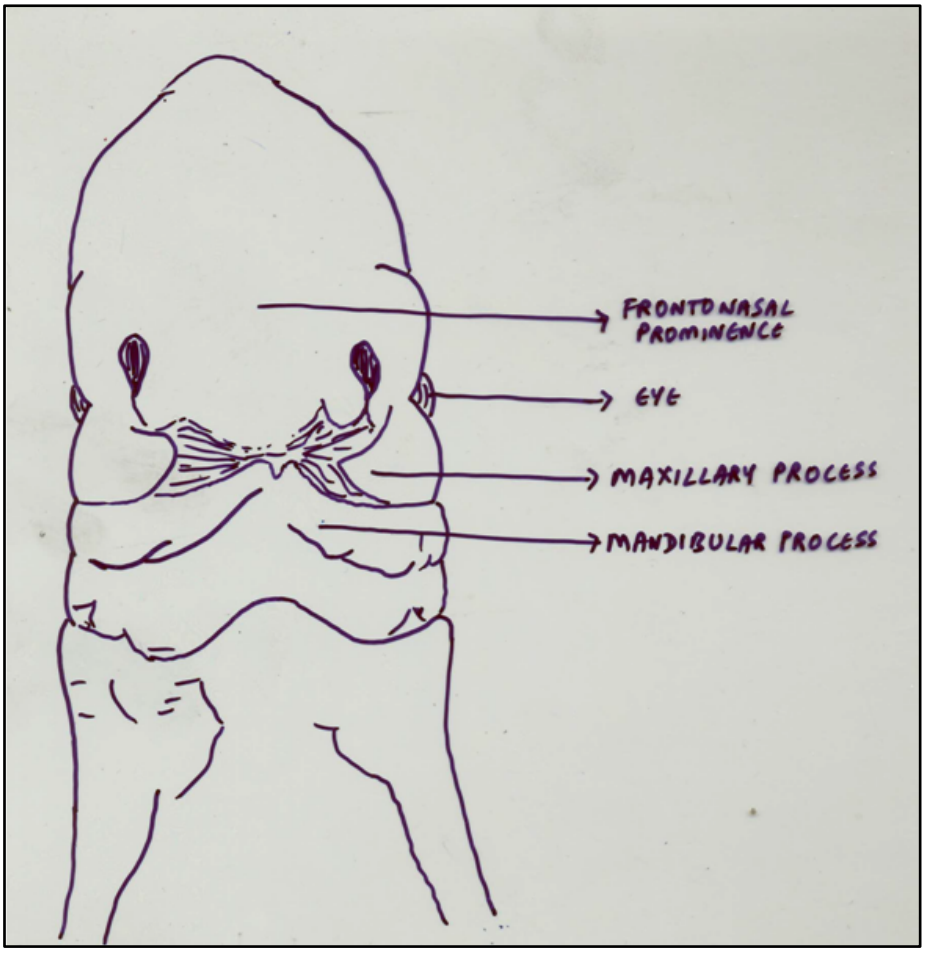

Figure 1: EMBRYOLOGY – 4th WEEK OF INTRA-UTERINE LIFE

ANATOMY OF THE ORAL CAVITY

Figure 2: Anatomy of oral cavity

The various anatomical subsites within the oral cavity as described by the American Joint Committee for Cancer staging [3] are:

- Lip
- Tongue (Anterior 2/3rd)
- Floor of mouth
- Gingiva - Upper alveolus
- Lower alveolus
- Buccal mucosa
- Retromolar trigone
- Hard palate

The oral cavity extends from the skin vermilion junction of the lips to the junction of the hard and soft plate above and to the line of circumvallate papillae below. It is divided into the following specific areas:

Mucosal lip: The lip begins at the junction of the vermilion border with the skin and includes only the vermilion surface that is the portion of the lip that comes into contact with the opposing lip. It is well defined into an upper and lower lip, which joins at the commissures of the mouth.

Buccal mucosa: This includes all the membrane linings of the inner surface of the cheeks and lips from the line of contact of the opposing lips to the line of attachment of mucosa to the alveolar ridge (upper and lower) and to the pterygomandibular raphe.

Lower alveolar ridge: This refers to the mucosa overlying the alveolar process of the mandible, which extends from the line of attachment of mucosa in the buccal gutter to the line of free mucosa of the floor of the mouth. Posteriorly it extends to the ascending ramus of the mandible.

Upper alveolar ridge: This refers to the mucosa overlying the alveolar process of the maxilla, which extends from the line of attachment of mucosa in the upper gingival buccal gutter to the junction of the hard palate. Its posterior margin is the upper end of the pterygopalatine arch.

Retromolar gingiva (Retromolar trigone): This is the area of the attached mucosa overlying the ascending ramus of the mandible from the level of the posterior surface of the last lower molar tooth to the apex superiorly, which is adjacent to the tuberosity of the maxilla.

Floor of the mouth: This is a semilunar space over the mylohyoid and hyoglossus muscles, extending from the inner surface of the lower alveolar ridge to the undersurface of the tongue. Its posterior boundary is the base of the anterior pillar of the tonsil. It is divided into two sides by the fraenulum of the tongue and contains the ostia of the submandibular and sublingual salivary glands.

Hard palate: This is the semilunar area between the upper alveolar ridge and mucous membrane covering the palatine process of the maxillary palatine bones. It extends from the inner surface of the superior alveolar ridge to the posterior edge of the palatine bone.

Anterior two –thirds of the tongue (Oral tongue): This is the freely mobile portion of the tongue that extends anteriorly from the line of circumvallate papillae to the under surface of the tongue at the junction of the floor of the mouth. It is composed of four areas: the tip, the lateral borders, dorsum and the under surface (non-villous ventral surface of the tongue).[3]

THE BLOOD SUPPLY OF THE ORAL CAVITY:

Branches of the external carotid artery provide blood supply to the oral cavity. Lingual arteries provide blood supply to the tongue. Blood supply to the lips and the cheek mucosa is provided through the facial arteries and the internal maxillary and inferior alveolar arteries provide blood supply to the alveolar ridges.[4]

THE NERVE SUPPLY OF THE ORAL CAVITY:

The sensory nerve supply to oral cavity is provided by sensory component of second and third division of trigeminal nerve, through superior and inferior alveolar and lingual nerves. Special senses of taste and secretomotor fibres to the salivary glands are provided through chorda tympani nerve traversing along the lingual nerve. Motor control of the lips and cheek is provided by the facial nerve. The hypoglossal nerve is the motor nerve for the intrinsic and extrinsic muscles of the tongue and for the movements of the medial and lateral pterygoid muscles, and their actions are controlled by the motor components of the second and third divisions of the trigeminal nerve.[4]

LYMPH NODE GROUPS [5]

The lymph nodes may be subdivided into specific anatomic subsites and grouped into seven levels:

Level I:	Submental IA
	Submandibular IB
Level II:	Upper jugular sublevels IIA and IIB (anterior and posterior to the spinal accessory nerve respectively)
Level III:	Mid-jugular
Level IV:	Lower jugular
Level V:	Posterior triangle
Level VI:	Prelaryngeal (Delphian)
	Pretracheal
	Paratracheal
Level VII:	Upper mediastinal

Other groups: Sub-occipital

Retropharyngeal

Parapharyngeal

Buccinator (facial)

Preauricular

Periparotid and intraparotid.

The location of the lymph node levels is as follows:

Level I: Contains the submental and submandibular triangles bounded by the anterior belly and the posterior belly of the digastric muscle, and the hyoid bone inferiorly, and the body of the mandible superiorly.

Level II: Contains the upper jugular lymph nodes and extends from the level of the skull base superiorly to the hyoid bone inferiorly.

Level III: Contains the middle jugular lymph nodes from the hyoid bone superiorly to the level of the lower border of the cricoid cartilage inferiorly.

Level IV: Contains the lower jugular lymph nodes from the level of the cricoid cartilage superiorly to the clavicle inferiorly.

Level V: Contains the lymph nodes in the posterior triangle, which are bounded by the anterior border of the trapezius muscle posteriorly, by the posterior border of the sternocleidomastoid muscle anteriorly, and by the clavicle inferiorly.

For descriptive purposes Level V may be further subdivided into upper and lower levels corresponding to the inferior belly of omohyoid.

Level VI: Contains the lymph nodes of the anterior central compartment from the hyoid bone superiorly to the suprasternal notch inferiorly. On each side, the medial border of the carotid sheath forms the lateral boundary.

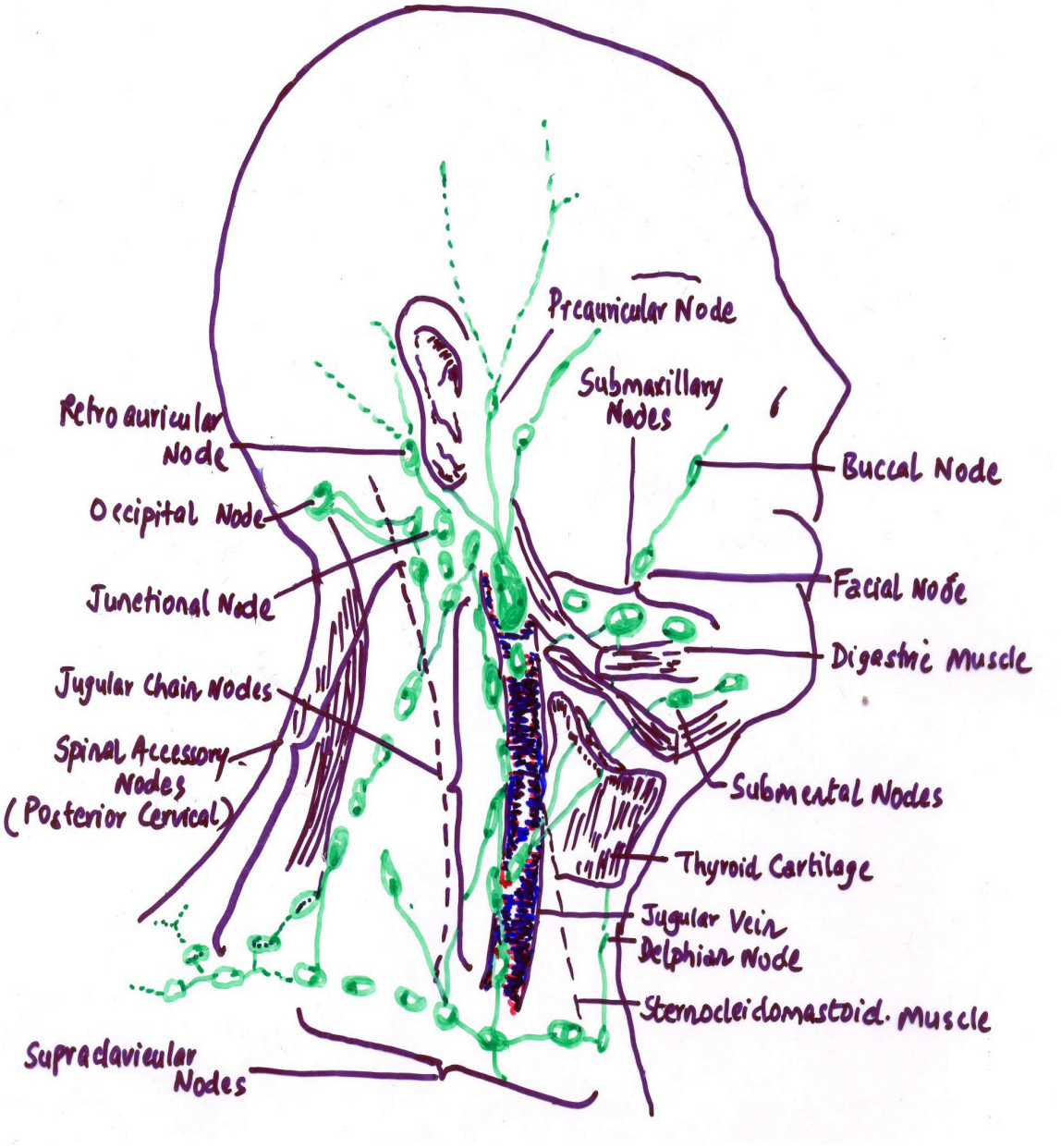

Figure 3. Anatomy of lymph nodes in head and neck

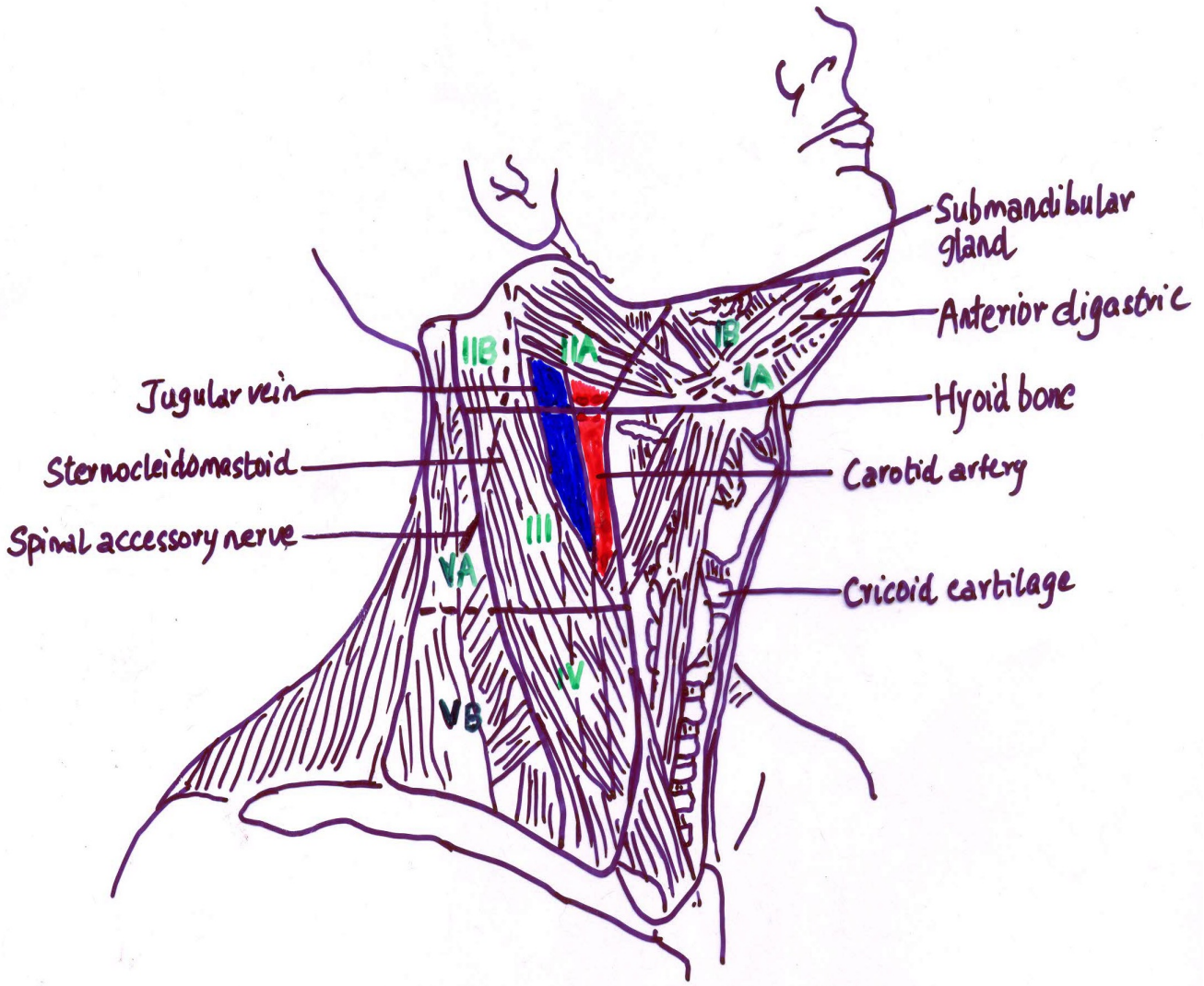

Fig 4. Levels of lymph nodes in head and neck

ORAL CAVITY CANCER

EPIDEMIOLOGY

Right down the history, man has been trying to conquer the malignant diseases. However malignancies remain a major cause for death and morbidity. It is estimated that about nine million new cancers are diagnosed every year in the world. Worldwide estimate of oral cancer detection each year is 4,05,000 cases with 2/3rd occurring in developing countries. India, Sri Lanka, Pakistan, Bangladesh, Hungary & France have the highest rates with the former 4 accounting for 30% of newly detected cases and seen more commonly in men.[6] The estimated number of new cancers in India is about seven lakhs, and about 3.5 lakh people die of cancer every year.[7] According to the cancer registry of Kidwai Memorial Institute of Oncology, Bangalore, Karnataka, on an average, about 5000 new cancers are registered per year.[8] Oral cancer ranks among the top three types of cancers in India. Age adjusted rates of oral cancers in India is 20 per 100, 1000 population and accounts for over 30% of all cancers in the country.[9]

In the western world the tongue and floor of the mouth are the most common sites of origin for primary squamous cell carcinoma in the oral cavity.

However, in India the buccal mucosa and retro molar trigone are the most frequently encountered primary sites.[10] Carcinoma of buccal mucosa

accounts for 40% of oral cancers in South East Asia.[11] 85% cases occur >50 years of age, except in developing countries where onset is earlier due to tobacco/ pan chewing habits. In India, the male: female ratio is said to be 4:1. Floor of mouth accounts 18-33% of oral cancers and seen more frequently in men in 6^{th}-7^{th} decade. 22-39% of oral carcinomas arise in the tongue, most commonly in middle $1/3^{rd}$ and in lateral aspect preceding ventral aspect. 90% of the cases are >40 yrs of age.[11]

Involvement of retromolar trigone in oral cancers occurs is 6 - 7% and is more common in males. Incidence of maxillary alveolar carcinoma is 3.5 – 6.5%, while that of hard palate is 1 – 3%. Oral cancers are more common in males except in hard palate carcinomas where occurrence is more in females due to reverse smoking. Mandibular cancers account for 7.5 – 17.5 % of oral cancers and the ratio of mandibular: maxillary alveolar cancers is 3:1 which is more common in males.[11]

ETIOLOGY:

The cause of oral cancer is yet to be completely understood. Several risk factors have been implicated.

1] Smoking:

Tobacco is smoked more commonly in the form of cigarette and bidi. Some smoke a chutta (a cigar) with the burning end inside the mouth. Chemical carcinogens in the burning tobacco or repeated thermal injury are agents, which are risk factors for oral cancer. Risk increases with the amount smoked and with the total cumulative lifetime smoking years. Tobacco is smoked commonly in the form of bidi, a type of cheap cigarette made by rolling a rectangular dried piece of tendu leaf (Diospyros melanoxylon) with 0.30-0.36 gm of Saurashtra or Nipani tobacco and securing the roll with thread. The length varies from 4 cms to 7.5 cms. As compared with cigarette smoke, bidi smoke has high content of several toxic agents such as carbon monoxide, ammonia, hydrogen cyanide, phenol and carcinogenic hydrocarbons.[12]

The other ways of smoking tobacco are clove-flavoured cigarette, various forms of pipes (wooden, clay, metal), the hookah (the Hubble bubble or water pipe), cheroots (or chuttas) and dhumtis. Tobacco may be used in raw or as processed mixtures and as a pyrolised form. The raw forms are used with

lime and with areca nut (Mawa-smokeless tobacco). Khaini is a mixture of freshly powdered tobacco and slaked lime; a quid of the mixture is kept for hours in the lower gingivolabial sulcus and sucked, which is risk factor for khaini cancer (squamous cell carcinoma of the lower lip). The processed forms, for example zarda, gutkha, and Manipuri tobacco are industrial products. The pyrolised (roasted) forms of tobacco (mishri, bajjar, etc) are used as dentifrice. Oral use of snuff is also practised in specific areas.[12]

Photo 1 : Different forms of tobacco

2] Spirits: - Consumption of calvados {a pot distilled spirit}

3] Sepsis: - Septic and decayed teeth.

4] Sharp teeth: - Poor oral hygiene, faulty restorations, and ill-fitting dentures.

5] Spices

6] Syphilis

7] Betel quid chewing habit: - The quid consists of a betel leaf wrapped around an areca nut, which is high in tannin, quick lime and tobacco. Oral cancer develops at the site where quid is habitually kept. Smoking along with betel quid chewing enhances the risk of oral cancer by 20 to 30 times.

8] Snuff dipping and other tobacco products

9] Alcohol: Alcohol consumption has a synergistic local effect of dissolving the carcinogen in the sump area of the mouth and a systemic downward effect on the immune system. Alcoholics often have nutritional problems.[13]

10] Industrial chemicals

11] Viruses: Herpes simplex virus and the Human papilloma virus (subtype 16)

12] Immune status: - Immune deficient due to low cell mediated immunity.

13] Genetic factors: - Most sporadic tumours are the result of a multi-step process of accumulated genetic alterations. These alterations affect epithelial cell behaviour by loss of chromosomal heterozygosity, leading to a series of events which progresses to the stage of invasive squamous cell carcinoma. These genetic alterations are seen in the clinical and microscopic pathology from hyperplasia to invasiveness of the tumour. Overexpression or underexpression of p53 and other genes may predispose to development of cancer and recurrence following treatment. Mutation of p16 causes cancer, but overexpression shows favourable prognosis. Overexpression of c-erbB-2 has shown correlation with nodal disease and metastasis and has worsened survival.

The syndromes that are characterized by mutagen sensitivity, includes Xeroderma pigmentosum, Fanconi's anaemia and Ataxic telangiectasia, which have all been associated with oral cavity cancers.[14] Other relevant genetic markers may include inducibility of cytochrome p450 enzyme system.[15]

14] Social status: - Related to social habits and to low socio-economic status

15] Diet

16] Occupation: Employment in textile industries

TNM CLASSIFICATION FOR ORAL MALIGNANCY[16]

Primary Tumor (T)

Table 1

TX	Primary tumor cannot be assessed
T0	No evidence of primary tumor
Tis	Carcinoma in situ
T1	Tumor 2 cm or less in greatest dimension
T2	Tumor more than 2 cm but not more than 4 cm in greatest dimension
T3	Tumor more than 4 cm in greatest dimension
T4a	Tumor invades adjacent structures (e.g. through cortical bone, into deep{extrinsic} muscles of tongue {genioglossus, hyoglossus, palatoglossus and styloglossus, maxillary sinus and skin of face)
T4b	Tumour 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	Metastasis in a single ipsilateral lymph node, 3cm or less in greatest dimension
N2a	Metastasis in a single ipsilateral lymph node more than 3 cm but none more than 6 cm in greatest dimension
N2b	Metastasis in multiple ipsilateral lymph nodes, none more than 6 cm in greatest dimension
N2c	Metastasis in bilateral or contralateral lymph nodes, none more than 6 cm in greatest dimension
N3	Metastasis in a lymph node more than 6 cm in greatest dimension

Distant metastasis (M)

MX	Distant metastasis cannot be assessed
MO	No distant metastasis
M1	Distant metastasis

Stage grouping

STAGE	T STAGING	N STAGING	M STAGING
STAGE 0	TIS	N0	M0
STAGE 1	T1	N0	M0
STAGE II	T2	N0	M0
STAGE III	T3	N0	M0
	T1	N1	M0
	T2	N1	M0
	T3	N1	M0
STAGE IV A	T4a	N0	M0
	T4a	N1	M0
	T1	N2	M0
	T2	N2	M0
	T3	N2	M0
	T4a	N2	M0
STAGE IV B	Any T	N3	M0
	T4b	ANY N	M0
STAGE IV C	Any T	Any N	M1

Histological Grade (G)

GX	**Grade cannot be assessed**
G1	Well differentiated
G2	Moderately differentiated
G3	Poorly differentiated

Residual tumour(R)

Rx	**Presence of residual tumour cannot be assessed**
Ro	No residual tumour
R1	Microscopic residual tumour
R2	Macroscopic residual tumour

THERAPEUTIC MODALITIES FOR ORAL CANCER

The factors that influence the choice of initial treatment are those related to the characteristics of the primary tumour (tumour factors), those related to the patients (patient's factors) and those related to the treatment delivery team (physician factors). [10,17]

PHYSICIAN FACTORS: -

- Surgery
- Radiotherapy
- Chemotherapy
- Combined modality treatment
- Dental
- Rehabilitation services
- Prosthetics
- Support services
- Photodynamic therapy
- Immunotherapy
- Gene therapy

Most therapies other than surgery are not known to be effective against large tumours. Therefore, the most promising results may be obtained with therapy of non metastatic tumours in an adjuvant setting after surgical removal of the primary tumour.

TUMOUR FACTORS:

- Site
- Size (T stage)
- Location (anterior versus posterior)
- Proximity to bone (mandible)
- Lymph node metastasis
- Previous treatment
- Histology (type, grade, depth of invasion)

PATIENT FACTORS:

- Age
- General medical condition
- Tolerance
- Occupation
- Acceptance and compliance with regards to treatment
- Life style (smoking, drinking, tobacco chewing)
- Socio-economic consideration
- Nutrition

CLASSIFICATION OF NECK DISSECTION

Comprehensive neck dissections - includes the radical neck dissection and three modifications, but always refers to a procedure in which all of groups I - V are removed.

1. **Radical neck dissection**

Involves removal of all lymphatics from the inferior border of the mandible and line joining angle of the mandible to the mastoid tip, to the clavicle between the lateral border of the sternohyoid and the anterior border of the trapezius. The deep margin of resection is the fascial carpet of the scalene muscles and the levator scapulae. The sternocleidomastoid, the internal jugular vein, and the spinal accessory nerve are removed with the specimen. Traditionally, this was the only surgical method of treating the neck. With the development of less morbid modifications, this is no longer indicated in the N_0 neck. Many surgeons no longer advocate this approach in N+ necks unless the metastatic nodes involve the muscle, vein, or nerve.

2. Modified Radical Neck Dissection (MRND)

Based on the work of Suarez as well as that of Bocca and Pignataro it indicates that an en bloc removal of the cervical lymphatics can be accomplished by stripping the fascia from the Sternocleidomastoid and internal jugular vein. No lymphatic communication was ever noted between these structures and the cervical lymphatics. These studies point out that both the spinal accessory and the hypoglossal nerve do not follow the aponeurotic compartments, but rather run across them; however, their conclusion was that if the tumour did not directly involve the nerves, they could be spared. From the above information and a desire to minimize the shoulder dysfunction associated with spinal accessory nerve sacrifice, the modified radical neck dissection came into development.

3. Type I Modified Radical Neck Dissection

Accomplishes the removal of the same regions of lymphatics in the radical neck dissection, but the spinal accessory nerve is spared. It is used less commonly in the N_0 neck, but would be a reasonable choice with neck disease that involved the sternocleidomastoid or jugular vein without involving the spinal accessory nerve.

4. **Type II Modified Radical Neck dissection**

Involves the same dissection as in the radical neck dissection, but the spinal accessory nerve and internal jugular vein are spared. It is indicated in N+ necks with metastatic involvement of the Sternocleidomastoid, but without involvement of the nerve and vein.

5. **Type III Modified Radical Neck dissection - "Functional Neck Dissection" (FND)**

It is similar to the radical neck dissection with preservation of all three above mentioned non lymphatic structures. However the indications for this procedure are controversial. In Europe, this operation is popular in the treatment of hypo pharyngeal and laryngeal tumors with N_0 neck. Molinari, Lingeman, and Gavilan proposed this procedure for N_1 necks when the involved nodes are mobile and not greater than 2.5 to 3cm. Bocca proposes this operation for any neck that has indications for a radical neck dissection as long as the nodes are not fixed.

B. Selective Neck Dissections

This type of dissection arose from the work of Shah, Lindberg and Byers who identified the pathways of lymphatic spread in the head and neck. The regions which have high risk for metastasis are removed.

Types of selective neck dissection:

a. Supraomohyoid (anterolateral) neck dissection

Levels I, II, and III are removed sparing the Sternocleidomastoid, IJV, and CN XI. This is indicated in the treatment of early oral cavity lesions.

b. Lateral neck dissection

Levels II, III, and IV are removed sparing the Sternocleidomastoid, IJV, and CNXI. This is indicated in tumours of the larynx, Oropharynx, and hypopharynx when the neck is N_0, although some advocate this approach with the N_1 neck with nodes limited to level II.

c. Posterolateral neck dissection

Levels II, III, IV, and V are removed sparing the SCM, IJV, and CNXI. This is useful in the treatment of skin tumours with metastatic potential located

in the posterior scalp or neck such as melanomas, squamous cell carcinomas, and Merkel cell carcinomas.

C. Extended neck dissections - describes any of the above dissections that include the removal of additional structures or other groups of lymph nodes.

Selective neck dissection (SND), which involves selective removal of nodal groups most at risk for metastasis with preservation of all non-lymphatic structures, has gradually gained acceptance in the clinically N_0 neck and has demonstrated regional control and survival rates similar to those of more extensive neck dissections.[18]

Although SND has been accepted by many as appropriate for use in the clinically node-negative neck, its use in patients with clinically obvious (palpable) metastatic disease remains extremely controversial; however, extension of the indications for its use in this setting seems logical. In the absence of factors that would alter normal lymphatic flow in the neck, such as previous neck surgery, radiotherapy, or the presence of massive obstructive adenopathy, the rationale behind the operation, which like its more radical counterpart seeks to remove the lymph nodes involved by or at risk for involvement by head and neck cancer, remains valid.

The present classification of MRND does not classify it as types 1 and 2 but only names the non-lymphatic structures spared.

Elective neck dissection: This is the neck dissection done in N_0 cases where metastasis is expected and is done as a staging procedure e.g.; Supraomohyoid neck dissection.

History of Flaps in Head And Neck Cancer

Definitions

A flap is a unit of skin and other tissues that maintains its own vascular pedicle while being transferred from a donor to a recipient site.

A graft is a free transfer of tissue without its own blood supply and entirely depends on the blood supply at the recipient site.

Flaps range from simple advancements of skin and subcutaneous tissue to composite flaps that may contain any combination of skin, muscle, bone, fat or fascia.

The origin of term flap originated from the 16th century Dutch word "**flappe**", meaning something that hung broad and loose, fastened only by one side.[19] The history of plastic surgical repair with flaps however can been documented as far back as 600 BC, when Sushruta described nasal reconstruction using a glabellar flap.

The origins of forehead rhinoplasty can be traced to India long before the birth of Christ.[20] The surgical procedures involved the use of rotation flaps, which transport skin to an adjacent area while twisting or rotating the pedicle.

The French are credited with the original description of sliding or advancement type flaps which transfer skin from an adjacent area without torsion.

Distant pedicle flaps, which transfer tissue to a remote site, were initially reported in the Italian literature during Renaissance.[21]

The three phases of historical evolution of flaps[22]

Phase 1- Before and early1900's

(from Sushrata to Sir Harrold Gillies)

Phase 2 – Between 1950's and 1960's

(McGregor, Bakamijan, Millard, Conley)

Phase 3 –1970's onwards

(Ariyan, Mathes, Nahai, Taylor, O' brien)

Table 2 : Milestones In The Evolution Of Flaps

Phase I

YEAR	NAME	CONTRIBUTION
1837	Horner	Z plasty principle
1848	Stein	Bilateral upper lip vascular pedicle flaps to the lower lip
1872	Estlander	Repair of lateral defects of the lower lip using lateral upper lip
1889	Manchot	Definition of vascular patterns of cutaneous circulation by dissection
1898	Halsted	Waltzing flaps
1898	Abbe	Bilateral cleft lip reconstruction with cross lip flaps
1905	Tansini	Latissimus dorsi musculocutanous flap for breast reconstruction
1912	Blair	Osseo-cutaneous flap
1916	Filatov	Tubed pedicle neck flap for lower eyelid reconstruction
1917	Gilles	Tubed pedicle neck flaps

Table 3 : Milestones In The Evolution Of Flaps

Phase II

YEAR	NAME	CONTRIBUTION
1917	Aymand	Tubed pedicle chest flap for nasal reconstruction
1917	Ganzer	Tubed pedicle flaps from the cheek, shoulder for nasal reconstruction
1919	Davis	Published observations on pedicle flap principles
1921	Blair	Delay phenomenon in non pedicled flaps
1937	Webster	Thoracoepigastric tubed pedicles
1942	Converse	Median forehead flap
1946	Kazanjian	Median forehead flap
1946	Shaw and Payne	Hypogastric tubed pedicle flap
1955	Owens	Compound sternocleidomastoid muscle-skin flap
1960	Littler	Neurovascular flap
1965	Bakamjian	Deltopectoral flap
1968	Ger	Muscle flap
1972	Mc Gregor &Jackson	Groin flap

Table 4 : Milestones In The Evolution Of Flaps

Phase III

YEAR	NAME	CONTRIBUTION
1973	Daniel,Taylor, O brien, Harii	Microvasscular free flap transfer
1975	Mc craw and Furlow	Dorsalis pedis flap
1976	Radovan	Tissue expansion for breast reconstruction
1977	Mc craw	Description of independent musculocutaneous vascular territories
1977	Mathes	Rectus abdominis flap
1979	Ariyan	Pectoralis major myocutaneous flap
1981	Nakayama	Arterialized venous flaps
1981	Ponten	Fasciocutaneous flaps
1987	Taylor and Palmer	Concept of angiosomes

Table 2, Table 3, Table 4 depicts the milestones in the evolution of surgical flaps.[23]

Classification Of Flaps In Head And Neck[24]

Flap classifications are multiple and vary according to the organizing principle. The sub-classification system will be better appreciated as the embryologic, anatomic and surgical principles of flaps are fully understood.

1. **Based on blood supply**

- Local
- Axial

2. **Based on constituents**

- Fasciocutaneous
- Musculocutaneous
- Osteomyocutaneous
- Cartilage
- Bone
- Nerve
- Visceral

3. **Based on contiguity**

- Local
- Pedicled
- Free

4. **Based on conditioning**

- Delay
- Tissue expansion
- Prefabrication

5. **Based on conformation**

- Special shapes
- Tubed
- Combined flaps

Fasciocutaneous, muscle and osseous flaps have been further classified as follows:

1. Fasciocutaneous flaps

(a) Cormack and Lamberty classified fasciocutaneous flaps based on the number of vessels and type of vascularization.[24] (Fig.1)

- Multiple perforators
- Single perforators
- Segmental perforators

(b) Mathes and Nahai's classified 3 different types of deep fascial perforators.[22]

(c) Nakajimas classified on basis of course of small vessels from their origin to the skin.

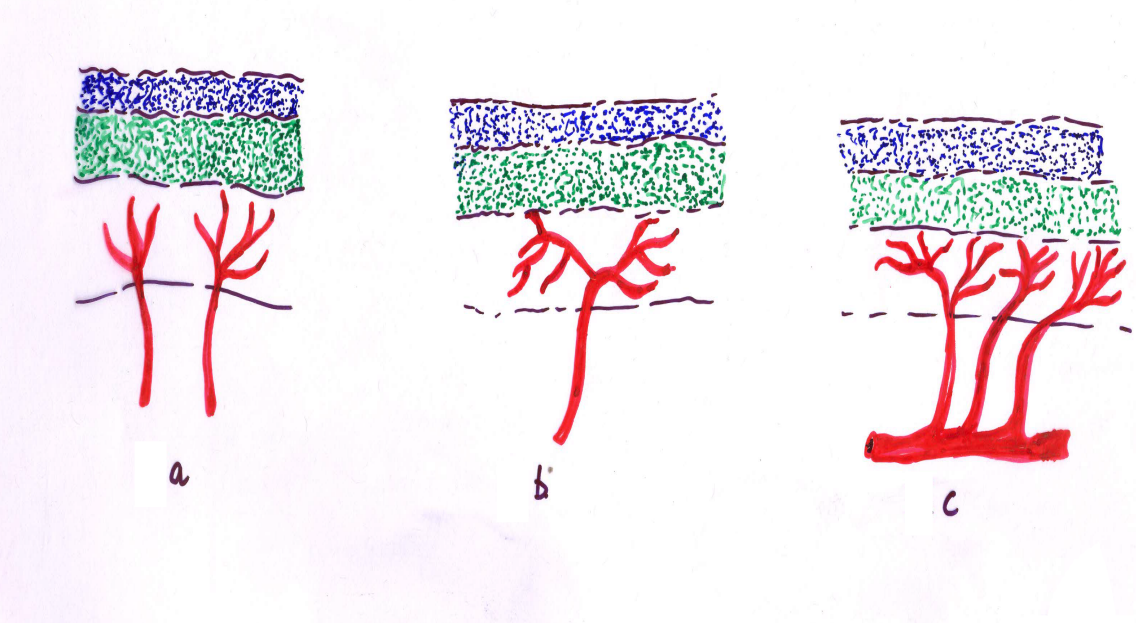

Fig 5 : Cormack and Lamberty classification of fasciocutaneous flaps

2. Classification of muscle flaps by Mathes and Nahai.[22]

Muscle flaps are categorized according to the pattern of the predominant vessel

Type I: A single vascular pedicle enters the muscle i.e tensor muscle. (Fig. 6a)

Type II: One dominant vascular pedicle with additional smaller vascular branches supplies the temporal muscle. (Fig. 6b)

Type III: Two vascular pedicles arising from separate regional arteries supply the muscle i.e rectus abdominis muscle.(Fig 6c)

Type IV: Several small vascular pedicles of similar size supply the muscle including the vastus medialis muscle. (Fig.6d)

Type V: one dominant vascular pedicle and several smaller segmental vascular pedicles supply the muscle, including the pectoralis major muscle. (Fig. 6e)

3. Osseous flaps, according to Serafin, are either directly (endosteal) or indirectly (periosteal) vascularized (osseous flaps).[25]

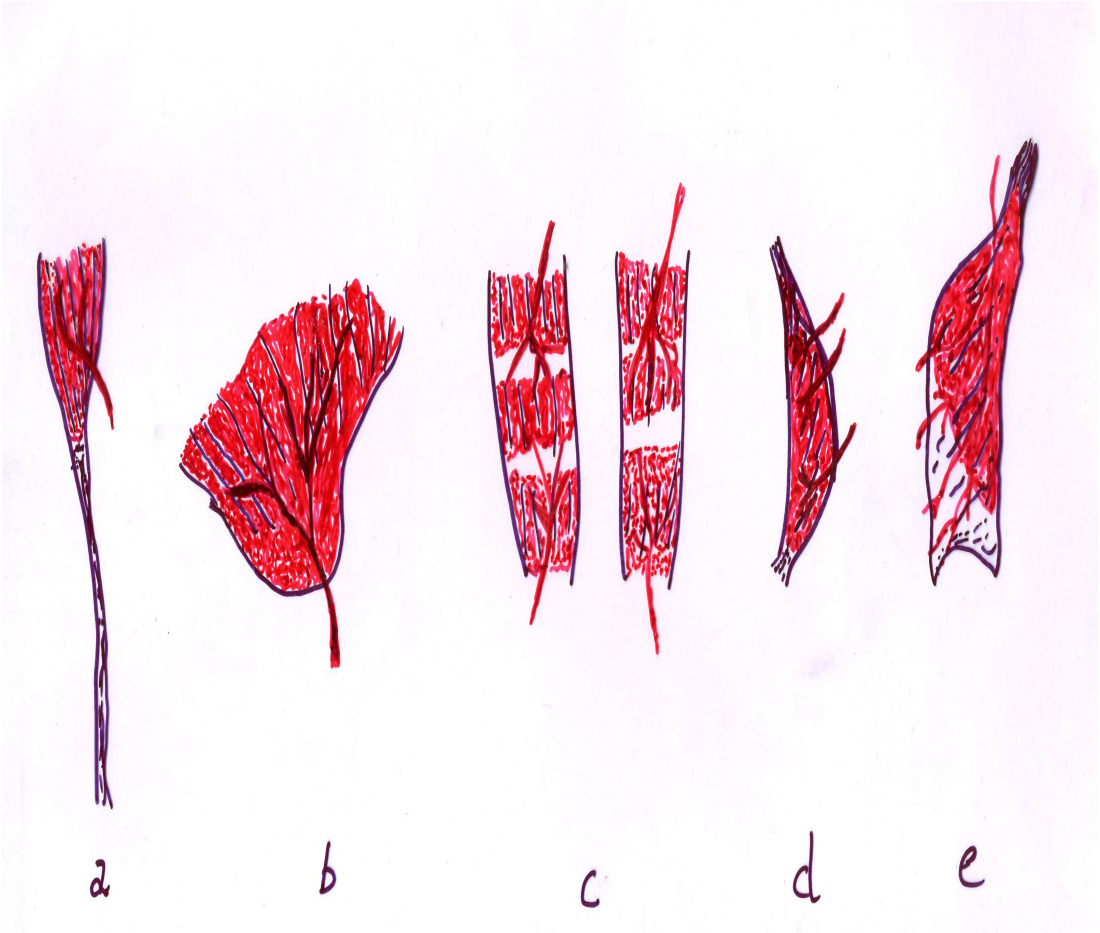

Fig 6: Classification of muscle flaps by Mathes and Nahai

History of Supraclavicular Flap

Toldt, in 1903, first illustrated and named the vessel *arteria cervicalis superficialis* describing it to orginate from the thyrocervical trunk, exiting between the trapezius and sternocleidomastoid muscle. [26,27]

In 1949, the first clinical application of a flap from shoulder was performed by Kazanjian and Converse which they described as "charretera or acromial flap"[28]

Charretera in spanish means the shoulder area where honors are bestowed on military personnel.

In 1979, Mathes and Vasconez performed the first anatomical studies, described the vascular territory and clinical applications of head and neck construction and renamed it the cervicohumeral flap.[29]

In 1983, Lamberty and Cormack named the vessel cephalad to the clavicular insertion of the trapezius muscle, the supraclavicular artery.[30]

In 1990's, Pallua rediscovered this flap and popularized its use by performing detailed anatomical studies examining the vascularity of what is described as the supraclavicular artery flap.[31,32,33]

Vascular Anatomy Of Supraclavicular Flap

The supraclaviclar artery(SCA) flap is a fasciocutaneous flap based on the supraclavicular artery- a perforator that arises from the transverse cervical artery in 93% of patients and the subscapular artery in the remaining cases.[30] The artery has a diameter of 1.1 to 1.5 mm and typically arises 3-4cm from the origin of the transverse cervical artery, offering a pedicle length ranging from 1 to 7cm.[34]

The anatomic location of the supraclavicular artery is found in the triangle formed by the dorsal edge of the sternocleidomastoid (SCM) anteriorly, the external jugular vein (EJV) posteriorly and medial part of the clavicle.

The transverse cervical artery runs across the anterolateral neck. The sternocleidomastoid muscle divides this region. The area anterior to this is the anterior triangle and that behind it is the posterior triangle. The posterior triangle is surrounded by the posterior border of sternocleidomastoid muscle anteriorly, anterior edge of the trapezius muscle posteriorly and middle third of the clavicle inferiorly. (Fig 7a) It is intersected, about 2.5 cm above the clavicle, by the inferior belly of the omohyoid muscle, which divides it into occipital triangle and supraclavicular triangle. In most cases the transverse cervical artery derives from subclavian artery but in a few it derives from the

thryrocervical trunk and is further divided into superficial and deep branch. There are many variations in the course of the transverse cervical artery (Fig. 7A).

Two veins drain the flap; one vein is found running adjacent to the artery and drains into the transverse cervical vein, it has a mean diameter of 0.8-1.6mm. The second vein has a diameter ranging from 0.4-1.0mm in diameter and drains either into the External jugular vein or subclavian vein.[32]

Angiosome of the Supraclavicular Flap

In cadaveric studies, Pallua demonstrated that the vascular territory of the supraclavicular artery extends from the supraclavicular region to the shoulder cap with distal part of the angiosome extending to the ventral surface of the deltoid muscle.[32]

More recently computed tomographic angiography has demonstrated that the distal portion of the flap is dependent on the interperforator flow from the direct linking vessels and recurrent flow through the dermal plexus. This area of the angiosome ranges from 8 to 16 cm in width and 22-35cm in length.[35-36] (Fig. 7b)

On body surface, the transverse cervical artery can be identified under the skin at a distance from the sternoclavicular joint that is on average 3.77 cm and ranges from 3- 4.5 cm.[37]

The average distance between the origins of the supraclavicular and transverse cervical arteries is 4.12cm and ranges from 3-5.5cm. [37]

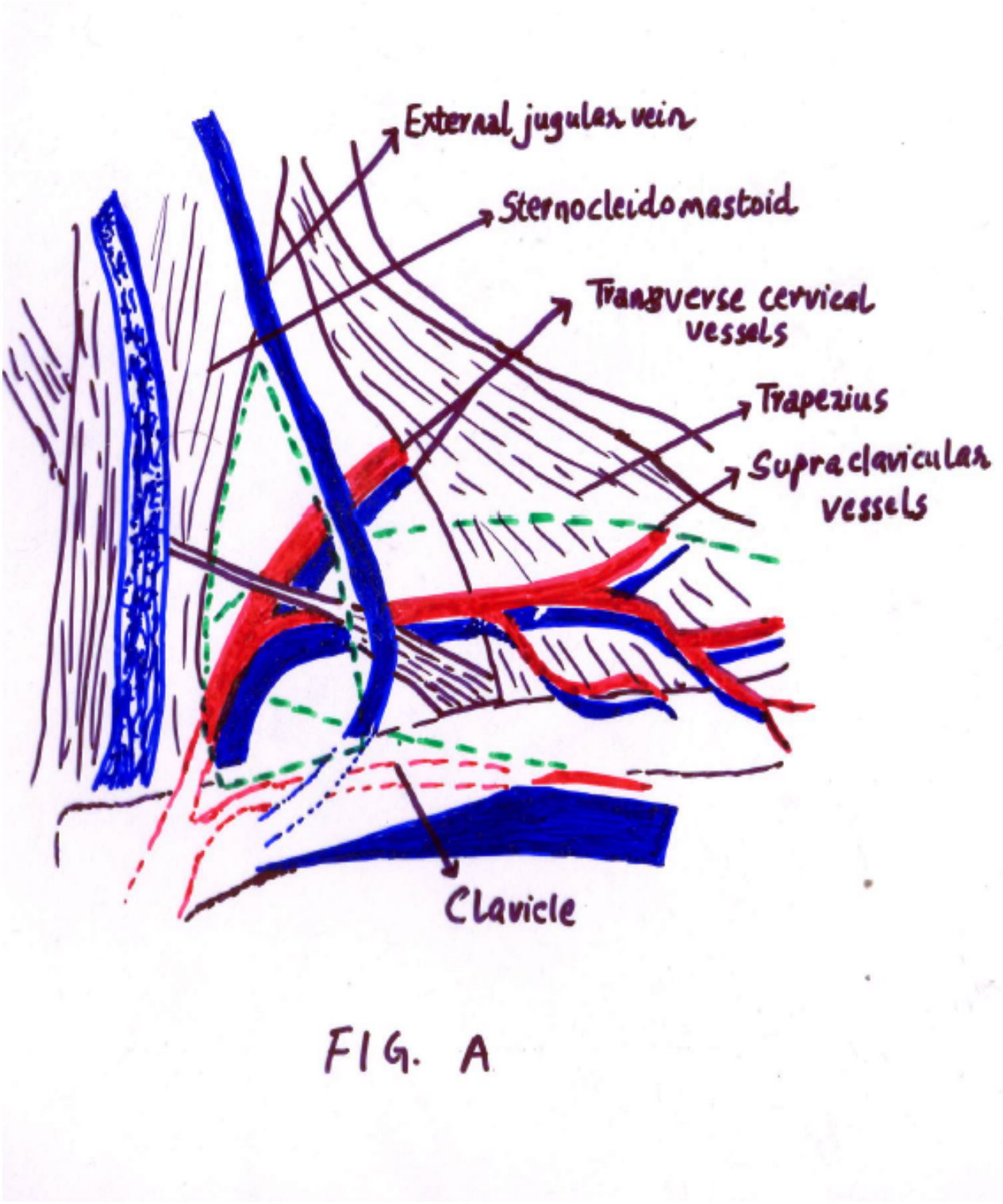

Fig.7a – Anatomical location of the supraclavicular artery

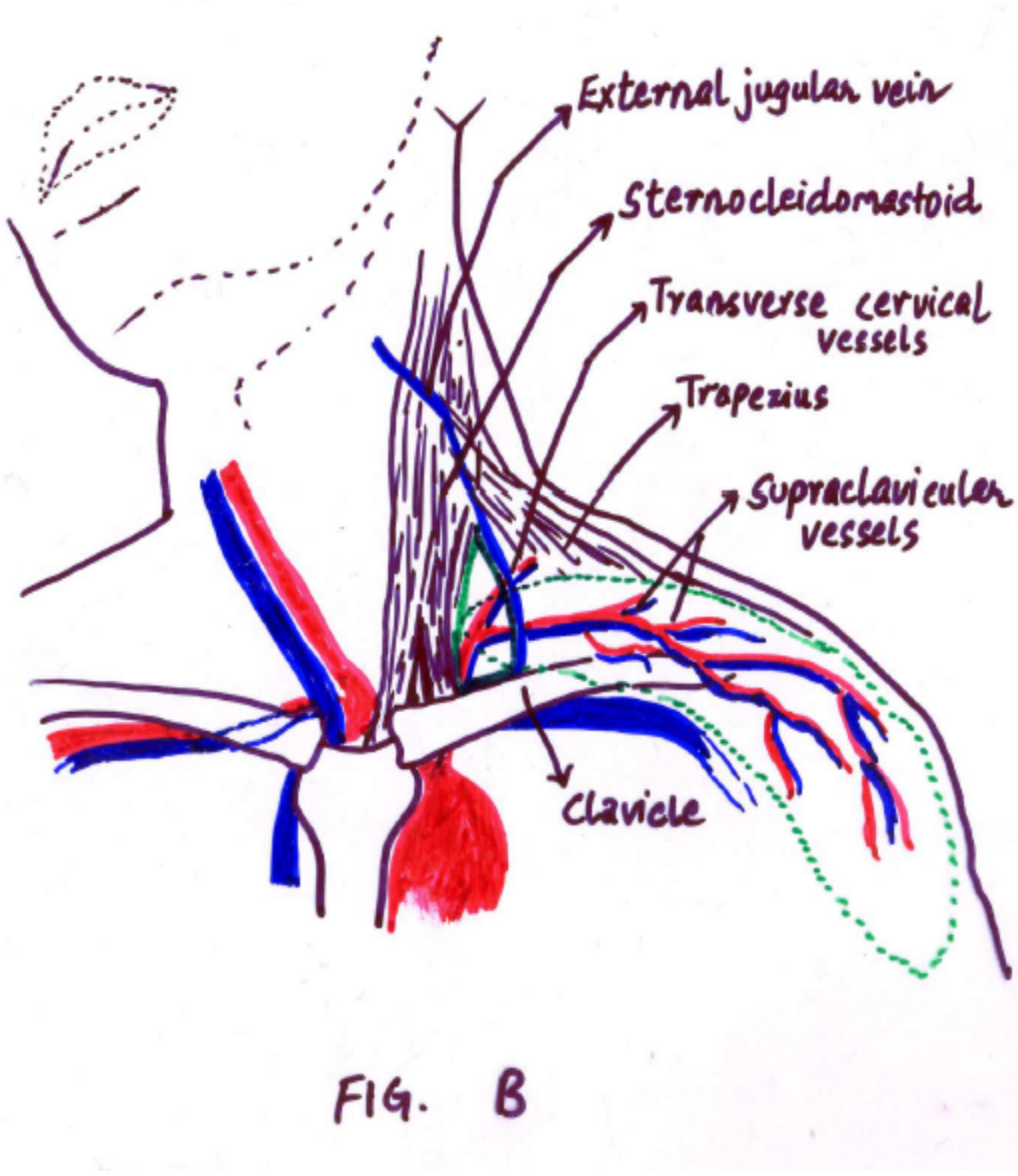

Fig. 7b – Angiosome of the supraclavicular flap

Nerve Supply and Applied Anatomy

The supraclavicular nerve, originating from the third and fourth cervical nerves, innervates the supraclavicular area. The nerve contains three branches – medial, intermediate and lateral- which all contribute to sensation of the lateral neck, shoulder and ipsilateral upper chest.

The main trunk of the supraclavicular nerve emerges from behind the SCM muscle and pierces the deep fascia 1-2 cm above the clavicle. In approximately 70% of cases, this nerve trunk has three branches (ranging from 2 to 5).[51]

If the supraclavicular flap is utilized as a pedicled flap, the anatomical location of the supraclavicular nerves can assist in identification and possible division to avoid dysthesia. In free flaps the supraclavicular nerves may be located and preserved for an anastomosis to a sensory nerve at the recipient site. Clinically the importance of a sensate flap lies in the maintenance of adequate cutaneous sensation, as well as its restitution of function for particular defects where function is intrinsically dependant on sensation, such as the hand, pharynx or intra oral cavity.[38] On the contrary, the nuisance of referred sensation and possible dysthesia suggests that these nerves may need to be divided to avoid sensory retraining rehabilitation.

Further studies are required to confirm the potential benefit of a regional, neurotized head and neck reconstruction flap alternative, thus aiding return of the patient closer to their preoperative sensate status.

The flap based on the supraclavicular branch of the transverse cervical artery was first described by Kazanijian and Converse as “in charretera ” or acromial flap.[28]

The Demergasso flap which was described by Mathes and Nahai and several other flaps have evolved into the supraclavicular artery flap as we know it today.[39-41]The first anatomical studies of the cervico-humeral flap were performed in 1977 by Mathes and Vasconez. The vessel described by them as “an ascending branch of the artery cephalad to the clavicular insertion of the trapezius muscle” was named the supraclavicular artery by Lamberty.

The supraclavicular fasciocutaneous flap was initially introduced by Lamberty in 1979 and described the artery as a perforator that arises from the transverse cervical artery in 93% of cases or from the suprascapular artery in 7% of cases.[30]

Cormack and Lamberty defined the flap as a laterally extended cervico-humeral flap and published an article about its vascular anatomy in 1983

In 1997, Pallua described the supraclavicular island flap for releasing post burn mentosternal contractures as a reliable and useful flap. Later in 2000, Pallua and Noah further defined anatomical features of the supraclavicular artery by their study on cadavers.[32]

In 2005, Pallua presented a novel modification of a previously published method as a pre-expanded ultra thin supraclavicular flaps for face reconstruction which had low donor site morbidity and no need for microsurgery.[32]

In 2005, Di Benedetto, introduced a modification of the supraclavicular island flap, harvesting it as a supraclavicular flap with a fascial pedicle, thus reducing the risk of flap necrosis.[42]

In the same year, Heitland introduced the single and double folded supraclavicular island flap for the treatment of large facial defects in noma patients. [43]

In 2007, Margulis introduced the prefabricated expanded supraclavicular flap carried on the thoraco-acromial for providing ample tissue for local transfer and was successful with respect to reconstruction of the anterior neck with good functional and aesthetic results.[44]

According to Cormack and Lamberty, an anatomical territory including the main blood flow into a flap is linked to the next anatomical territory through choke vessels and these two anatomical territories, including choke vessels, are the basic flap survival area.[45] Keeping this guiding principle in mind, in our study we found that supraclavicular flap could be safely elevated within dimensions of 20 x 10cm.[45]

However it should be taken into account that the distal portion of the flap may be perfused in a retrograde fashion by branches of the porterior circumflex humeral artery through the anastomoses over the point of the shoulder.

Multiple variations and modifications have been described which include tunneled island flaps[46], bilateral supraclavicular flaps[46] , super charged flaps[37] , extended flaps[47] , pre-fabricated / delayed flaps[48], pre expanded flaps[49] and osteo cutanoeus flaps [50].

Harmozi and Shafi described the successful use of bilateral tunneled supraclavicular flaps for simulataneous reconstruction of a massive facial defect and intra oral lining.[46]

Vinh described the use of posterior circumflex humeral artery to super charge a large flap measuring 17 x 26 cm.[37]

Pallua and Von Heimberg use preexpansion to create very large thin flaps used for facial reconstruction.[49]

Sommerlad and Boorman described the anatomy of the supraclavicular nerve to demonstrate the availablitiy of a fasciocutaneous sensate flap for reconstruction of degloving hand injuries. It was determined that the main trunk of the supraclavicular nerve emerged from behind the SCM muscle and pierced the deep fascia 1-2 cm above the clavicle and that in approximately 70% of cases, this nerve trunk had 3 branches (ranging from 3-5) suitable for usage of flap innervation.[51]

Vinh and Chiu presented total flap necroses because the pedicle was severed. Di Benedetto suggested maintaining a fascia around the vessels to ensure protection of the vessels. Alves in his series has mentioned division of the superficial cervical fascia as a routine manoeuvre to provide extra length and arc of rotation, thereby avoiding direct approach to the vascular pedicle and preserving its integrity.

Granzoe recently described their technique for additional length in which a hand held Doppler was used to define the lateral extent of the vessel, resulting in a viable flap for 5 cm beyond where the Doppler signal is lost.[52]

Blevins and Luce described total flap loss in three of 19 cases treated and partial necrosis occurred in three more patients with the need to raise a myocutaneous portion of the lateral trapezius muscle, despite a preventive delay. The probable reason for the complications they encountered was attributed to the ligation of the external jugular vein in view of inadequate length of the flap to reach the defect. In their article they had better results over all, using the vertically axial patterned flap.[53]

Vinh proposed the use of split thickness skin graft or local flap for closure of donor sites wider than 10cm while other authors prefer primary closure whenever it is possible. [37]

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RESEARCH HYPOTHESIS

Reconstruction of the defects following resection for oral cancer can be done with supraclavicular flap with a good functional and aesthetic outcome.

RESEARCH QUESTION

Will supraclavicular flap reconstruction for defects following resection of oral cancer give a good function and aesthetic outcome?

AIMS AND OBJECTIVES

1. To surgically resect the malignant tumor (staged T2 and above) from the oral cavity and to reconstruct the defect using the supraclavicular flap.

2. To evaluate the functional outcome following reconstruction.

3. To evaluate the aesthetic outcome following reconstruction.

MATERIALS AND METHODS

Source :

This study was conducted in the Department of Otorhinolaryngology, R.L.Jalappa Hospital and Research centre, Tamaka, Kolar attached to Sri Devaraj Urs Medical College, from January 2014 to June 2015.

25 Patients who presented to R.L Jalappa hospital , Department of Otorhinolaryngology and Head and Neck surgery , with confirmed oral malignancies staged T2 and above (AJCC classification) and who underwent resection of the tumor with subsequent reconstruction of the defect using the supraclavicular artery flap were included in this study.

Study Design

This was a prospective interventional study.

Inclusion Criteria

1. Patients aged less than 70 years with oral malignancy stage T2 and above (AJCC) undergoing composite resection and requiring reconstruction.

Exclusion Criteria

1. Patients who have had previous bilateral neck dissections or radiated necks.
2. Unresectable head and neck malignancies.
3. Orocutaneous or pharyngocutaneous fistulas.
4. Large scars and contractures in neck or shoulder.
5. T_4 lesions of oral cavity with skin involvement.

METHODOLOGY

The institution's ethics and research review board approved the present study.

- Informed and written consent were taken after explaining the patients regarding the procedure and its anticipated complications.

- A detailed history was elicited.

  The following information was collected from all the patients that were recruited in the study:

  - ✓ Age, Religion, Education, Occupation, Contact details.
  - ✓ Chief complaints, duration of the complaint, history of the presenting illness
  - ✓ Any significant past/present medical history like hypertension, diabetes mellitus, tuberculosis or any other significant illness was noted.
  - ✓ Any significant family history for similar complaints/ medical conditions or any other significant illness was noted.
  - ✓ Dietary history and a history of habits, if any, were noted.

- A detailed clinical examination was performed in each patient.

  The following points were documented with regard to the lesion:

The site, epicenter, extension, greatest anterior/posterior diameter of lesion/greatest transverse diameter of the lesion and type of growth.

- Clinical examination of cervical group of lymph nodes was performed. The adjacent mandible was examined for involvement and clinical staging was documented for each case..

- Hand held doppler (10Mhz) was used in obese patients preoperatively in whom we anticipated difficultly in identification of supraclavicular pedicle.

- Wide excision of the lesion, ipsilateral neck dissection marginal or hemimandiblectomy (as required to accepted standard of care for the patient) were performed under general anaesthesia and the defect was reconstructed using the supraclavicular artery flap.

Surgical technique of harvesting the flap

- Patient was placed in supine position with sand bags under the shoulder and neck extended.

- Entire neck, axilla and shoulder region were prepared with povidone iodine and draped.

- Flap outline was marked posteriorly 2cm anterior to the spine of scapula, anteriorly a line parallel to posterior line in front of the clavicle, while lateral margin is extended 2cm lateral to deltopectoral groove. (Photo 2)

- Flap was elevated from distal to proximal in plane deep to the fascia and just superficial to the muscle avoiding damage to pedicle. (Photo 3)

- The communicating perforators from the deltoid branch of the thoraco-acromial axis and posterior circumflex humeral artery were sacrificed.

- The flap was raised at a subfascial level just superficial to deltoid muscle taking care to irrigate the area continuously with saline. The flap was elevated proximally towards its pedicle, which was visualized all along the anterior border at trapezius.

- In the upper neck above the apex of the posterior triangle, plane of elevation was subplatysmal. The fibrofatty pedicle was not raised in the posterior triangle as the ascending deep branches lie within it. (Photo 4)

- Near the point of exit of the supraclavicular vessels, the dissection was done preserving a fascial pedicle of about 3-5cm in width.

- The cutaneous sensory nerve fibres to the flap from the cervical plexus were identified near the posterior apect running deep into the platysma and dennervated to prevent a sensate flap .

- Ensuring viability and vascularity of the flap, it was tunneled below the cervical incision along an arc of 120 -180 degrees. (Photo 4)

- The area of the pedicle that had to be buried under skin flaps was de-epithelized preserving the subcutaneous over the superficial aspect of the fat flap entirely.

- Arc of rotation was maximized by transecting the sternal and clavicular heads of the sternocleidomastoid muscle elevating it as a fascioareolar pedicle flap leaving the base undisturbed to protect the vessels from

tension/ torsion. Thus a fully mobilized flap was transposed into defect while the intervening skin not needed for closure of the defect was de-epithelized.

- The raw surfaces with respect to defect at the donor site were approximated in 2 layers closing the subcutaneous layer using absorbable 3-0 polygalactin (quilting suture technique) and skin using 3-0 nylon sutures (half mattress suture technique).

- A self-retaining non-traumatic suction drain was placed to drain the donor site, which was subsequently removed on the 7^{th} post-operative day.

- Intra operative details regarding defect dimensions, flap dimensions, skin- paddle dimensions, pattern of flap, time taken to raise the flap and intraoperative complications were documented.

Immediate postoperative complications, if any, were noted down.

- Postoperative complications like wound dehiscence, flap dehiscence, flap necrosis, sepsis, were noted down carefully. We also recorded the postoperative day on which these complications arose.

If secondary suturing was required, we recorded the date on which it was done.

- Histopathological examination report was collected. We defined the tumor type, staging, assigned the TNM class to the tumor. Tumor margins were defined. Lymph node spread, if present, was noted.

- The requirement for radiotherapy or chemotherapy post surgery was decided according to histopathological findings. The dose of radiation, compliance of the patient in completing the adjuvant therapy was documented.

- The total duration of stay at the hospital was noted.

- The patients were followed up monthly following the surgery and donor area status, recipient area status and complications encountered were documented.

- Finally, the performance of the supraclavicular artery island flap with respect to the function and aesthetic outcome was graded according to a scoring system.

Patients were assessed using seven parameters

Improvement in each parameter was scored on a rank of 0-10

(0 - no improvement, 10 –perfectly functional)

A total score was calculated out of 70 (10 for each parameter evaluated).

The parameters they were assessed upon were: (Score 0-10)

- Ability to swallow without difficulty
- Ability to chew in cases where mandible has been resected
- Adequate mouth opening
- Free movements of the tongue
- Obvious deformity/ poor aesthetic appearance
- Unwillingness/ apprehension of the patient to keep the operated site exposed / hide the reconstructed area
- Social behavior of the patient/ attends community meetings

A total score between

- 0-20 : Poor functional and aesthetic outcome,
- 20- 40 : Good outcome
- 40- 70 : Excellent functional and aesthetic outcome.

Table 5: Components of Functional and Outcome score

PARTICULARS	YES (SCORE =10)	NO(SCORE =0)
Ability to swallow without difficulty		
Ability to Chew in cases where mandible has been resected.		
Adequate mouth opening		
Free movements of the tongue		
Obvious deformity/ poor aesthetic appearance		
Unwillingness/ apprehension of patient to keep the operated site exposed / hide reconstructed area		
Social behaviour of patient /attends community meetings.		

Photo 2: Ulcerative growth in the right buccal mucosa which was consistent with sqummous cell carcinoma

Photo 3: Ulcerative growth involving right lower alveolus also consistent with squammous cell carcinoma

Photo 4: Skin marking outlining the dimensions of the flap corresponding to the defect

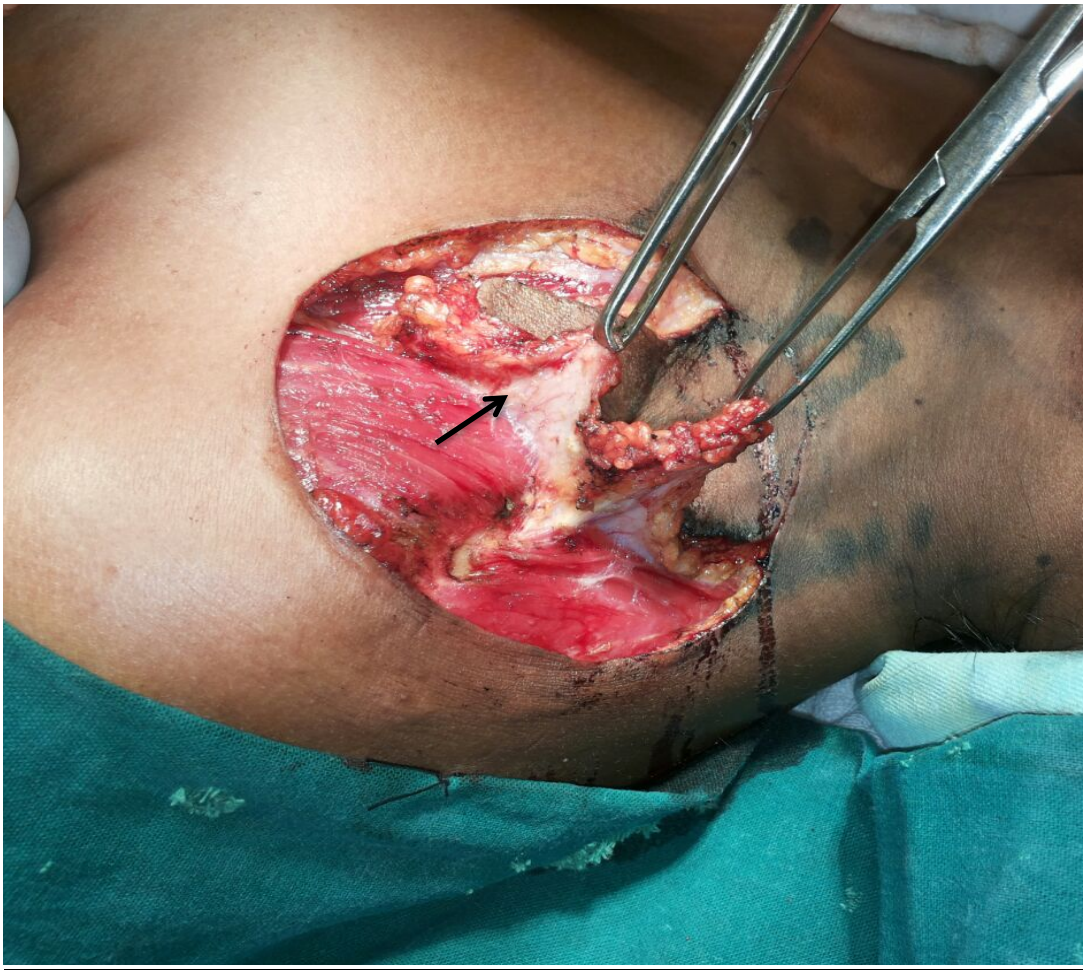


Photo 5: Elevation of left supraclavicular flap

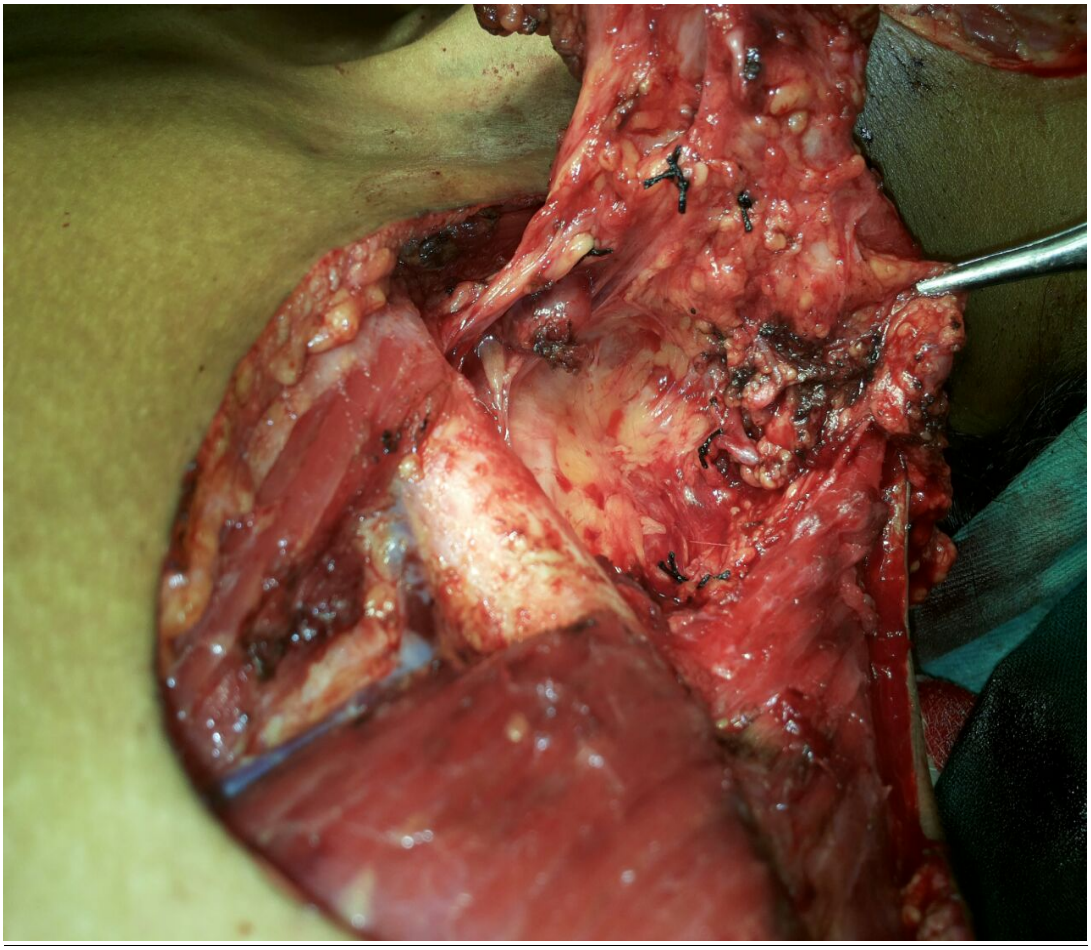


Photo 6: Elevation of supraclavicular flap preserving the underlying fat fascial pedicle

Photo 7: Rotation of the flap to reach the defect preserving the EJV (indicated by arrow)

Photo 8: Marginal mandibulectomy in progress

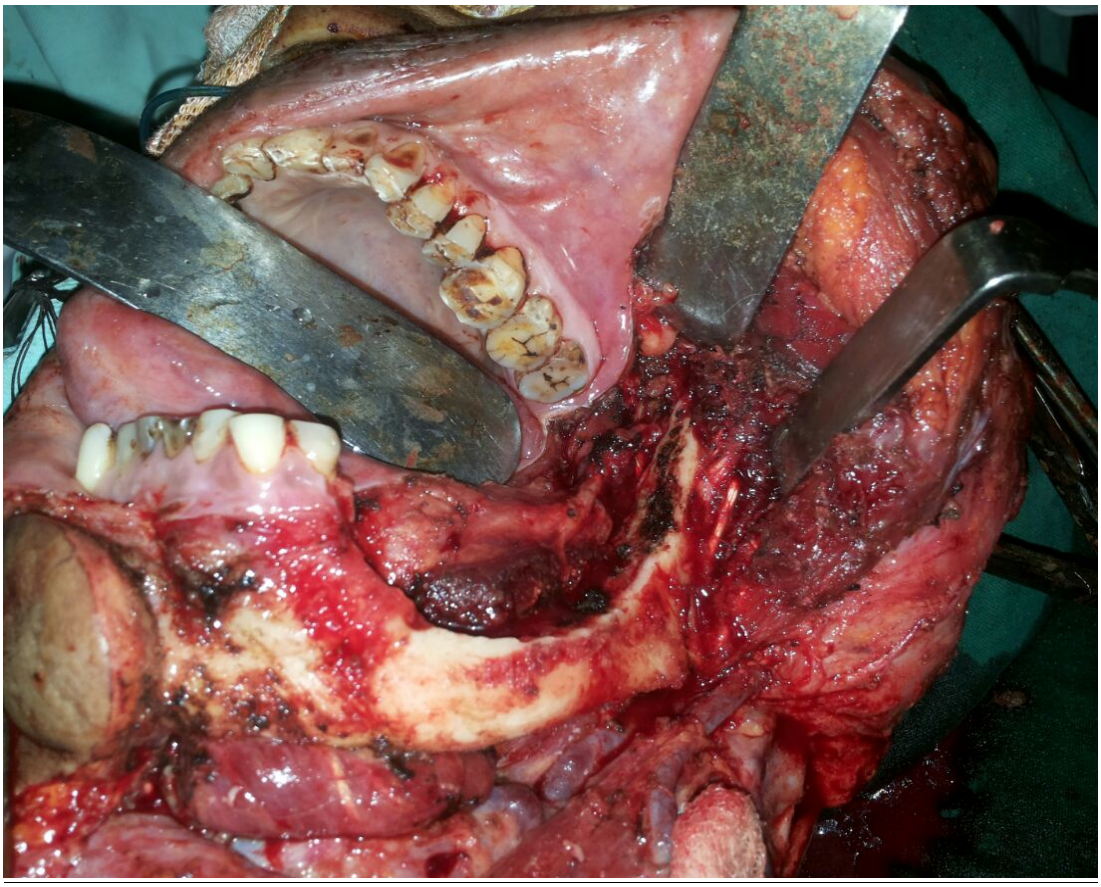


Photo 9: Completed marginal mandibulectomy

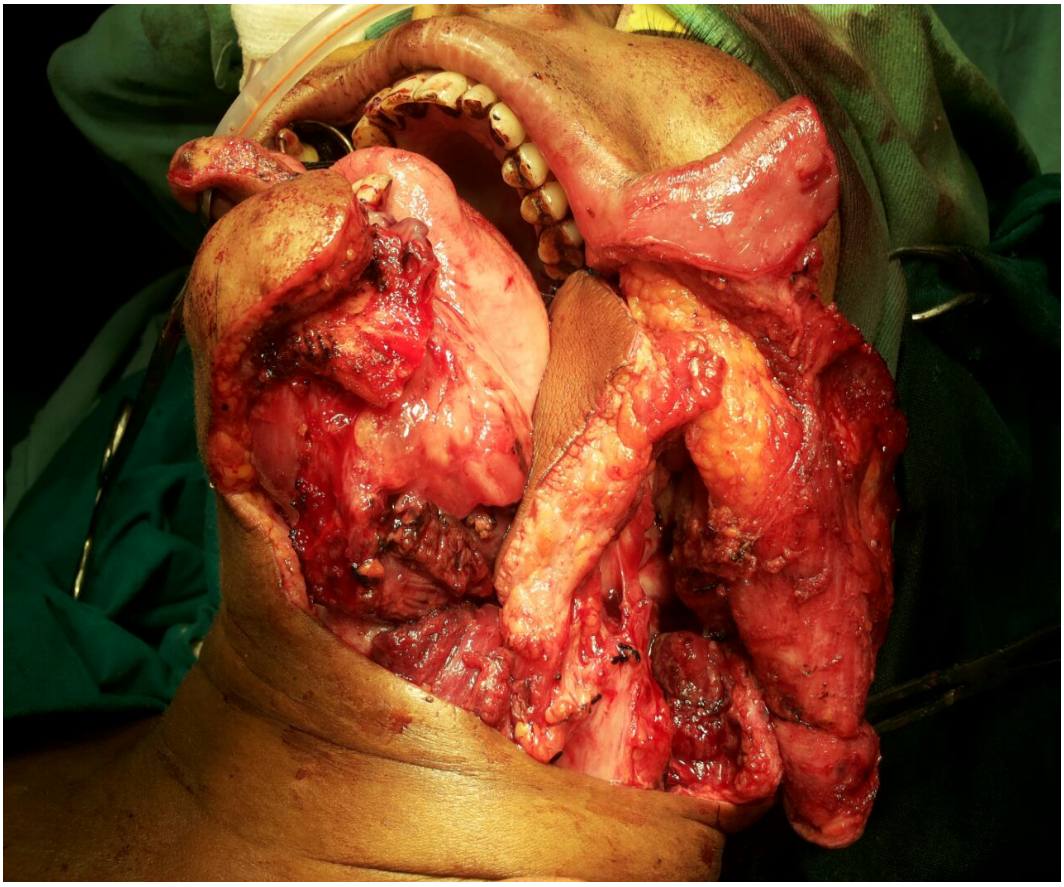


Photo 10: Reaching the flap to the defect ensuring no torsion/ tension occurs on the pedicle

Photo 11: Flap sutured to the defect

Photo 12: Donor site closed by primary closure

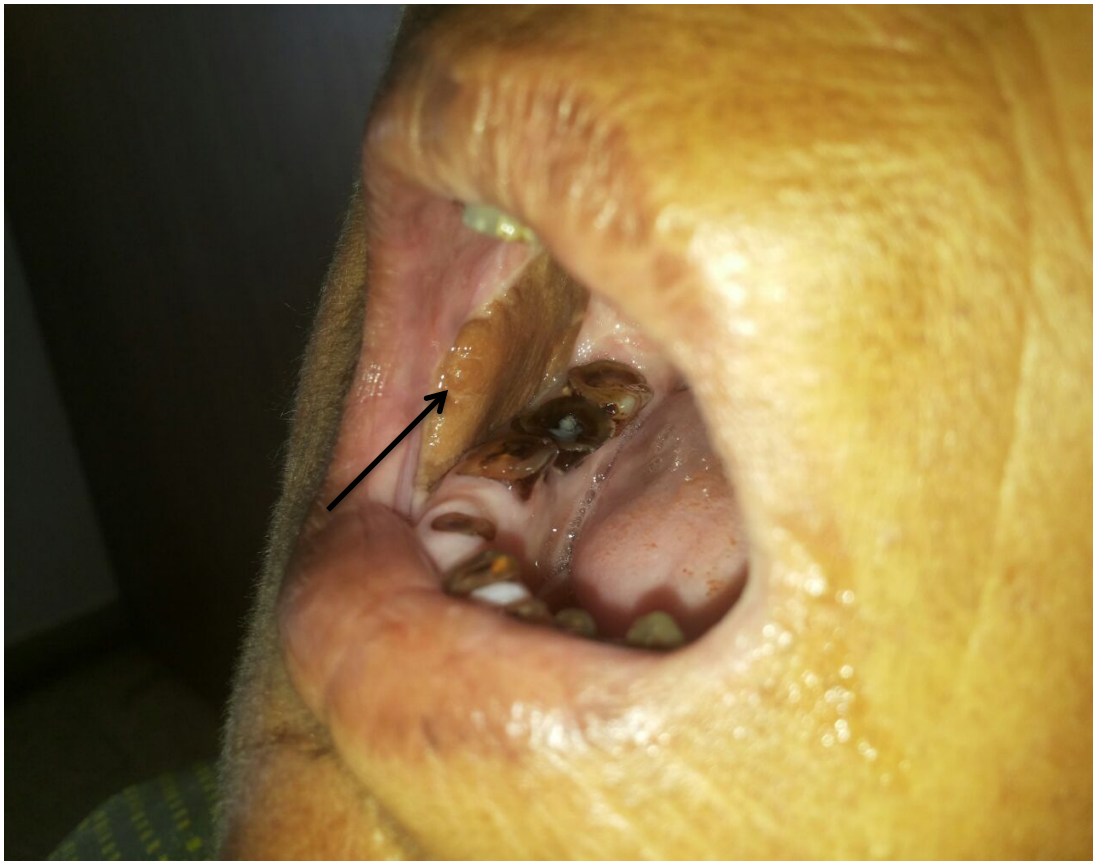


Photo 13: 3 weeks post operative status

Photo 14: 3 months most operative status following radiotherapy

Photo 15: Donor site status 3 months following surgery

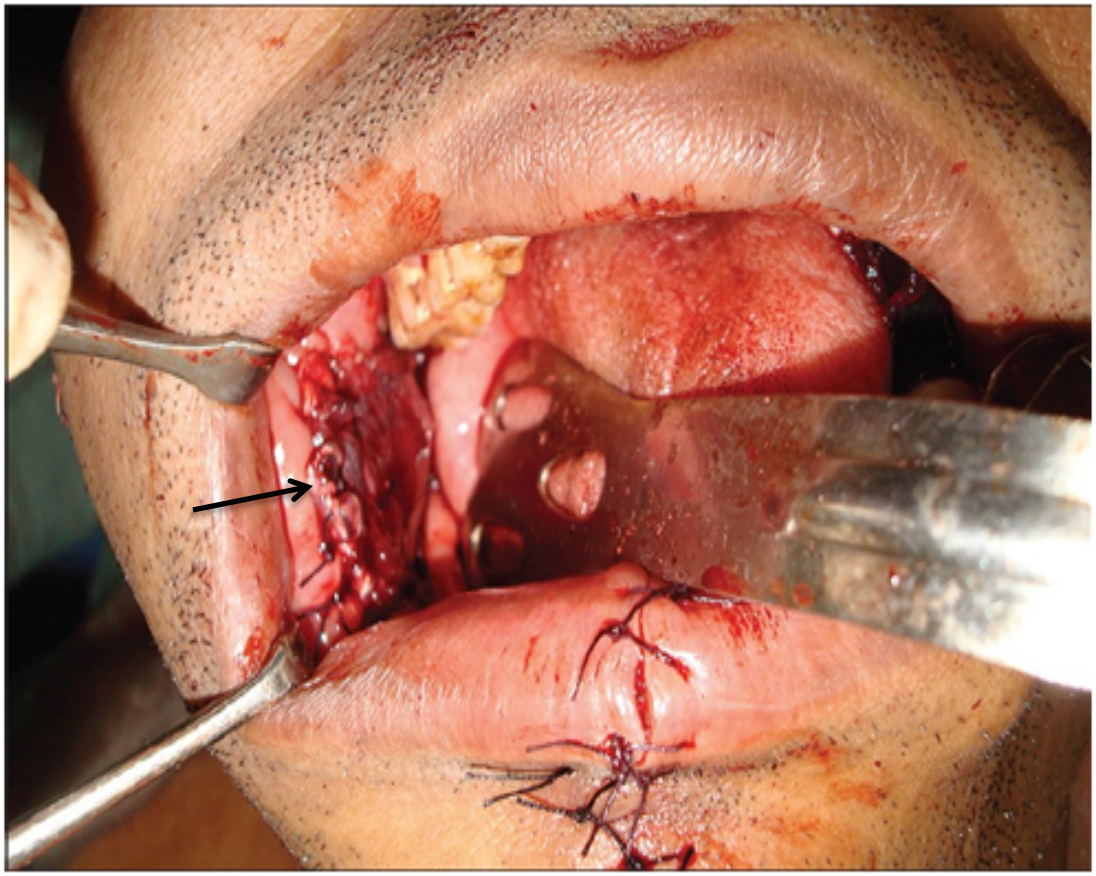


Photo 16: Flap discoloration during the 2nd post- operative day

OBSERVATIONS AND RESULTS

The present study **"Evaluation of usefulness of Supraclavicular flaps with respect to functional and aesthetic outcome in reconstructing head and neck defects"** was conducted in the department of Otorhinolaryngology, R.L.Jalappa Hospital and research centre, Tamaka, Kolar attached to Sri Devaraj Urs Medical College, during the time period of January 2014 to June 2015.

We included in our study a total number of twenty five patients who were admitted to the hospital during this time period. All the cases fulfilled the inclusion and exclusion criteria. After admission the patients were explained regarding the details and the purpose of the study. An informed, written consent was taken from the patient.

We elicited a detailed clinical history from each of these patients. All patients were examined in detail. The patients were counselled preoperatively. They underwent the surgery under general anaesthesia and were followed up monthly following the surgery for a minimum period of 6 months.

Patient Demographics

A total number of **twenty five** patients were included in this study **(n=25).**

All patients were diagnosed histologically as **Squammous cell carcinoma**.

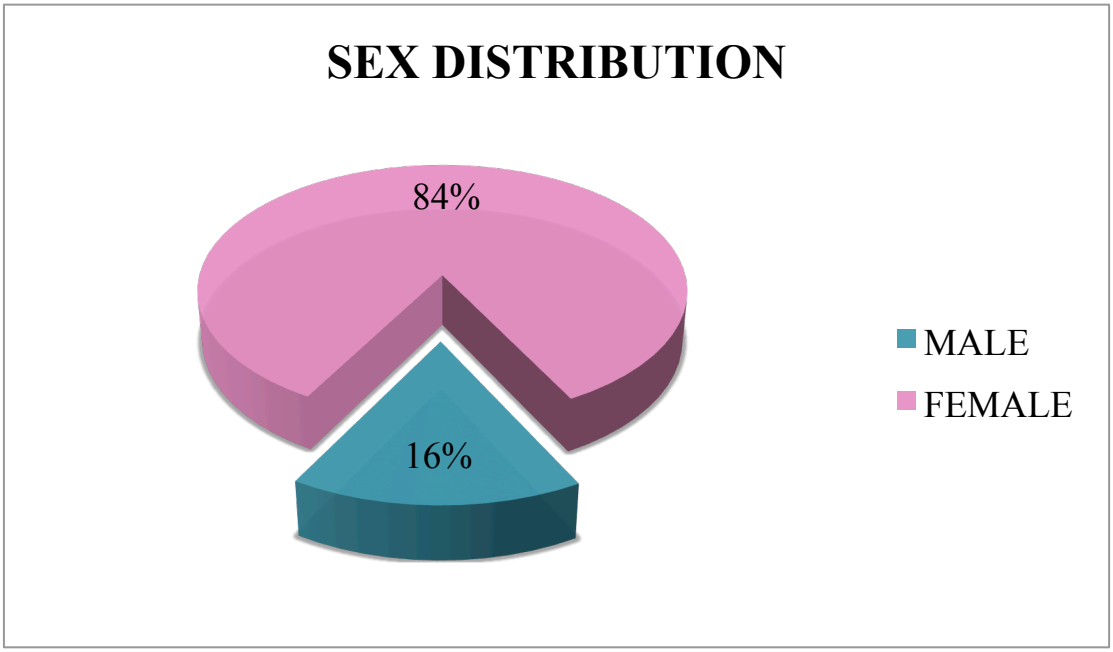


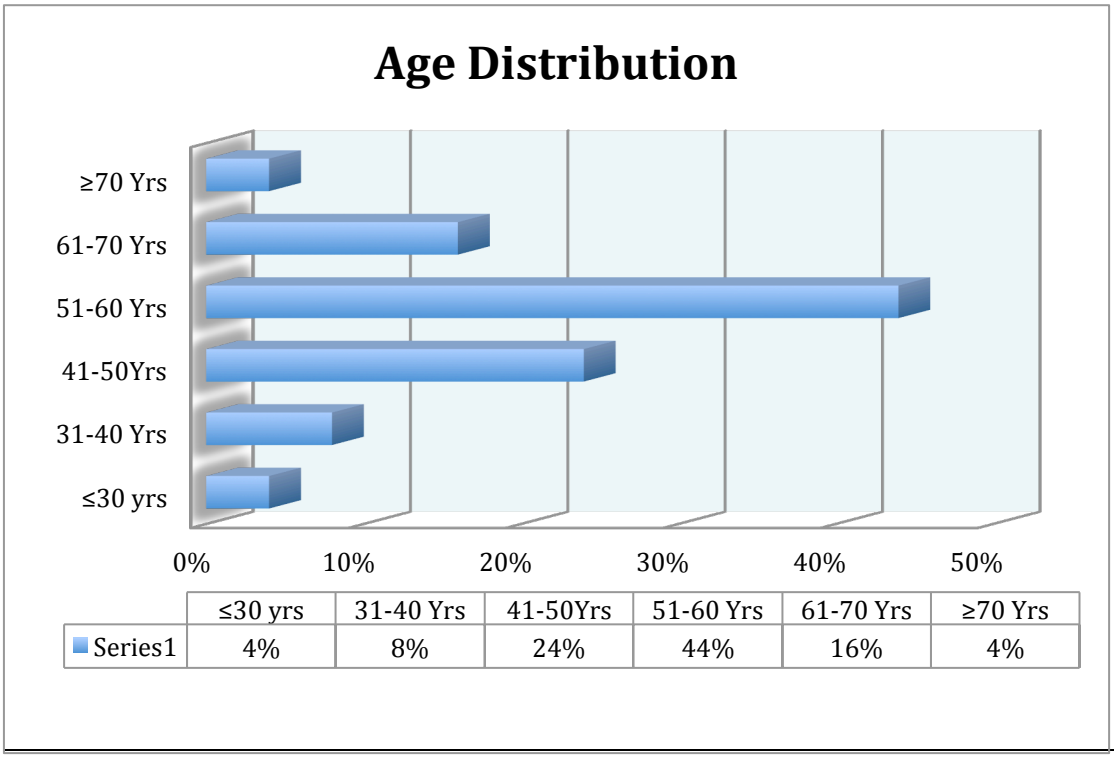
Fig 8 : Distribution Of Patients According To Gender

Among 25 patients, **4 were male (16%)** and **21** patients **were female (84%)**.

Table 6 : Age Distribution

Age Group	Number of Cases	Percentage
≤ 30 Years	1	4%
31 – 40 Years	2	8%
41 – 50 Years	6	24%
51 – 60 Years	11	44%
61 – 70 Years	4	16%
≥ 70 Years	1	4%
Total	25	100%

Fig 9: Age Distribution



Majority of our patients were between 40 and 60 years of age

Table 7: Distribution of cases according to clinical TNM Stage

	T_2	T_3	T_{4a}
N_0	5	1	-
N_1	8	1	-
N_{2b}	2	2	6

Maximum number of cases belonged to the T_2 staging comprising 15 patients (60%) while least number of patients belonged to the T_4 category comprising 6 patients (24%).

Fig. 10: Distribution of cases according to clinical TNM Stage

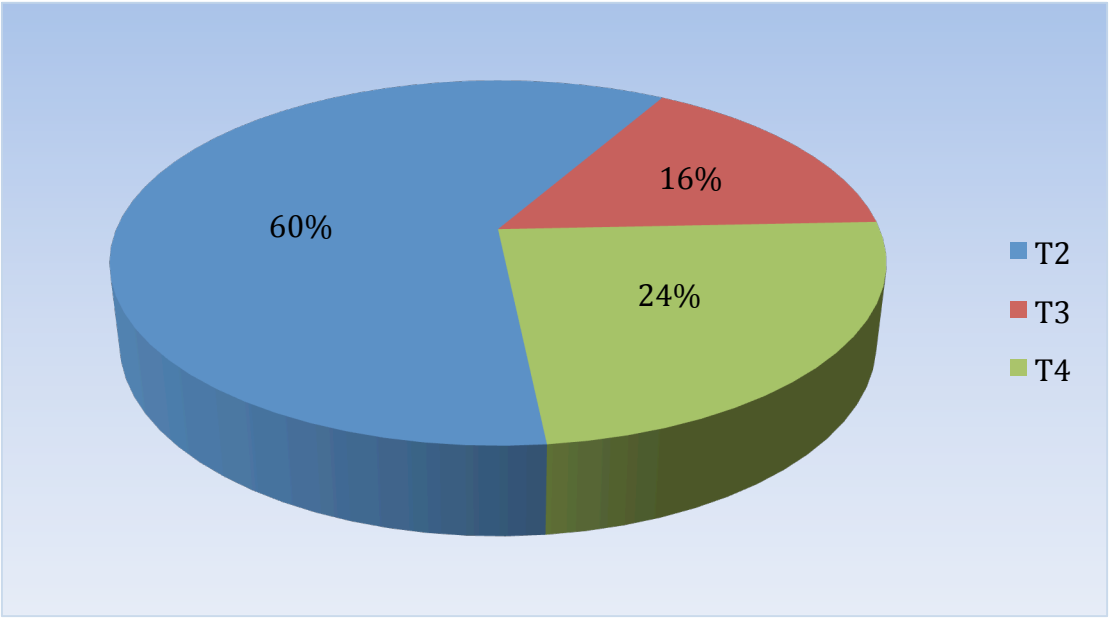
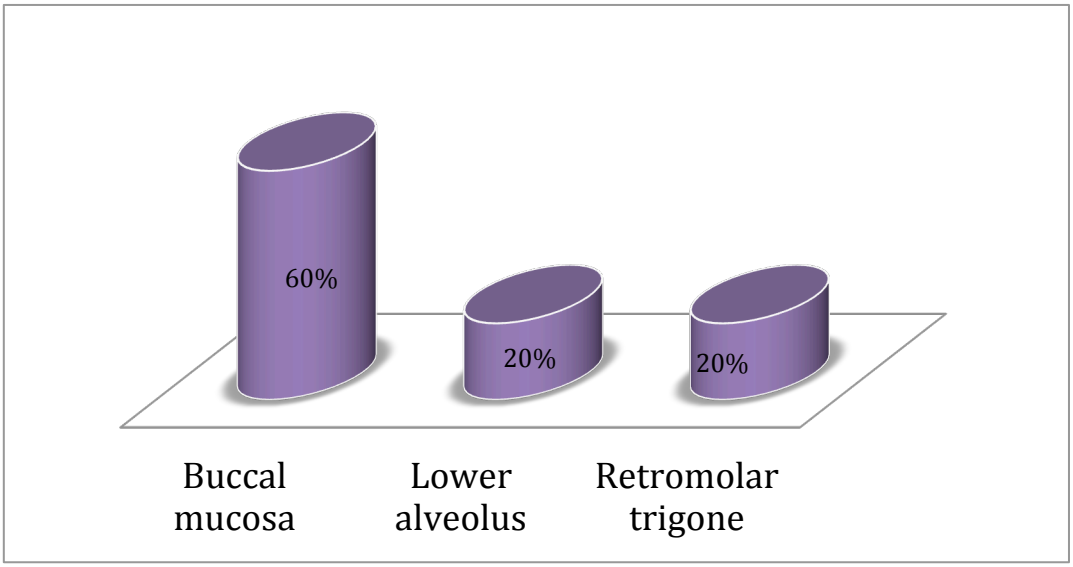


Table 8 : Distribution of cases according to the site of the lesion.

Epicentre of the lesion	No. of cases	Percentage
Buccal mucosa	15	60%
Lower alveolus	5	20%
Retromolar trigone	5	20%

Fig.11: Distribution of cases according to the site of the lesion.



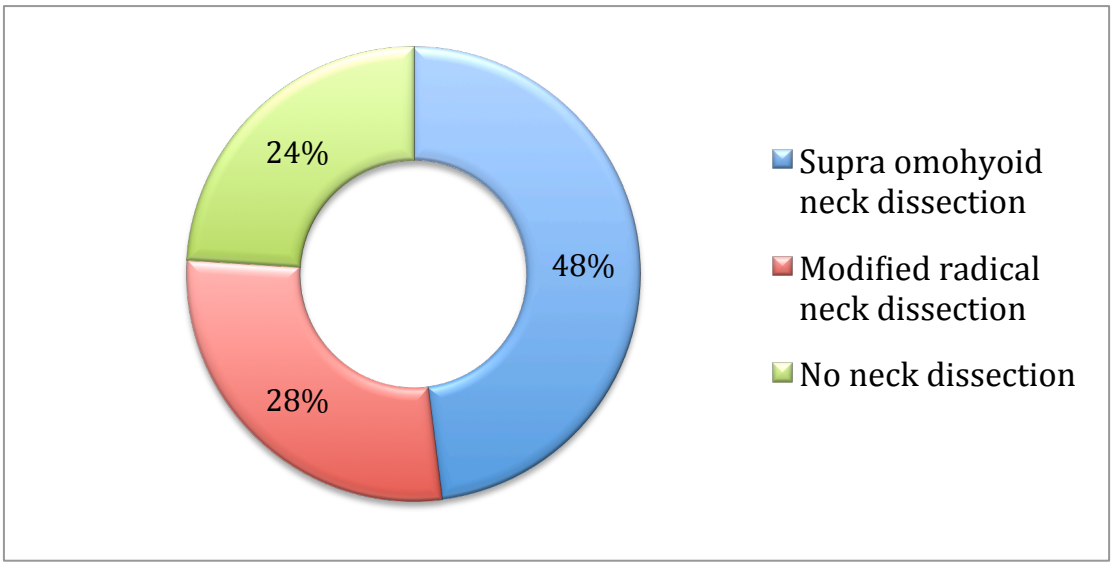
Amongst all the cases that we included in our study, majority had the epicenter of the lesion situated in the buccal mucosa constituting 60% of our cases. 20% of our patients had the epicenter of the lesion in the lower alveolus and retromolar trigone repsectively. (Table 8, Figure 11).

NECK DISSECTION

Table 9 : Distribution of cases according to neck dissection

NECK DISSECTION	No. of cases	Percentage
Supraomohyoid neck dissection(SOHD)	12	48%
Modified radical neck dissection (MRND)	7	28%
No Neck dissection	6	24%

Fig 12: Distribution of cases according to neck dissection

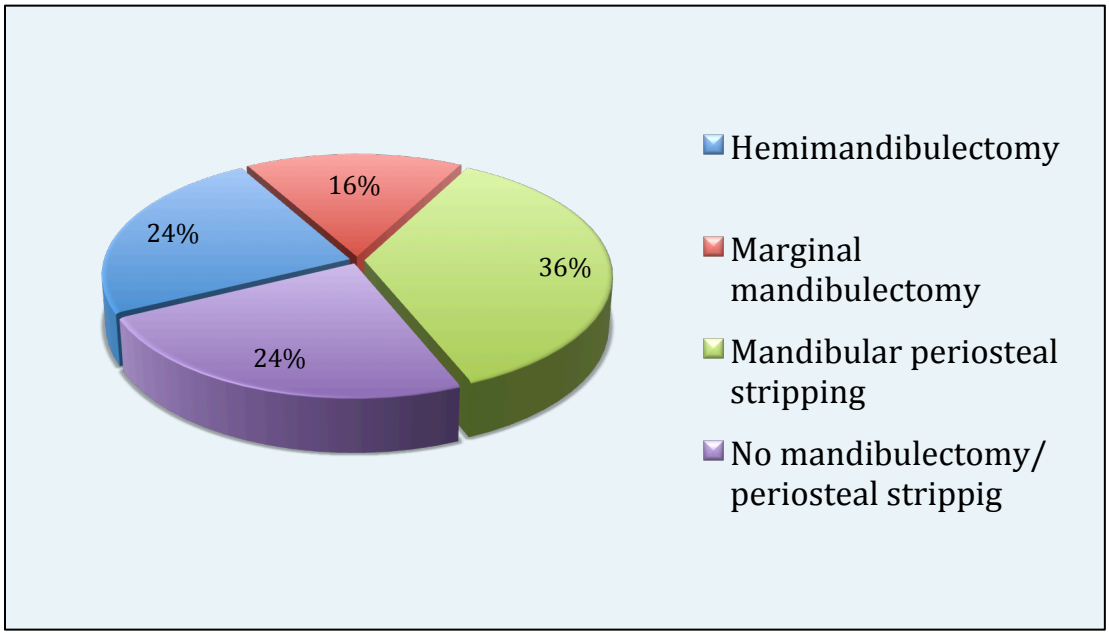


19 Patients (76%) who had clinically palpable lymph nodes underwent a subsequent neck dissection along with the wide excision. 12 patients underwent supra-omohyoid neck dissection, while 7 patients underwent modified radical neck dissection. 6 Patients who did not undergo neck dissection were clinically N_0 and did not have detectable lymph nodes on ultrasonography (USG) scan of neck.

Table 10: Mandibulectomy

Mandibulectomy	Clinical staging		Site of the lesion		Mandible involvement	Cases	%
Hemimandibu-lectomy	$T_{4a}N_{2b}M_X$		RMT	5	Yes	6	24%
			Buccal Mucosa	1	Yes		
Marginal mandibul-ectomy	T_3N_{2b}	2	Buccal Mucosa	4	No	4	16%
	T_2N_{2b}	2			No		
Mandibular periosteal stripping	T_2N_1	8	Buccal mucosa	4	No	9	36%
	T_3N_0	1	Lower alveolus	5			
No mandibulectomy/ periosteal stripping	T_2N_0	2	Buccal mucosa	6	No	6	24%
	T_2N1	3					
	T_3N_0	1					

Fig 13 : Mandibulectomy



6 (40%) patients were clinically staged T_{4a} due to ispsilateral mandible involvement by the tumor (skin was not involved by the lesion). All the 6 patients underwent hemimandibulectomy. 4 patients underwent marginal mandibulectomy for cleareance of the disease. 9 patients underwent mandibular stripping due to close proximity of the lesion to the adjacent mandible. 6 patients did not undergo mandibulectomy nor periosteal stripping since an adequate margin was present all around the malignant lesion.

Table 11 : SUPRACLAVICULAR ARTERY FLAP DETAILS

Variables		Mean (Cm)
Defect Dimension	Defect Length	4
	Defect Width	3.7
Flap Dimension	Flap Length	5.8
	Flap Width	5.62
Skin Paddle Dimension	Paddle Length	5.2
	Paddle Width	5.0
Average time taken to raise the flap		50.2 mins

DISTRIBUTION OF CASES ON THE BASIS OF FLAP PATTERN

Table 12: Flap pattern

Flap Pattern	No. of Cases	Percentage
Vertical axis pattern	**18**	**72%**
Horizontal axis pattern	**7**	**28%**

Fig. 14: Flap Pattern

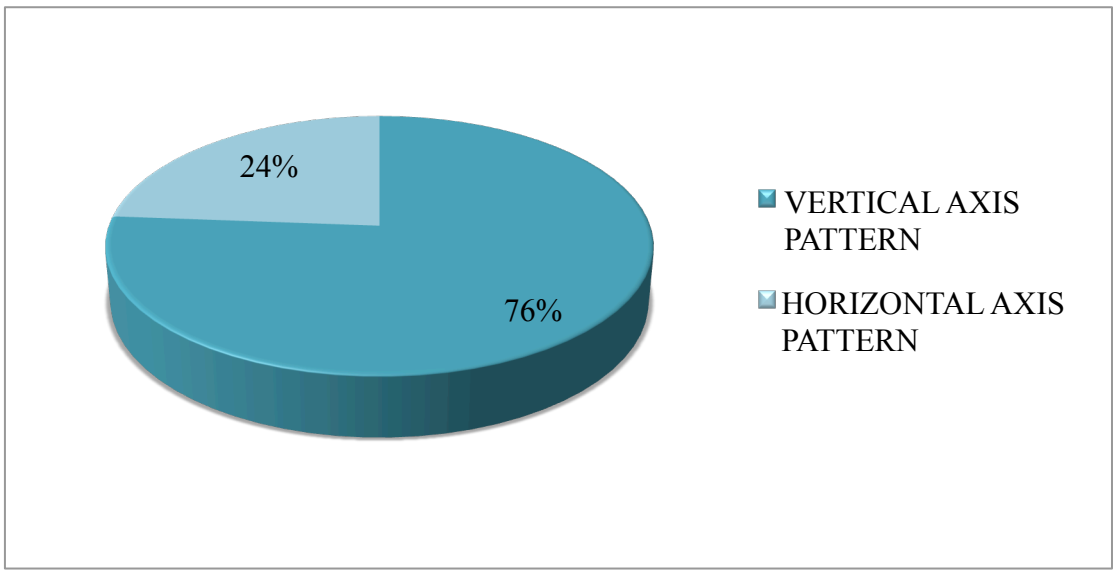


Table 12 and Figure 14 depict that the maximum number of flaps (76%) that were raised in our study was vertically based.

When vertically based and horizontally based flaps were compared, the horizontally based flaps performed better with respect to cosmesis at the donor site, whereas, vertically based flaps performed better with regard to overall outcome.

We made important observations in our study regarding flap patterns.

Vertically patterned flaps :

- Gave a better length
- Provided a more tension free arc of rotation, especially in case of posterior defects where more length was required.

Horizontally patterned flaps :

- Were more preferred for anteriorly defects were less than 10 cm length was required

OUTCOME OF THE SUPRACLAVICULAR FLAP

Table 13: Outcome of the Supraclavicular Flap

Flap Outcome			No. of Patients	Percentage
Flap Healthy			18	72%
Flap Necrosis	Post Op Day 2 (Venous congestion)	5	7	28%
	Post Op Day 8 (Infection at donor site)	2		

Fig. 15: Outcome Of The Supraclavicular Flap

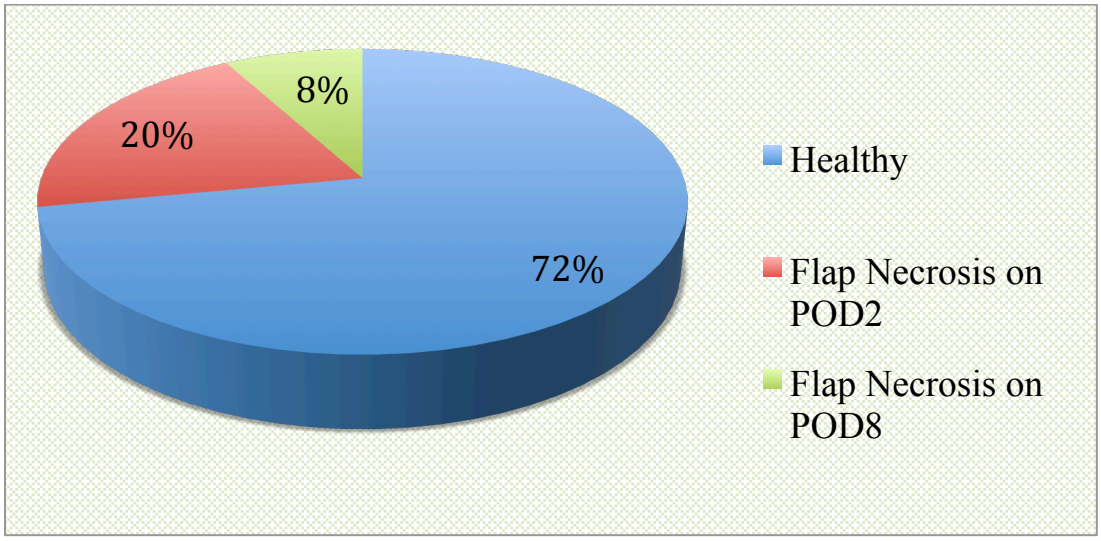


Table 13 and Figure 15 depict the distribution of cases on the basis of the flap outcome.

In the immediate postoperative period, we experienced flap discoloration in a total of eight patients.

All patients who had flap discolouration on the 2nd post op day were immediately treated with low molecular weight heparin and sutures were released in the vicinity of discolouration. Amongst these, three patients regained their flap colour within 2 days while five patients had complete flap necrosis by the 4th post operative day.

Two patients developed infection at the site of the flap leading to subsequent wound dehiscence and complete flap necrosis within 8th postoperative day of the surgery.

In total we experienced seven complete flap necrosis. In these patients we performed a wound debridement and covered the defect using a pectoralis myocutaneous flap (PMMC).

Apart from these seven cases of flap necrosis, the rest of the patients (72%) the flaps were healthy.

In all patients who had flap discolouration and subsequent complete flap necrosis, the external jugular vein was ligated either as a part of modified radical neck dissection or due to the vein obstructing the arc of rotation, thereby causing inadequate length of the flap reaching the defect.

CASES REQUIRING EXTERNAL JUGULAR VEIN LIGATION

Table 14: Cases requiring external jugular vein ligation

EXTERNAL JUGULAR VEIN LIGATION	No of Cases	Percentage
NO	**17**	**68%**
YES	**8**	**32%**

Fig 16: Cases requiring external jugular vein ligation

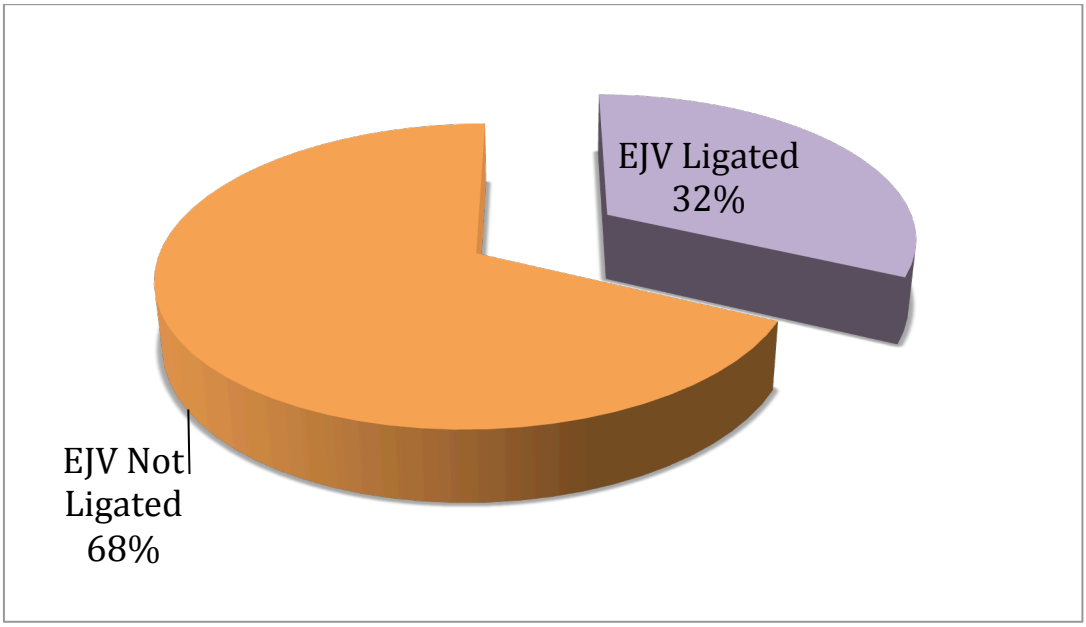
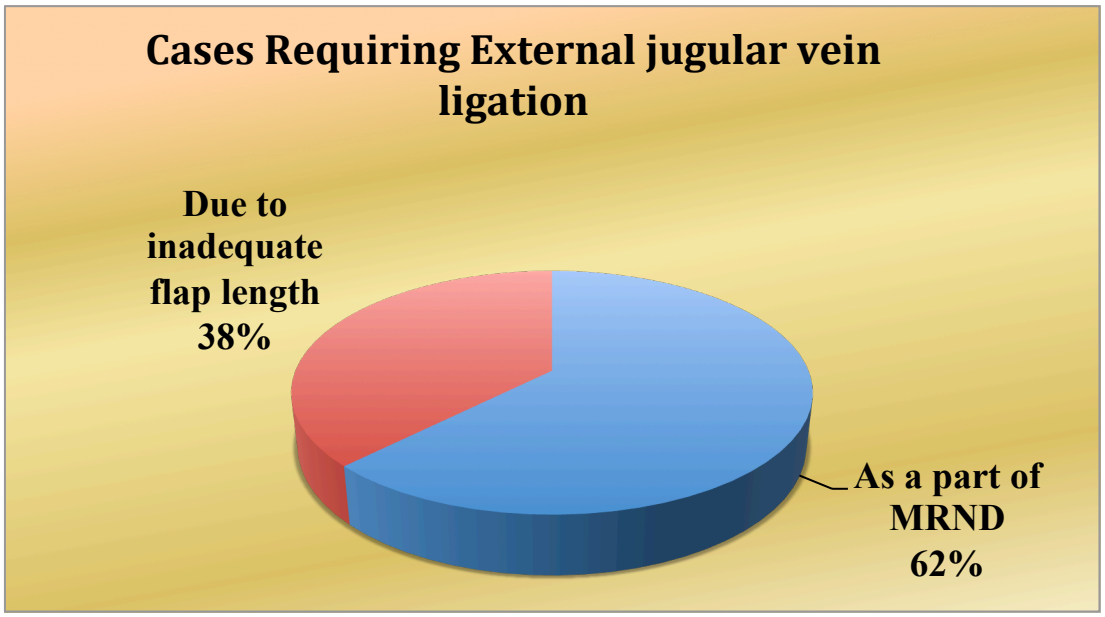


Table 15 : Reason for external jugular vein ligation

Reason for External jugular vein ligation	No. Of cases	Percentage
As a part of modified radical neck dissection	**5**	**62%**
Due to inadequate flap length	**3**	**38%**

Fig 17: Reason for external jugular vein ligation



A total of eight patients underwent external jugular vein ligation.

- Five Patients had the external jugular vein ligated as a part of the modified radical neck dissection.
- The rest three patients had to undergo the EJV ligation due to inadequacy of the flap length to reach the defect.

POSTERATIVE RADIOTHERAPY AND CHEMOTHERAPY

Fig.18 : No. of patients who underwent radiotherapy and chemotherapy

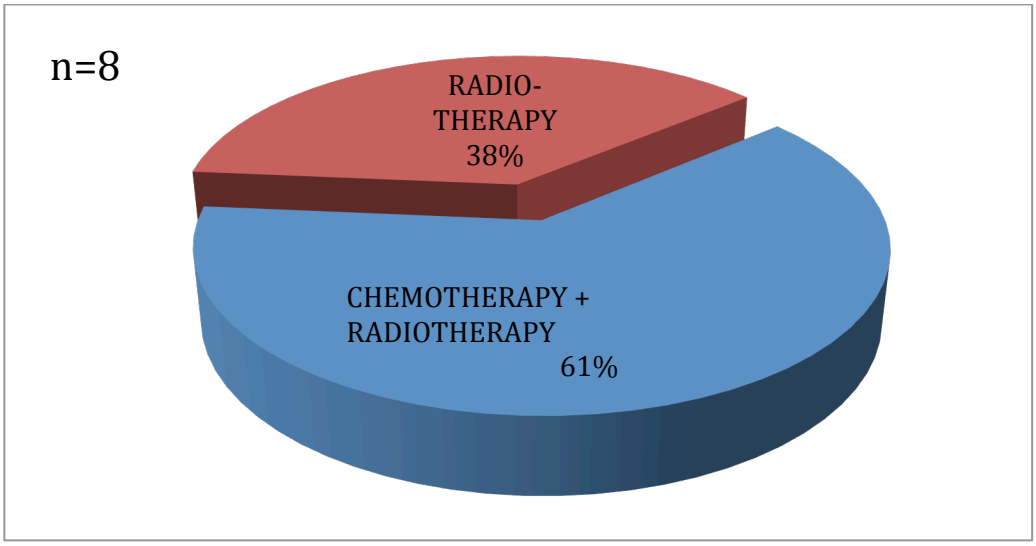


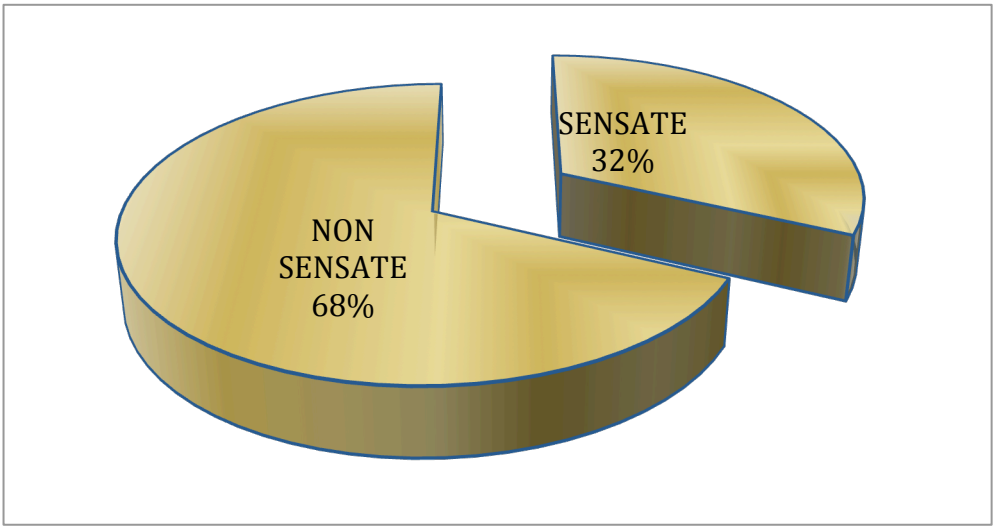
Figure 18 depicts the number of patients who underwent chemotherapy and radiotherapy.

5 patients underwent adjuvant chemoradiotherapy following surgery, while 3 patients underwent only radiation following surgery. Patients who had close / margin involvement were subjected to radiotherapy (35 fractions to the tumor bed) while those with perinodal metastasis were given chemotherapy with cisplatinum and 5 Flurouracil. Those who had both positive margins as well as perinodal metastasis received adjuvant chemoradiation.

Flap was healthy in all patients after receiving radiation to the tumor bed.

SENSORY INNERVATION

Fig 19: Sensate v/s Nonsensate flaps



We also observed that 8 of our patients consistently complained of referred pain to the donor site

- 5 of them had this pain only while chewing food
- 3 patients had dull aching pain present throughout the day.

This was probably due to preservation of the supraclavicular nerves during the surgery.

In subsequent patients, the supraclavicular nerves were carefully denervated from the cervical plexus and these patients did not have referred pain in the post operative period.

FUNCTIONAL AND AESTHETIC OUTCOME SCORE RESULTS

Post operatively patients were followed up monthly and assessed in detail with respect to various aspects. Possible local / distant recurrence of disease, functional outcome with respect to mouth opening, ability to chew food, aesthetic outcome with respect to patient satisfaction were measured and documented using a scoring system.

Scoring was given on seven parameters, to evaluate functional and aesthetic outcome with respect to the flap.

The total scores ranged from 0 to 70

(Each parameter scored out of 10 points)

Table 16:Functional and Aesthetic Outcome Scores

Total score	Inference	No. of Patients	Percentage
0-20	Poor functional and aesthetic outcome	7	29%
21-40	Good outcome	3	13%
41-70	Excellent functional and aesthetic outcome	14	58%
1 patient could not be assessed due to recurrence.			

Fig 20: Functional and Aesthetic Outcome Scores

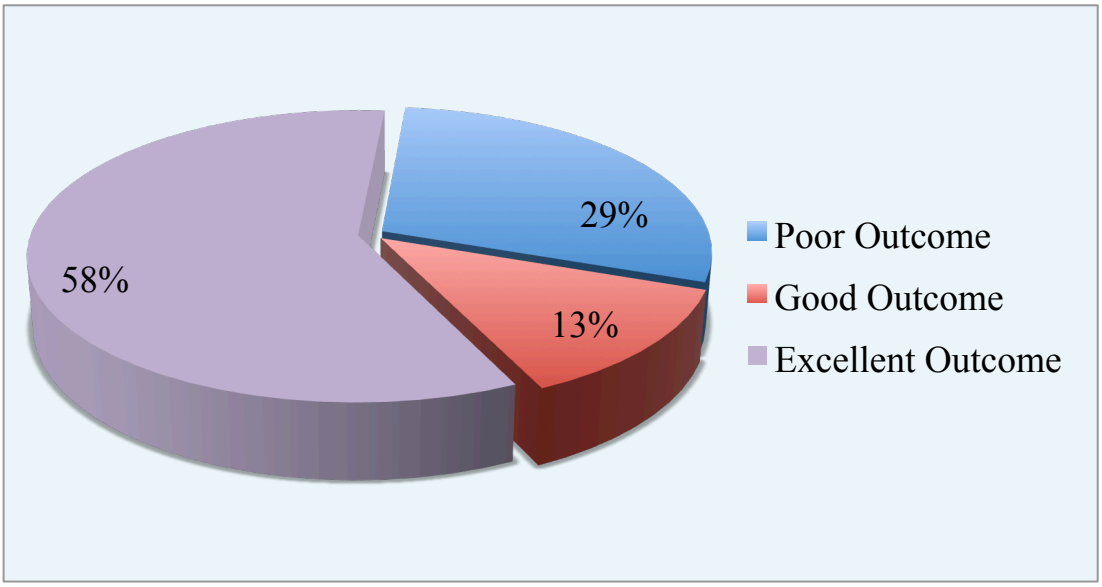


Table 16 & Fig 20 show the functional and aesthetic outcome score in our present study.

14 patients had an excellent outcome score (58%),3 patients had a good outcome score (13%), while 7 patients had a poor outcome score (58%).

One patient, who had deferred radiotherapy post surgery, presented with a local recurrence 2 months later and could not be evaluated for aesthetic and functional outcome, even though the flap was healthy in spite of the local recurrence. This patient was eventually lost during follow-up period.

To summarize, out of 25 patients who were included in the study in total, 7 patients had complete flap necrosis, of which, 5 patients underwent a complete flap necrosis in the immediate post operative period while 2 patients developed infection at the site of flap leading to flap necrosis.

Of the 5 patients who underwent complete flap necrosis, 3 patients had a horizontal axial flap while 2 had a vertical axial flap. All 5 patients had the External jugular vein ligated during the procedure.

Out of 8 patients who developed flap discoloration, 3 regained the flap color. All these patients had a vertically designed flap and all underwent external jugular vein ligation, however care was taken to preserve atleast one draining vein.

Table17: Association of flap status with flap design, infection, and EJV status

FLAP STATUS	INFECTION	FLAP DESIGN (AXIS)		EJV STATUS	
FLAP NECROSIS (7 patients)	2	VERTICAL	2	All 5 patients EJV ligated	
		HORIZONTAL	3		
FLAP HEALTHY (18 patients)	NIL	VERTICAL	17	NOT LIGATED	15
		HORIZONTAL	1	LIGATED	3

Among 7 patients who had a complete flap necrosis, 3 patients had a horizontally based axial flap while 2 had a vertically based patterned flap. All 5 patients had the external jugular vein ligated which would have been one of the major contributing factors leading to venous congestion disturbing the vascular integrity of the flap leading to complete flap failure.

All 18 patients who had a healthy flap in the post operative period had a vertical axial designed flap. Amongst these, 15 patients did not undergo external jugular vein ligation while 3 patients underwent EJV ligation.

Table 18: Association between Functional outcome score with flap design, EJV ligation and intact sensory innervations

FUNCTIONAL OUTCOME SCORE	%	FLAP DESIGN (AXIS)		EJV LIGATED	SENSATE
EXCELLENT	58%	VERTICAL	14	3	4
		HORIZONTAL	Nil		
GOOD	13%	VERTICAL	2	Nil	3
		HORIZONTAL	1		
POOR	29%	VERTICAL	4	5	1
		HORIZONTAL	3		

Majority of the patients (58%) had an excellent outcome score. All these patients had a vertically based axial flap and inspite of ligation of EJV in 4 patients, the flaps survived. This was attributed to the preservation of atleast one transverse cervical vein . Eventhough 4 patients only complained of dull boring pain at the donor site, they performed well as far as other attributes were concerned.

Table 19 : Association between mandibulectomy, epicenter,T staging and local recurrence.

Mandibulectomy	Clinical staging		Epicenter		Mandible involvement	Recurrence
Hemimandibulectomy	$T_{4a}N_{2b}M_X$		RMT	5	Yes	1
			Buccal Mucosa	1	Yes	
Marginal mandibulectomy	T_3N_{2b}	2	Buccal Mucosa	4	No	Nil
	T_2N_{2b}	2			No	
Mandibular periosteal stripping	T_2N_1	8	Buccal mucosa	4	No	Nil
	T_3N_0	1	Lower alveolus	5		
No mandibulectomy/ periosteal stripping	T_2N_0	2	Buccal mucosa	6	No	Nil
	T_2N1	3				
	T_3N_0	1				

Majority of the patients who underwent hemimandibulectomy had the epicenter of the lesion in the buccal mucosa and were clinically staged T_4.One patient deferred chemoradiotherapy postoperatively and presented with a local recurrence 2 months later.

Patients in whom the lesion was close to the adjacent mandible but did not have clinically/ radiological evidence of mandible involvement underwent periosteal stripping following wide excision to obtain disease clearance. All the patients had the epicenter of the lesion in the lower alveolus.

DISCUSSION

The expected esthetics of the head and neck region in terms of color, texture match, and the functional dexterity that is desired, make any reconstruction in this region a very challenging one. Even though primary closure and release of contractures, or split skin grafting are available options for closure of small buccal mucosal defects, they have many disadvantages. The lack of color and texture match, chance of re-contracture etc lead to poor esthetic outcome and dissatisfaction amongst patients. At the other end of the spectrum, options like ultra thin free flaps need specialized equipment and long operative time.

Unlike the pectoralis major myocutaneous flap which is the workhorse for reconstruction in developing countries, the supraclavicular flap doesn't include a muscular paddle, thereby being lighter in weight and a potential advantage for lining reconstructions. The pedicle of this flap is superficial and a straight forward dissection of the flap can be achieved by keeping the dissection limited to the subfascial plane.

Donor site morbidity of pectoral major flap includes loss of anterior axillary fold, distortion of breast in females, and minor functional deficit due to loss of muscle.[61]

Donor site morbidity of radial free forearm flap includes need of skin graft to close donor area, tendon injuries, reduced strength of grip power, and sensory disturbances.[60]

In this study, we operated 25 patients who were diagnosed and confirmed with oral squammous cell carcinoma staged T_2 and above. All patients underwent reconstruction using the supraclavicular artery flap and were followed up every month for at least 6 months during which they were assessed for the functional and aesthetic outcome using a scoring system. The details of the scoring system as mentioned earlier comprised of 7 attributes. Each attribute was given a score of 10, if the patients experienced that attribute while a score of 0 was given if the patient did not experience that particular attribute.

14 patients had an excellent outcome score (58%), 3 patients had a good outcome score (13%), while 7 patients had a poor outcome score (58%).

The cervical region is functionally and anatomically designed to achieve maximum range in three dimension motion. Furthermore the cervical area, as does the facial region, functions as a medium to interact with human society;

hence optimal cosmetic results for reconstruction of cutaneous defects in these regions are best accomplished using local tissue.

The vascularity of the flap comes from the transverse cervical artery in 93% of cases while in 3 % it takes origin from branch of the suprascapular artery.[32]

In our study we found the supraclavicular artery to arise from the transverse cervical artery in 100% of cases. This was similar to the study performed by Pallua and Magnus Noah .[37,38] However in contrast to this observation other studies in literature have shown the supraclavicular artery to airse from transverse cervical in 62.9% and from the suprascapular artery 37.1% in 28 dissections from 14 cadavers.[56]

After raising the flap, we found the transverse cervical artery to be consistently present in a triangle formed by the dorsal edge of the sternocleidomastoid, the external jugular vein and the medial portion of the clavicle. With respect to surface marking, the supraclavicular artery arose above the middle one 1/3rd of the clavicle in 95% of our patients while in 5 % , the artery was found to arise from the lateral third. Similar observations have been made in other studies, in which this artery was found the artery to arise from the middle third of the clavicle in 90% of patients and from the lateral one third in 10%.[38] It should be noted that there has been contrasting variance with respect

to the anatomical location of the supraclavicular artery as quoted in one study where the artery was found to arise from the middle third of clavicle in 33.3% and from lateral one third in the remaining 44.4%. It was also noted that the take off of the supraclavicular artery was located 22.2mm superior to the upper border of the clavicle.[56]

In our study, the average dimension of the flap was approximately 5.8cm x 5.6 cm. All donor-site defects were closed primarily. These flap dimensions are similar to those of other reports using the SAI flap for reconstruction of oncologic defects of the head and neck.[27,47,58,59] Other studies examining the SAI flap for neck and mentosternal contracture after burn injuries have used much larger flaps and with preoperative expansion, flaps have been raised 14 cm wide and 35 cm long.[49] In one study, 3.8% of patients required a skin graft to cover the donor site; however, all other donor sites were closed primarily. Our flap harvest time was 50 minutes which was similar to other studies where less than 1 hour was required to harvest the flap.[27,47,58,59.] Mean harvest time in radial free forearm flap is 76 min[60] and additional time for microvascular anastomosis prolongs surgery compared to supraclavicular artery flap. In our study no handheld Doppler was used to trace vascular pedicle.

The maximum dimension of the flap that was successfully harvested (without post operative flap complications) measured 20x10cm. Successful elevation of the flap is particularly important with respect to the basic flap

survival area. This area is regulated by choke vessels which links the main blood flow to the flap and neighboring anatomical territory as described by Lamberty and Cormack.[45]

Dye injection studies show that the area of the angiosome supplied by the supraclavicular artery ranges from 10 to 16 cm in width and 22 to 30 cm in length.[32]

The most common complication we encountered was flap discolouration which occurred on the 2nd post operative day in all 8 patients who underwent EJV ligation. 5 patients recovered from the flap discolouration by the end of 1st post operative week after release of few sutures and tension along with anticoagulant therapy. Complete flap nercrosis occurred in the remaining 3 patients. 2 patients developed infection 1 week after surgery at the recipient site. Both these patients developed flap necrosis. The probable reason for the flap discoloration and subsequent flap necrosis was due to ligation of the external jugular vein which we performed in 8 patients. Similar to our observation most authors suggest preservation of the venous drainage within the fascial pedicle itself to maintain the vascular integrity of the flap.[61,37,27,42]

To our knowledge only one author has mentioned that in order to get a better arc of rotation, the external jugular vein can be divided, since it contributes for a secondary drainage of the flap.[63] However it should be borne

in mind that in such circumstances, one draining vessel should be constantly present.

The other factor that contributed to the poor score in these patients was a constant dysthesia at the donor site which did not respond to analgesics. As discussed earlier, this was related to the preservation/ incomplete denervation of the supraclavicular nerves from the cervical plexus. Similar observations have been reported in few other studies and authors recommend to cut the supraclavicular nerves from the plexus in order to prevent dysethesia . However, in view of free flaps, the supraclavicular nerves might be preserved for anastomosis to a sensory nerve at the recipient site. This might be important in the maintenance of adequate cutaneous sensation, as well as its restitution of function for particular defects where function is intrinsically dependant on sensation, such as the hand or pharynx.[38,54]

Another complication which contributed to the decrease in the functional and aesthetic outcome score was the development of infection at the recipient site, occurring in 2 of our patients. This occurred, in spite of maximum efforts to maintain a good intra-oral hygiene, minimal handling of the flap, ensuring adequate hydration and good nutritional status in the post operative period. These patients did not respond to cephalosporin group of antibiotics and were found to be positive for MRSA (Methicillin Resistant Staphyloccus Aureus) during subsequent culture and sensitivity.

We also have observed that this flap can be safely elevated upto 20x10cm , maintaining maximum arc rotation upto 180 degrees. Obtaining adequate length can be a major setback in this flap especially with respect to posterior defects. However in case of inadequate length, extension of the proximal fascial pedicle can be performed 3 cm lateral from the identified vascular pedicle at clavicle. Further release of supraclavicular fascia over the clavicle in the subperiosteal plane gives significant release to reach the defect without tension. For a better rotation, the flap can be designed extending it vertically to the infraclavicular area.[54] In such circumstances one should be well aware of the angiosomes of the flap and hence skin paddle beyond the inferior aspect of the angiosome should be avoided keeping in mind its random vascularity.[54]Vascularity might also be compromised in patients who have received radiation to the neck and alternative reconstructive techniques may be considered.

Among 25 patients, 7 patients underwent supraoomohyoid neck dissection while 12 patients underwent modified radical neck dissection. 3 patients received post operative adjvuvant radiotherapy to the tumor bed while 5 patients received adjuvant chemoradiotherapy. We found that neck dissection did not compromise survival of the flap as long as the vascularity and venous drainage system was kept intact. Patients who received radiation to the tumor bed did not have any complications associated with the supraclavicular flap. These observations were similar to studies performed by Razdan, who

concluded in his studies that neck dissection or radiation did not compromise the viability of this flap.[64]

In the initial part of the study we used the horizontal axial pattern of the flap but in subsequent cases with posterior defects, the flap length required was more. In such cases we used vertical patterned flap and found it more useful and safe in reaching the defect. This pattern not only gave adequate length, but also gave a good arc of rotation upto 180 degrees without exerting any tension/torsion on the pedicle. These observations were similar to cadaveric microangiographic studies describing a cervicopectoral flap pattern with the main blood supply coming from the perforator of the transverse cervical artery.[65]

To highlight, the main advantages of the supraclavicular artery are:

(1) Elevation of flaps is relatively easy.

(2) If the flap has a small design, donor sites morbidity is minimal.

(3) Operating time is shorter.

(4) Texture and color match is better than using other donor sites.[55]

However the disadvantages include:

(1) if the skin design is too large, to close the donor site, a skin graft might be required.

(2) This flap may not be of good value in patients having T3/T4 disease requiring modified radical neck dissection, where there would be a possibility of damage to the main vascularity of this flap. However it should be noted that performing a modified radical neck dissection is not a contraindication for the use of this flap, if a careful technique is employed to preserve the vascular pedicle.[55]

Supraclavicular flaps have been recently successfully also used in reconstructing defects of the pharynx, parotid region and lateral skull base including total auriculectomy defects.[56]

This flap is a very good option in patients with multiple morbidities who are not fit for long surgical procedures.

CONCLUSION

- There is a high incidence of oral cancers among lower socioeconomic group, especially females, in Kolar region.

- Majority of the patients had T_2 lesion involving buccal mucosa and all patients were histologically confirmed as squammous cell carcinoma.

- All patients underwent wide excision of the tumor with reconstruction of the defect using the supraclavicular flap.

- The supraclavicular flap based on the supraclavicular artery was a branch of the transverse cervical artery in all our cases.

- The transverse cervical artery was consistently found in the triangle formed by the dorsal edge of the sternocleidomastoid(SCM) anteriorly, the external jugular vein (EJV) posteriorly and medial part of the clavicle inferiorly.

- The vascular territory of the supraclavicular artery extended from the supraclavicular region to the ventral surface of the deltoid muscle.

- The maximum dimension of the flap we successfully harvested measured 20cm in length and 10cm in width.

- Most common complication we encountered was flap discoloration which occurred in 8 patients; complete flap necrosis occurred in 5 patients and 4 patients had dysthesia at the donor site.

- The transverse cervical vein should be preserved in all cases to maintain the vascular integrity of the flap. However in cases where the transverse cervical vein could not be preserved, the external jugular vein was preserved.

- Preserving the supraclavicular nerve caused dysthesia in all our patients. After cutting the nerve from the cervical plexus, subsequent patients did not have this complaint.

- 58% of our patients had an excellent outcome score, 13 % had a good outcome while 29% had a poor outcome with respect to aesthetic and functional value.

- Horizontally patterned flaps were more preferred in anteriorly based defects where less than 10cm of pedicle length was required while

vertically patterned axial flaps were preferred in cases where more length was required.

- Supraclavicular flap was found to be safe in patients who subsequently received chemo-radiotherapy.

- This flap is a very good option in patients with multiple morbidities who are not fit for long surgical procedures.

Summary

Our study comprised of 25 patients of which, 4 were male and 21 were female. All patients were diagnosed and confirmed cases of squammous cell carcinoma of the oral cavity. Patients who were clinically staged T_2 and above were included in this study. These patients underwent a wide excision of the lesion, following which the supraclavicular flap was used to close the underlying defect. Average dimensions of the defects in our patients were 4cm x3.7cm while average dimension of the flap was 5.8cm x 5.62cm. Average time taken to raise the flap was 50 minutes. All patients had the donor site closed primarily. We encountered 7 complete flap failures and the defects in all these patients were reconstructed using the pectoralis major myocutaneous flap (PMMC). One patient had a local recurrence 2 months following surgery and could not be evaluated as she was lost during follow up. Remaining 17 patients were followed up after surgery and a scoring system was adopted to evaluate the functional and aesthetic outcome of the supraclavicular flap. 14 patients (58%) had an excellent outcome score, 3 patients (13%) had a good outcome while 7 patients (29%) had a poor outcome.

Reasons for poor functional outcome were related to significant details in surgical technique which included ligation of the external jugular vein, preservation of the supraclavicular nerves, raising horizontally patterned axial flaps which did not give adequate length causing tension and ultimately compromising the vascularity.

Among 7 patients who had a complete flap necrosis, 3 patients had a horizontally based axial flap while 2 had a vertically based patterned flap. All 5 patients had the external jugular vein ligated which would have been one of the major contributing factors leading to venous congestion disturbing the vascular integrity of the flap leading to complete flap failure.

All 18 patients who had a healthy flap in the post operative period had a vertical axial designed flap. Amongst these, 15 patients did not undergo external jugular vein ligation while 3 patients underwent EJV ligation.

Patients had a vertically based axial flap and inspite of ligation of EJV in 4 patients, the flaps survived. This was attributed to the preservation of atleast one transverse cervical vein.

Even though 4 patients had dysthesia at the donor site, they performed well as far as other attributes were concerned.

With recent CT angiographic studies, the angiosome of the flap has been further studied and has shown the distribution of its vascularity, thus enabling the surgeon to wisely design the safe dimensions of the flap.

The main advantages of using the supraclavicular flap were relatively easy elevation of flaps, donor sites morbidity was minimal, operating time was shorter and the texture and color match was better than other donor sites.

However the few disadvantages included requirement of a skin graft at the donor area if the flap harvested was too large and flap may not be viable in patients who have previously undergone radiation.

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ANNEXURE I

CONSENT FORM

I Mr/Mrs _____ have been explained in a language I understand, that I will be included in the study which includes use of tissue over the neck and shoulder for reconstructing the defects which will be a result of cancer surgery as planned for my treatment.

I understand this is a relatively new procedure which has given good results, according to previous studies performed and that this procedure involves short anaesthesia and surgical time compared to conventional procedures.
I have been made to understand that I will not incur any added expenditure other than investigations, materials and cost for the surgery for the treatment of cancer reconstruction.

I have also been made to understand that this study will require a 3 weekly follow up for a minimum period of 6 months and that I can withdraw myself from the study at any period of time and that there will be no compromise in my treatment in case I withdraw myself from the study.

I have been informed that in case of any adverse reactions occurs to me during the period of study , immediate appropriate treatment will be given by the attending doctor.

I have been informed regarding confidentiality that will be strictly maintained regarding my personal details throughout study and if details

regarding procedure needs to be published, I will be informed in advance prior to the publication.

I have been explained regarding the complications associated with the procedure such as failure of flap, possible need for secondary suturing , need for ICU admission and antibiotics in presence of infection.

I have understood the same and willingly give valid consent and agree to be a part of this study.

Patients signature/ thumb impression:

1st Witness signature : 2nd witness signature :

ರೋಗಿಯ ಮಾಹಿತಿ ಪತ್ರ

ಅಧ್ಯಯನದ ವಿಷಯ:– ಎವಲುಷನ್ ಆಫ್ ಯುಸ್‌ಫುಲ್‌ನೆಸ್ ಆಫ್ ಸೂಪ್ರಕ್ಲವಿಕ್ಯುಲರ್ ಫ್ಲಾಪ್ಸ್ ವಿತ್ ರೆಸ್ಪೆಕ್ಟ್ ಟು ದ ಫಂಕ್ಷನಲ್ ಅಂಡ್ ಆಸ್ತೆಟಿಕ್ ಔಟ್‌ಕಮ್ ಇನ್ ರೀಕನ್ಸ್ಟ್ರಕ್ಟಿಂಗ್ ಹೆಡ್ ಅಂಡ್ ನೆಕ್ ಡಿಫೆಕ್ಟ್ಸ್

ಕಿವಿ,ಮೂಗು ಹಾಗೂ ಗಂಟಲು ವಿಭಾಗ
ಶ್ರೀ ದೇವರಾಜು ಅರಸು ವೈದ್ಯಕೀಯ ಕಾಲೇಜು
ತಮಕ,ಕೋಲಾರ

ಪರೀಕ್ಷಿಸುವವರ ಹೆಸರು :– ಡಾ. ಬಿ. ವಗೀಶ್‌ಪಡೆಯರ್
ಮಾರ್ಗದರ್ಶಿಯ ಹೆಸರು:– ಡಾ. ಎಸ್.ಎಮ್ ಅಜೀಮ್ ಮೋಹಿದ್ದೀನ್
ಪ್ರೊಫೆಸರ್ ಹಾಗೂ ವಿಭಾಗ ಮುಖ್ಯಸ್ಥರು
ಕಿವಿ ಮೂಗು ಹಾಗೂ ಗಂಟಲು ವಿಭಾಗ

ಈ ಅಧ್ಯಯನವು ಕುತ್ತಿಗೆಯ ದೋಷವನ್ನು ಪುನರ್ರಚಿಸುವುದರ ಬಗ್ಗೆ. ಈ ಪುನರ್ರಚಿಸುವುದನ್ನು ರೋಗಿಯ ಕ್ಯಾನ್ಸರ್ ಗಡ್ಡೆಯನ್ನು ಸೂಪ್ರಕ್ಲವಿಕ್ಯುಲರ್ ಫ್ಲಾಪ್ಸ್ ತಾಂತ್ರಿಕತೆಯ ವಿಧಾನದಿಂದ ತೆಗೆದ ನಂತರ ಮಾಡಲಾಗುತ್ತದೆ. ಈ ಅಧ್ಯಯನ್ನು ಫ್ಲಾಪ್‌ನ ಮೌಲ್ಯಮಾಪನದ ಬಗ್ಗೆ ಹಾಗೂ ಕಾರ್ಯಸಂಬಂಧದ ಮತ್ತು ಅಂಗರಾಗ ಕಂತಿವರ್ಧಕ ಫಲಿತಾಂಶವನ್ನು ಮೌಲ್ಯಮಾಪನ ಮಾಡುವಾಗ ಸೇರಿಸಲಾಗುತ್ತದೆ.
ಈ ಅಧ್ಯಯನದ ಮೌಲ್ಯಮಾಪನವನ್ನು ಶಸ್ತ್ರಚಿಕಿತ್ಸೆ ಆದ ಮೇಲೆ ಮಾಡಲಾಗುತ್ತದೆ.ಪುನರ್ರಚಿಸಿದ ಭಾಗದ ಭಾವಚಿತ್ರ ಹಾಗೂ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆ ಮಾಡಿದ ಭಾಗವನ್ನು ಕಾಗದ ಪತ್ರಗಳ ಮೂಲಕ ತಯಾರಿಸಲಾಗುತ್ತದೆ.

ಈ ಅಧ್ಯಯನದ ತೆರಳಿನಲ್ಲಿ ಗೊಂದಲವೆಂದರೆ ಪುನರ್ರಚಿಸುವುದರ ಭಾಗದ ಸಾಧ್ಯತೆ ಕಡಿಮೆ ಇರುತ್ತದೆ,ಮತ್ತೆ ಶಸ್ತ್ರಚಿಕಿತ್ಸೆ ಮಾಡುವ ಸಾಧ್ಯತೆ ಇರುತ್ತದೆ. ಈ ಚಿಕಿತ್ಸೆಯಿಂದ ನಿಮಗೆ ಯವುದೇ ತರಹದ ಅಧಿಕ ಹಣವನ್ನು ಯಾವುದೇ ಪುನರ್ರಚಿಸುವ ಚಿಕಿತ್ಸೆಗೆ ತೆಗೆದುಕೊಳ್ಳುವುದಿಲ್ಲ.

ಈ ಚಿಕಿತ್ಸೆಗೆ 3 ವಾರಗಳ ಕಾಲಾವಕಾಶ ಬೇಕಾಗುತ್ತದೆ. ಈ ಸಮಯದಲ್ಲಿ ನೀವು ಈ ಚಿಕಿತ್ಸೆಯಿಂದ ಹೊರಹೋಗಬಹುದು. ನೀವು ಚಿಕಿತ್ಸೆಯಿಂದ ಹೊರಹೋದರೆ ಚಿಕಿತ್ಸೆಯ ಬಗ್ಗೆ ಯಾವುದರ ಬಗ್ಗೆ ರಾಜಿ ಇರುವುದಿಲ್ಲ, ಅಧ್ಯಯನದ ಸಮಯದಲ್ಲಿ ಯಾವುದೇ ರೀತಿಯ ಅಡ್ಡ ಪರಿಣಾಮ ಉಂಟಾದರೆ ವೈದ್ಯರು ಚಿಕಿತ್ಸೆ ಕೊಡುತ್ತಾರೆ. ರೋಗಿಯ ಅಧ್ಯಯನದ ಉದ್ದೇಶ ಖಾಸಗಿಯ ವಿಷಯ ಹಾಗೂಮಾಹಿತಿಗಳನ್ನು ಗೌಪ್ಯವಾಗಿ ಕಾಪಾಡಲಾಗುತ್ತದೆ. ಯಾವುದೇ ತರಹದ ಚಿಕಿತ್ಸೆಯ ಬಗ್ಗೆ ವಿಚಾರಿಸಬೇಕೆಂದರೆ ವೈದ್ಯರನ್ನು ನೋಡಿ ಪರಿಹರಿಸಿಕೊಳ್ಳಬಹುದು.

ಧನ್ಯವಾದಗಳು

ಪರೀಕ್ಷಿಸುವವರ ಹೆಸರು:– ಡಾ. ಬಿ.ವಗೀಶ್ ಪಡಿಯರ್

ಫೋನ್ ನಂ:– 09964839201

ANNEXURE II

PROFORMA

EVALUATION OF USEFULNESS OF SUPRACLAVICULAR FLAPS WITH RESPECT TO FUNCTIONAL AND AESTHETIC OUTCOME IN RECONSTRUCTING HEAD AND NECK DEFECTS

PATIENT NO :

NAME: HOSPITAL NO:

AGE: ___ YRS DATE:__/__/__

SEX: MALE/ FEMALE

RELIGION: OCCUPATION:

ADDRESS:

PHONE NUMBER : (M)_____

CHIEF COMPLAINTS :

DURATION of a) 1st complaint -

b) 2nd complaint-

HISTORY OF PRESENTING COMPLAINT

1. ONSET : INSIDIOUS/ SUDDEN
2. PROGRESSION : GRADUAL / RAPID
3. INITIAL SITE :
4. INITIAL SIZE :
5. PRESENT SIZE:

6. PROVOKING FACTORS:YES / NO

IF YES –

7. ANY OTHER ASSOCIATED DISEASE: YES / NO IF YES _____

PAST HISTORY: HISTORY OF SIMILAR ILLNESS: PRESENT / ABSENT
IF YES:

FAMILY HISTORY: SIGNIFICANT—YES / NO.
IF YES SIGNIFICANCE:

PERSONAL HISTORY

DIET: VEGETARIAN / MIXED
APPETITE: ADEQUATE / INCREASE/ DECREASED
LOSS OF WEIGHT: YES / NO
BOWEL: REGULAR / IRREGULAR
MICTURITION: REGULAR / IRREGULAR
ADEQUATE SLEEP: YES / NO
H/O RADIATION EXPOSURE: YES / NO
MENSTRUAL HISTORY: NORMAL / ABNORMAL / NOT APPLICABLE
HABBITS: BETEL NUT/ TOBACCO CHEWER: YES / NO, IF YES DURATION:
PATIENT KEEPS QUID OVER NIGHT: YES / NO, IF YES DURATION
TOBACCO SMOKING: YES/ NO, IF YES DURATION:
ALCOHOL CONSUMPTION: YES / NO, IF YES QUANTITY PER DAY:
DURATION OF CONSUMPTION:

GENERAL PHYSICAL EXAMINATION

BUILT: NOURISHMENT:

PALLOR: TEMPERATURE: ^{0}C

PULSE RATE: BLOOD PRESSURE:

WEIGHT: RESPIRATORY RATE:

LOCAL EXAMINATION

ORAL CAVITY:

ORODENTAL HYGIENE:

NICOTINE STAINS: YES/ NO :

LIPS:

MOUTH OPENING: TRISMUS: +/-

Lesion	Site	Greatest Antero Posterior diameter in cms	Greatest Transverse diameter in cms	Type of growth

LYMPHADENOPATHY: YES/ NO

IF YES –

NUMBER:

LEVEL OF NODE:

SIZE:

CONSISTENCY:

TENDERNESS:

MOBILTIY:

SKIN OVER THE NODE:

PALLOR: YES/ NO

EDEMA: YES / NO

CLUBBING: YES/ NO

CYANOSIS: YES/ NO

ICTERUS: YES / NO

SYSTEMIC EXAMINATION

CARDIOVASCULAR SYSTEM:

CENTRAL NERVOUS SYSTEM:

RESPIRATORY SYSTEM:

PER ABDOMEN :

DIAGNOSIS:

AJCC STAGING:

Investigations:

Hb:	TC:	DC:	Plt Count:
BT:	CT:	HIV:	HbsAg:
RBS:	CHEST X RAY:		ECG :

CT SCAN:

FNAC:

BIOPSY NUMBER & REPORT:

PLAN OF MANAGEMENT:

SURGERY PERFORMED:

DURATION OF SURGERY:

VARIABLE		DATA
FLAP DIMENSIONS	LENGTH	
	WIDTH	
SKIN PADDLE DIMENSIONS	LENGTH	
	WIDTH	
TIME TO RAISE THE FLAP		
TIME TO DE-EPITHELIALISE		

DONOR SITE CLOSED BY :

COMPLICATIONS ENCOUNTERED 1. INTRAOPERATIVE

2. IMMEDIATE POSTOPERATIVE

3. POSTOPERATIVE

COMPLICATION	YES	NO
FLAP DISCOLOURATION		
FLAP NECROSIS		
FLAP INFECTION		
DYSTHESIA		

REQUIREMENT OF SECONDARY SUTURING: YES / NO

HISTOPATHOLOGY REPORT:

DURATION OF HOSPITAL STAY:

REQUIREMENT OF CHEMOTHERAPY: YES/ NO

REQUIREMENT OF RADIOTHERYAPY: YES/ NO

FOLLOW UP OF PATIENT:

DURATION POST SURGERY	DATE	DONOR AREA	RECEPIENT AREA	COMPLICATIONS IF ANY
1ST FOLLOW UP				
2ND FOLLOW UP				
3RD FOLLOW UP				
4TH FOLLOW UP				

S.NO	HOSP NO	AGE(YR)	SEX	EDUCATION	WT(KG)	BIOPSY	SITE OF LESION	SIDE	TYPE OF GROWTH	PATHOLOGICAL DIAGNOSIS	TUMOR STATUS	CLINIC STAGING	X RAY MANDIBLE INVOLV	PATH STAGING	DOS	WIDE EXCISION	NECK DISSECTION
1	962858	35	M	6STD	60	SCC	BUCCAL MUCOSA	RIGHT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	T1NOMX	27/11/13	YES	SOHD
2	961721	66	M	10STD	50	SCC	BUCCAL MUCOSA	RIGHT	ULCEROPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T3N2bMX	YES	T2NOMX	20/11/13	YES	MRND
3	962579	78	M	10STD	60	SCC	RMT	RIGHT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T4AN2BMX	NO	T4N2BMX	22/11/13	YES	MRND
4	966182	50	F	10 STD	65	SCC	BUCCAL MUCOSA	RIGHT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T3N1MX	NO	T2NOMX	29/11/13	YES	SOHD
5	991117	28	F	10TH STD	45	SCC	BUCCAL MUCOSA	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N2bMX	YES	T2NOMX	28/2/14	YES	SOHD
6	1018402	45	F	10TH STD	50	SCC	BUCCAL MUCOSA	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N2bMX	YES	T2NOMX	18/6/14	YES	SOHD
7	6908	60	F	6TH STD	35	SCC	BUCCAL MUCOSA	RIGHT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T2NOMX	NO	N/A	7/7/2014	YES	NO
8	4880	56	F	8TH STD	60	SCC	BUCCAL MUCOSA	RIGHT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2NOMX	NO	T1NOMX	9/7/2014	YES	NO
9	7370/33177	50	F	9TH STD	52	SCC	RMT	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T4AN2bMX	YES	T3NOMX	6/8/2014	YES	MRND
10	19761/51091	55	F	10STD	48	SCC	RMT	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T4AN2bMX	YES	T3NOMX	26/9/14	YES	SOHD
11	101948	50	F	10TH STD	47	SCC	BUCCAL MUCOSA	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T3N2bMX	NO	T2NOMX	15/10/14	YES	MRND
12	77147	52	M	2ND PUC	68	SCC	BUCCAL MUCOSA	RIGHT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	T1NOMX	26/11/14	YES	SOHD
13	77216	54	F	10TH STD	54	SCC	RMT	RIGHT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T4AN2bMX	YES	T2NOMX	3/12/2014	YES	MRND
14	76003	67	F	10STD	46	SCC	BUCCAL MUCOSA	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	T1NOMX	11/12/2014	YES	SOHD
15	89014	60	F	8STD	54	SCC	LOWER ALVEOLUS	RIGHT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T2NOMX	NO	T1NOMX	1/1/2015	YES	NO
16	62265	50	F	10STD	56	SCC	BUCCAL MUCOSA	LEFT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T2NIMX	NO	T1N1MX	7/1/2015	YES	SOHD
17	100218	56	F	8STD	48	SCC	BUCCAL MUCOSA	RIGHT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T2NOMX	NO	T1NOMX	11/2/2015	YES	NO
18	102064	60	F	9STD	65	SCC	RMT	RIGHT	ULCERATIVE	WELL DIFF SCC	PRIMARY	T4AN2bMX	YES	T3NOMX	19/3/15	YES	MRND
19	106142	56	F	10STD	56	SCC	BUCCAL MUCOSA	RIGHT	ULCERATVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	T1N1MX	24/03/15	YES	SOHD
20	107768	65	F	5STD	62	SCC	BUCCAL MUCOSA	LEFT	ULCEROPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T4AN2bMX	YES	T3NOMX	25/03/15	YES	MRND
21	1020915	55	F	5STD	54	SCC	BUCCAL MUCOSA	RIGHT	ULCEROPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T3NOMX	NO	T2NOMX	17/04/15	YES	NO
22	133670	45	F	7STD	55	SCC	LOWER ALVEOLUS	RIGHT	ULCEROPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2NOMX	NO	T2NOMX	21/04/2015	YES	NO
23	1021495	65	F	6STD	47	SCC	LOWER ALVEOLUS	LEFT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	TINOMX	2/6/2015	YES	SOHD
24	154812	54	F	6STD	55	SCC	LOWER ALVEOLUS	RIGHT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	T1NOMX	2/7/2015	YES	SOHD
25	168432	40	F	6STD	50	SCC	LOWER ALVEOLUS	RIGHT	ULCERATOPROLIFERATIVE	WELL DIFF SCC	PRIMARY	T2N1MX	NO	T1NOMX	18/08/2015	YES	SOHD

MANDIBULECTOMY	SIZE OF LESION	DIMENSION OF FLAP	PADDLE DIMENSION	PATTERN OF FLAP	EJV LIGATION	TIME TO RAISE FLAP	RECEPIENT AREA CLOSURE	INNERVATION	FLAP DISCOLOURATION	FLAP NECROSIS	REC SITE INFECTION	RADIOTHERAPY	CHEMOTHERAPY	F AND A SCORE	FOLLOW UP
PERIOSTEAL STRIPPING	2x3	4X4	3X3	VERTCAL AXIAL	YES	70	PRIMARY	NO	YES	NO	NO	NO	NO	EXCELLENT	1.9 YR
MARGINAL MANDIBULECTOMY	6X8	10X15	4X4	VERTCAL AXIAL	YES	60	PRIMARY	YES	YES	NO	NO	NO	NO	EXCELLENT	1YEAR
HEMIMANDIBULECTOMY	10x8	20x10	3X4	HORIZONTAL AXIAL	YES	60	PRIMARY	NO	YES	YES	NO	COMPLETED	COMPLETED	POOR	1 YEAR
PERIOSTEAL STRIPPING	5X5	6x6.5	4X3	VERTCAL AXIAL	NO	45	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	1 YEAR
MARGINAL MANDIBULECTOMY	3.4X2.5	5X4	4.5X3.5	VERTCAL AXIAL	NO	45	PRIMARY	YES	NO	NO	NO	DEFERRED	DEFERRED	N/A	RECURRENCE ON 3/7/2014
MARGINAL MANDIBULECTOMY	4X3	5X4	4.5X3.5	HORIZONTAL AXIAL	YES	45	PRIMARY	YES	YES	YES	YES	COMPLETED	NO	POOR	1 YEAR 3 MONTHS
NO	4X3	5X4	4.5X3.5	VERTCAL AXIAL	NO	45	PRIMARY	YES	NO	NO	NO	NO	NO	EXCELLENT	1 YEAR 2 MONTHS
PERIOSTEAL STRIPPING	2X2	4X4	4X3	VERTCAL AXIAL	NO	60	PRIMARY	YES	NO	NO	NO	NO	NO	EXCELLENT	1 YEAR 1 MONTH
HEMIMANDIBULECTOMY	6X3	8X5	5X3	VERTCAL AXIAL	YES	70	PRIMARY	YES	YES	NO	NO	COMPLETED	NO	EXCELLENT	1YEAR
HEMIMANDIBULECTOMY	5X4	8X8	5X5	VERTCAL AXIAL	NO	40	PRIMARY	NO	NO	NO	NO	COMPLETED	NO	EXCELLENT	12 MONTHS
MARGINAL MANDIBULECTOMY	4X3	6X5	3X2	VERTCAL AXIAL	NO	70	PRIMARY	NO	NO	NO	NO	COMPLETED	COMPLETED	EXCELLENT	10 MONTHS
PERIOSTEAL STRIPPING	2X2	5X4	1.5X1.5	VERTCAL AXIAL	NO	40	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	8 MONTHS
HEMIMANDIBULECTOMY	4X5	6X8	2X2	HORIZONTAL AXIAL	YES	40	PRIMARY	NO	YES	YES	NO	COMPLETED	COMPLETED	POOR	8 MONTHS
NO	2X3	4X4	2X2	VERTCAL AXIAL	NO	40	PRIMARY	NO	NO	YES	YES	NO	NO	POOR	8 MONTHS
PERIOSTEAL STRIPPING	2X1	3X2	2X1	VERTCAL AXIAL	NO	40	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	7 MONTHS
NO	2X2	2X1	2X1	VERTCAL AXIAL	NO	40	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	6 MONTHS
NO	2X2	2X1	2X1	HORIZONTAL AXIAL	NO	40	PRIMARY	NO	NO	YES	YES	NO	NO	POOR	6 MONTHS
HEMIMANDIBULECTOMY	5X5	7X7	3X2	VERTCAL AXIAL	YES	40	PRIMARY	NO	YES	YES	NO	COMPLETED	COMPLETED	POOR	5 MONTHS
NO	4X3	5x5	2X1	VERTCAL AXIAL	NO	45	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	5 MONTHS
HEMIMANDIBULECTOMY	6X4	8X8	3X2	VERTCAL AXIAL	YES	60	PRIMARY	NO	YES	YES	YES	COMPLETED	COMPLETED	POOR	5MONTHS
NO	4X8	5X5	2X4	VERTCAL AXIAL	NO	60	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	4 MONTHS
PERIOSTEAL STRIPPING	3X3	4X4	2X2	VERTCAL AXIAL	NO	50	PRIMARY	NO	NO	NO	NO	NO	NO	EXCELLENT	4MONYHS
PERIOSTEAL STRIPPING	3X4	5X8	2X2	VERTCAL AXIAL	NO	45	PRIMARY	YES	NO	NO	NO	NO	NO	GOOD	2 MONTHS
PERIOSTEAL STRIPPING	4X3	6X8	4X3	VERTCAL AXIAL	NO	45	PRIMARY	YES	NO	NO	NO	NO	NO	GOOD	1MONTH
PERIOSTEAL STRIPPING	4X3	6X7	4X3	HORIZONTAL AXIAL	NO	60	PRIMARY	YES	NO	NO	NO	NO	NO	GOOD	1 YR