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A Clinical Study of Free Flap Reconstruction in Cancer of Oral Cavity

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Abstract

Background: Microvascular free flap surgery for reconstruction of head and neck region in surgical ablation of cancer cases has gained tremendous advancement and interest of oncology and plastic surgeons in recent few years as a sophisticated surgical procedure. This study was conducted at our center to evaluate the patient demographics, determine risk factors on outcome of surgery and complications related with the commonly used free flaps for head and neck reconstruction at our center. *Methods:* This prospective clinical study was conducted in JSS hospital for duration of 3 yrs between January 2013 and December 2016. Free flaps used at our center, i.e. free radial artery forearm flap (FRAFF), free fibular osseocutaneous flap (FFOCF) and free anterolateral thigh flap (FALT) were considered for the study. *Results:* This study included 43 patients with oral cavity cancer, of which 36 were males and 7 females, with a mean age of 39.8 yrs. Tobacco consumption was seen in staggering more than 90% of cases with most common primary tumor site being buccal mucosa (27.9%), and squamous cell carcinoma being most common cancer type in 88% of the study cases. FRAFF was the most common flap used for reconstruction in 67% of cases with overall flap loss being in 20%. Recurrence was recorded in 20.9% of cases with a minimum follow up of 6 months but no mortality was noted during the study period. *Conclusion:* This study emphasizes that free flaps are ideal for good cosmetic and functional outcome in reconstruction of oral cavity. Among the flaps used in our study, FRAFF is safe, reliable, and versatile. In mandibulectomy cases, FFOCF is ideal but technically more demanding and needs more expertise to improve the outcome and success rate. We would like to conclude that we need to hone our surgical skills and technique to improve the outcome of free flaps with proper flap selection accordingly, adequate preparation and isolation of reliable recipient vessels and good surgical technique.

Keywords: Oral Cavity; Cancer; Reconstruction; Free flap; Free Radial Artery Forearm Flap; Free Fibular Osteocutaneous Flap; Free Anterolateral Thigh Flap.

Introduction

Tumors of the head and neck region lead to not only functional deficits but devastating cosmetic deformities too. The lower overall survival rate even with advances in the field of cancer therapy has led to the notion of tumor excision with maximum possible tissue sparing.

Oral cancer customarily includes sites such as lips, salivary glands, tongue, oral cavity and pharynx [1]. There is no consensus as to which sites ought to be included in epidemiological surveys of oral cancer. The incidence of oral cancer shows variability between countries and geographical regions. About two thirds of new oral cancer cases arise in developing areas, such as Africa, Central and South America, the Caribbean, China, parts of Asia [1].

Tobacco chewing was identified as its cause about a century ago but continued practice and research proved it as the most important avoidable factor of oral cancer. In India the incidence of oral cancer is about 3-7 times more common as compared to rich countries. Men are more than twice as often affected as women. Head and neck cancers account for a fourth of all cancers in Indian males and tops in the prevalence of oral cancer in the world [2]. Oral cancer is the third most common cancer in India after cervical and breast cancer amongst women. The increased

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prevalence of the oral cancer in the Indian subcontinent seems to be due to the high exposure to sunlight due to farming, smoking and other smokeless tobacco habits, alcohol, spicy food, and neglect of overall oral health. It is said that one third of all oral cancers are preventable and one third of them occur due to above mentioned risk factors. In the West, the cancer of tongue and floor of mouth is common whereas in Indian subcontinent the cancers of gingival and buccal mucosa are common due to placement of tobacco quid in the oral cavity. This cancer of gingivobuccal complex is termed as Indian oral cancer (Oral Cancer Prevention and Research Foundation, India). Smoking or consumption of smokeless tobacco and excess of alcohol act synergistically and are the major risk factors for oral and pharyngeal cancers [3,4]. Human Papilloma Virus (HPV) especially types 16 and 18 (there are over 100 variables) and Herpes simplex virus are known risk factors and independent causative factor for oral cancer [8]. Clinical entities, such as hyperplastic candidosis, tertiary syphilis, and immune deficiency such as HIV infected individuals (not an independent risk factor for intraoral SCC), and familial genetic/non genetic factors may predispose to oral cancer. Diet containing as of yet formally unidentified micronutrients of fresh fruits and vegetables is linked to a decreased risk of oral cancer [5,6,7,8].

Malignancies of the head and neck are often advanced at the time of diagnosis and have a poor prognosis. Over the past three decades, many advances have been made in the treatment of head and neck cancer. These include the combination of radiation therapy and chemotherapy with surgery, conservation laryngeal surgery, modifications of the classic radical neck dissection, Marginal mandibulectomy and microvascular free flap. The desire to improve postoperative outcomes by focusing on preservation of tissue and function led to these advances and resulted in more rapid recovery and decreased cosmetic deformities while maintaining equal cure rates to prior techniques [1,9].

Surgical extirpation of tumors is usually required, which often results in a soft tissue defect necessitating reconstruction. Traditionally, local and regional pedicled flaps were used to reconstruct these defects. The Forehead flap, Deltopectoral flap, and Pectoralis major myocutaneous flap were the mainstays of head and neck reconstruction prior to the advent of microvascular free tissue transfer. These flaps are still used when indicated, but free tissue transfer has become the standard reconstruction technique following surgical excision of head and neck tumors, and success rates of 95% are achievable [2,8,9,10].

Despite the fact that these changes have decreased morbidity, overall survival rates for patients with head and neck cancer has reached a plateau over the past several decades. Because of this, the focus of many head and neck surgeons in the past 20 years has been directed at further decreasing morbidity from surgery and improving functional and reconstructive outcomes.

The use of free tissue transfer and microvascular anastomosis for the reconstruction of head and neck defects from extirpative oncologic surgery is a relatively recent practice. Prior to the past 3 decades, the majority of head and neck defects were closed with either local tissue or random skin flaps that were pedicled and "walked" up to the head and neck region from other sites such as the trunk. Very rarely were large soft tissue and bony defects replaced with anything other than skin. As further investigations continued, new donor sites for free flaps emerged that possessed longer and larger vascular pedicles and made up of various tissues including skin, muscle, bone, and nerve [2].

This allowed for much more refined tailoring of harvested tissue to the recipient site. Free flaps can provide a much wider range of skin characteristics that can match the host site well. In addition microvascular transfer makes much more efficient use of harvested tissue as nearly all is used directly in the reconstruction [3]. Free flaps can provide a much wider range of skin characteristics that can match the host site well [3]. In addition microvascular transfer makes much more efficient use of harvested tissue as nearly all is used directly in the reconstruction [3,10].

The excellent perfusion of free flaps in the head and neck region significantly improves wound healing and serves to protect against wound breakdown and osteoradionecrosis when postoperative radiotherapy or brachytherapy is utilized [1]. Because revascularized tissue transfers maintain their independent blood supply, they are not as subject to resorption, providing for greater long term stability and cosmesis to the reconstruction [3]. The current research is intended to study the use of free flaps in the head and neck region post ablation.

Aims and Objectives

The aim of this prospective study is to report on our experience on the use of microvascular free flap for reconstruction of defects after oral cavity cancer ablation. The results of this technique are evaluated and the impact on flap survival, cause of flap loss and to standardize the technique.

1. To study patient demographics in cancer of oral cavity
2. To determine risk factors of oral cavity tumours
3. To study the result of microvascular free flaps in oral cavity cancer
4. To study the surgical outcome of functional and aesthetic goals for reconstruction in patients with oral cavity malignancies.

Materials and Methods

This study was conducted in JSS Medical College and hospital from August 2013 to December 2016. 43 patients having malignant tumors of the oral cavity were subjected to local wide excision with or without mandibulectomy and neck dissection, and immediate reconstruction of defect using free flap during the study period. Patients were thoroughly counseled in the preoperative period of all options for reconstruction after extirpation (including secondary intention, primary closure, skin grafting, regional flaps, and free tissue transfer).

Pre operative evaluations included local radiographic evaluation with orthopantomogram (OPG), computerized tomography (CT) or magnetic resonance imaging (MRI) to evaluate the extent of the disease. Allen's test and Doppler to evaluate the appropriate collateral circulation in the hands and dental examination by a prosthodondist was also undertaken.

Broad spectrum fourth generation cephalosporin was given for antibiotic control and in the post operative period NSAIDs were given for analgesia.

Post operatively flap viability was monitored clinically by the color, temperature, turgor and response to pin prick. Doppler was also used for monitoring in some cases. Donor site healing was checked a week after surgery. OPG has been done post operatively to check the viability of fibula in all free fibular cases.

Post operative medications included intravenous administration of dextran 40 for 5 days at 20 ml/hr, aspirin 100 mg orally per day for 14 days, and/or pentoxyfyline 400 mg orally thrice daily for 14 days. Heparin was prescribed in selected patients.

Free flap failure was defined as a complete loss of the flap or partial loss of the flap wherein flap loss prevented it from providing the desired functional or esthetic result. In other words, a flap loss was one that failed to meet the original reconstructive goal.

Patient demographics, hospital stay, indications, complications and flap survival were analyzed. Periodic follow up was done and data were entered.

Fig. 1: Showing marking for free radial flap from donor site

Fig. 2: Showing flap harvest from donor site

Fig. 3: Radial flap with intact pedicles

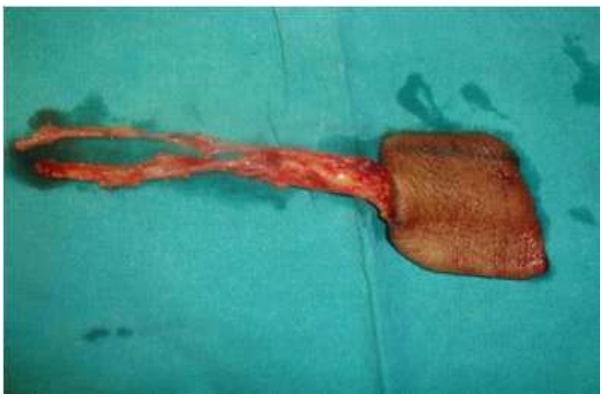

Fig. 4: Prepared radial forearm flap ready for anastomosis

Results

Patients of the study included 36 males and 7 females with an average age of 39.8 years (range, 23 to 58 years). Out of which 7 belonged to high socio economic status, 8 to mid, and 28 to low socioeconomic status. Primary site of malignancy was buccal mucosa alone in 12 patients, tongue in 7 patients, buccal mucosa with gingivobuccal sulcus in another 7 patients, lower alveolus in 5 patients, central arch in 4 patients, gingivobuccal sulcus alone in 4 patients, 2 each in floor of mouth and parotid region (Table 1). 39 of them gave history of tobacco consumption either in the form of smoking or chewing (Chart 1). 3 out of twenty five patients were hypertensive, and 4 patients had diabetes.

Extirpative surgery done for the tumor included local wide excision with an additional marginal mandibulectomy in 9 of them, segmental mandibulectomy in 5 patients, central arch excision in 4 patients, distal mandibulectomy in 2 patients, and partial upper alveolectomy in 5 patients (Table 2). For nodal clearance, supraomohyoid neck dissection was done in 10 patients and modified radical neck dissection

Table 1: Site distribution of malignancy

Site of Malignancy	Number of Patients (%)
Buccal Mucosa	12 (27.9)
Tongue	7 (16.3)
Buccal Mucosa + GBS	7 (16.3)
Lower Alveolus	5 (11.5)
GBS	4 (9.3)
Central Arch	4 (9.3)
Floor of Mouth	2 (4.7)
Parotid Region	2 (4.7)
Total	**43 (100)**

Table 2: Type of surgical extirpation used for cancer ablation

Surgical Procedure	Number of Patients
Wide local excision alone	16
Wide local excision of buccal mucosa + Marginal mandibulectomy	9
Wide local excision of buccal mucosa + Segmental mandibulectomy	5
Wide local excision of buccal mucosa + Partial upper alveolectomy	5
Wide local excision of buccal mucosa + Central arch excision	4
Wide local excision of buccal mucosa + Distal mandibulectomy	2
Wide local escision of buccal mucosa + Superficial Parotidectomy	2

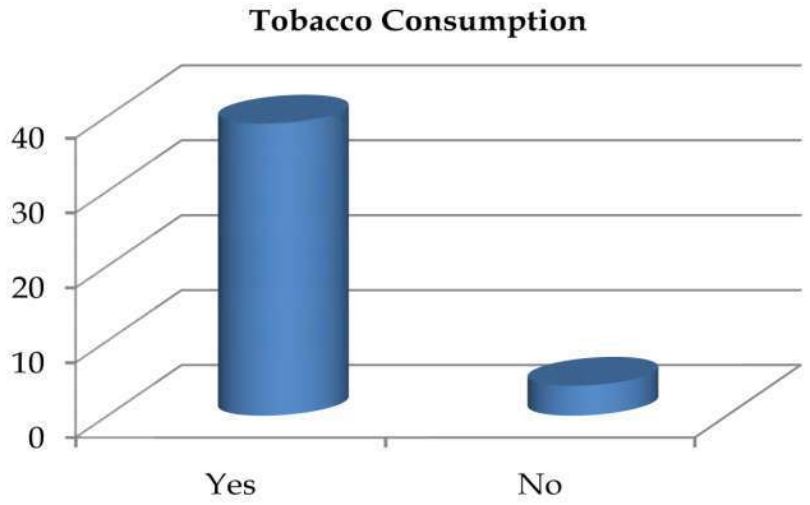

Chart 1: Tobacco consumption in the study group

in 28 patients and bilateral neck dissection (ipsilateral modified radical neck dissection and contralateral supraomohyoid neck dissection) in 4 patients.

Radial free flap was used for reconstruction in 29 of them, fibular free flap in 10 of them and antero lateral thigh flap in 4 patients (Chart 2). Predominantly arterial anastomosis was done to facial artery in 39 patients and venous anastomosis was done to facial vein and tributaries of internal jugular vein in 27 patients (Table 3). The mean operation time, including the time for extirpative surgery, was 6.44 hours (range was 5.5 to 8.5 hours).

Intra operatively heparin and dextran 40 was used in all 43 patients with Inj.Papaverin being added to 2 of them. Post operative medications included dextran 40 only, in 36 of them and dextran 40 with heparin in the remaining 7 patients. Post operative antiplatelet drugs used was Pentoxyfylline in 10 patients, combination of Pentoxyfylline and Ecospirin in 29 of them, combination of Pentoxyfylline and Low molecular weight Heparin in 3 patients and Ecospirin alone in one of them.

Postoperatively all patients initially received enteral feeding through a nasogastric feeding tube. Oral feeding was started on 7th postoperative day on an average (range, 2 to 25 days). Patients were ambulated postoperatively on 2 to 9 days (mean 5.8 days).

Post operatively, viability of the flap was assessed by clinical signs (i.e. skin color and turgor, capillary refill, and needle puncture under aseptic technique) in all patients. Doppler ultrasound was used additionally in 9 of them. Adjuvant therapy in the

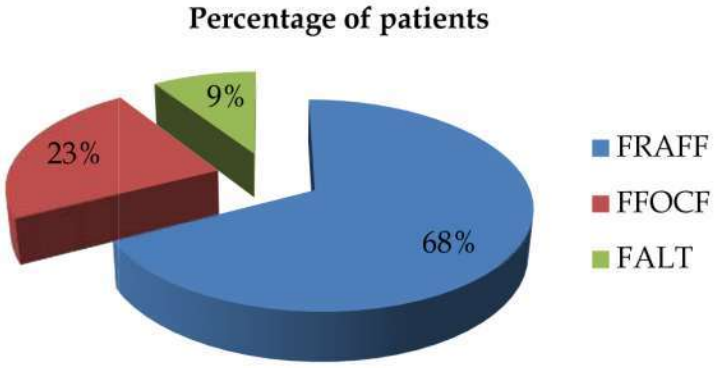

Chart 2: Type of free flaps used for reconstruction in the study

Table 3: Vessels used for microvascular anastomoses

Vascular Anastomosis	Number of Patients
Arterial	
Facial artery	39
Superficial temporal artery	2
Superior thyroid artery	2
Total	43
Venous	
Facial vein + Tributaries of IJV	27
Facial vein + External jugular vein	14
Facial vein + Retromandibular vein	2
Total	43

Table 4: Post operative complications

Post-Operative complication	Number of patients
No complication	22
Partial flap loss	4
Complete flap loss	9
Oral bleeding	2
Lip commissure necrosis	2
Parotid leak	7
Thoracic duct leak	1
Lymphatic leak	2

form of radiotherapy was given to 24 of them and 5 patients received concurrent chemoradiotherapy along with radiotherapy while 14 patients received no adjuvant therapy.

Twenty two patients had an uneventful post operative period. While 9 patients had complete flap loss, reason being venous congestion as shown by Doppler study included 5 and 4 patients who had undergone FFOCF and FRAFF respectively. Those patients were managed by debridement of flap and application of conventional PMMC flap. In 2 patients, comissuroplasty was done for lip comissure necrosis. 7 of them had parotid leak, 1 patient had thoracic duct leak and 2 patients had right lymphatic leak (Table 4). 2 patients had donor site morbidity in the form of STSG loss. There was no major functional morbidity in both faciocutaneous and osteocutaneous free flap patients. Table 5 shows the characteristics of each free flap in the study and Table 6 compares our study with previous studies.

Histological examination revealed squamous cell carcinoma in 38 patients, 2 cases each of squamous papilloma, verrucous carcinoma and 1 case of basal cell carcinoma. Of the 38 cases of squamous cell carcinoma, 21 of them were moderately differentiated, 15 well differentiated, and 2 were poorly differentiated (Table 7). Table 8 shows the pathological stage in the study group of which most patients presented with T_2N_0 followed by T_2N_1.

Mean hospital stay was 10 days (range from 7 to 30 days). Recurrence was seen in 9 patients, which included 5 nodal metastases, 2 local recurrence and 2 pulmonary metastases. There was not a single case of hospital mortality.

Table 5: Free flap characteristics in the study

Flap Type	Number of Patients	Number of Complete Flap Loss	Success Rate
FRAFF	29	4	86%
FFOCF	10	5	50%
FALT	4	0	100%

Table 6: Study comparison

Author	Experience	Success Rate
Serafin[13]	First 25 cases	72%
	Last 25 cases	96%
Godhina[14]	First 100 cases	74%
	Last 100 cases	96%
Harashina[15]	First 3 years	75%
	Last 5 years	97%
Buncke[16]	First 3 years	83%
	Last 3 years	97%
Present Study	43 cases (First 3 years)	80%

Table 7: Histopathological pattern of oral malignancy in study group

Histopathology	Number of Patients
Squamous Cell Carcinoma	
Well Differentiated	15 (34.8)
Moderately Differentiated	21 (48.8)
Poorly Differentiated	2 (4.7)
Verrucous Carcinoma	2 (4.7)
Squamous Papilloma	2 (4.7)
Basal cell Carcinoma	1 (2.3)
Total	43 (100)

Table 8: Pathological staging of the study population

Pathological Stage	Number of Patients (%)
T_1N_0	5 (11.6)
T_2N_0	15 (34.9)
T_2N_1	12 (27.8)
T_3N_0	4 (9.3)
T_3N_1	2 (4.7)
T_4N_1	5 (11.7)

Fig. 1: FRAFF for tongue reconstruction: 10th post operative day

Fig. 2: FRAFF for buccal reconstruction: after three months

Fig. 3: Orthopantomogram showing FFOCF reconstruction after one year

Discussion

Free flap procedure has become a gold standard in reconstructive plastic surgery after tumor ablation. The success rates in esthetic and functional aspect following the 'steep learning curve' are superior to other conventional techniques. It is said that free flap is the reconstructive method of choice for defect in all areas of the body especially for a complex tissue defect, a difficult wound, and a three dimensional defect. Over the past two decades, free flap procedure has progressed from being scientific curiosity to everyday workhorse process. It is now routinely performed not only on an elective patient but also in urgent situation as emergency free flap or early free flap. When indicated, a free flap is now a preferred method for transfer of distant tissue. At present, there are more than 50 free flaps of various components and designs to fulfill the reconstructive need or to replace 'like with like' for reconstruction in all areas of the body.

In this study, a population of 43 oral cavity cancer patients was analyzed in a prospective manner for flap survival and complications after free flap reconstruction with or without chemoradiotherapy. Surgical management of oral or pharyngeal cancer combined with free flap reconstruction is regarded as a major surgery with lengthy operative time and substantial blood loss. The mean operative period in our study is 6.4 hrs almost similar to study of ArthiKruavit et al. [11] which was 7hrs. The socio demographic factors of the patient also play a major role in flap survival. In our study there were two patients suffering from diabetes and one from hypertension. One of the patients who had flap loss in our study had diabetes. Aging influences several organ systems, reducing their tolerance to operative stress. Many patients are heavy smokers and drinkers and may be afflicted by a yet undiagnosed disease that would have necessitated regular medical attendance. In our study 92% patients were tobacco addicts which could be an independent risk factor for flap loss. Referring to the aforementioned patient characteristics, complications (rate for all complications, 60%) after major surgery in this study must be considered partly unavoidable. These results are in line with other studies. Excellent flap success (96% and 98%) and low frequencies of reoperation and fistula rates are representatives of high standard surgical technique. The flap success rate in our experience is 80% including two complete free radial and three complete free fibular loss. The cause of the flap loss is venous congestion in all cases as diagnosed in Doppler study. The success rate of flap in our study is less as compared to other's experience like arthikruvait et al. [11] & magdy et al. [12] shows 96% and 98% respectively. The following table compares our experience of free flap success rates with previous studies.

This result is believed to hold clinical relevance. It could be beneficial if, in the preoperative screening and counseling of the oral or pharyngeal cancer patient awaiting microvascular reconstruction, special emphasis would be engaged to these sociodemographic factors along with searching for other operative risks. Among them, we have found

that RFFF has become the workhorse because of its large size with thin and pliable skin of the flap even in an obese patient. Furthermore, the RFFF is easy to dissect with a constant anatomy. Long vascular pedicle and large veins of 2 3 mm in diameter of both superficial and deep veins make safe for microvascular anastomosis without interposition vein graft and more than one venous anastomosis can be achieved to solve the problem of post operative venous congestion.

The other main criticism of the RFFF is the donor site defect, which requires skin graft that may produce a contour deformity especially in a young woman. This concern is directly related to the design of the flap; but the advantages of this method of reconstruction greatly outweigh esthetic considerations. Apart from this, frequent problems or complications of the donor sites are skin graft failure, skin graft and tendon adhesions, fracture of the radius, and probably dysesthesia secondary to superficial radial nerve injury, all of which cause functional problems. Donor site morbidity is only one of a number of factors affecting the choice of flap used in reconstruction. With regards to the RFFF, experience has shown that donor site problem can be avoided if meticulous flap dissection is employed. In our experience, there were two patients developed skin graft loss and subsequently repeat skin graft done. No patients developed major morbidity which can lead to severe functional problem. Several techniques for prevention of the donor site problems have been reported and recommended by many authors.

Conclusion

Based on our experience, we conclude that free flaps are ideal for good cosmetic and functional outcome in reconstruction of head and neck region. Among them, the radial forearm free flap is safe, reliable, and versatile. In mandibulectomy cases Fibular free flap is the ideal reconstruction which is a technically demanding procedure and needs more expertise to improve the outcome and success rate. Previous studies have shown better results with regards to fibular free flap. Hence we would like to conclude that we need to hone our surgical skills and technique to improve the outcome of fibular free flap. The loss of a free flap is devastating to both the patient and the microvascular surgeon. Hence it is of utmost importance to select the proper free flap donor site including adequate preparation and isolation of reliable recipient vessels and good surgical technique to improve the success rate.

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