International Surgery Journal
Narayan N et al. Int Surg J. 2020 Feb;7(2):376-381
http://www.ijsurgery.com
pISSN 2349-3305 | eISSN 2349-2902

DOI: http://dx.doi.org/10.18203/2349-2902.isj20200054

Original Research Article

Combining free tissue transfer with pedicled flap in reconstruction of extensive oromandibular malignancy defects: a clinical study

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Received: 24 December 2019
Revised: 09 January 2020
Accepted: 10 January 2020

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ABSTRACT

Background: Extensive composite defects of the oromandibular site involve skin, mandible, soft tissue and oral mucosa. Though many opine that with the coming on of free flap surgery, the pedicled flap is an outdated surgical option, the latter still has its uses. Free flaps are criticized as being medically risky, expensive, and time-consuming. Combining both these flaps in a single surgery would bring in the baggage of all negatives along with the benefits of these flaps.
Methods: Over a period of 3 years, 13 patients with expected large composite oral defects after ablative surgery for malignancy were included in the study requiring both skin cover and mucosal lining. A one-stage reconstructive procedure employing combination of free and pedicled flaps was used. Data was abstracted pertaining to cancer demography and surgical outcome.
Results: The free fibula osteocutaneous flap (FFOCF)- deltopectoral fasciocutaneous flap (DPF) combination was most commonly used (n=5), secondly by free radial forearm flap (FRAFF)-DPF combination (n=4), FRAFF-pectoralis major myocutaneous flap (PMMF) amalgamation and FFOCF-PMMF (n=2). The complete flap survival rate was 88.5 percent with 3.8% percent total (1 of 26 flaps) and 7.7% partial (2 of 26 flaps) flap failures. Minimum follow-up period was 6 months with 2 (7.7%) recurrences and 2 (7.7%) mortalities.
Conclusions: We believe that in combined use of free-flap and pedicled flap procedure for one-stage reconstruction of massive mandibular defects with through-and-through cheek defects is justified because it is safe and effective and improves the quality of life for these patients albeit a bit prolonged surgery which can effectively be shortened with 2 reconstructive team approach as in our study.

Keywords: Free flap, Pedicled flap, Oral cancer, Oromandibular defect, Oncoreconstruction

INTRODUCTION

Oral carcinomas form a major volume of the cancers in head and neck cancer region. Head and neck cancers account for 23-25% of all cancers occurring in different sites and oral cancers account for 50% of these or 12.5% of the whole-body cancers. The most common variant of the oral cavity is squamous cell carcinoma. Apart from squamous cell carcinoma, the commonest oral cancer is mucoepidermoid cancer arising out of the minor salivary glands. 675,000 patients worldwide are diagnosed with head and neck cancer annually.[1]

Surgical excision of the primary lesion and neck dissection form the mainstay of treatment. Adjuvant therapies - radiation or chemotherapy, addition depends

on the stage of the disease at presentation. Not only the cancer but the ensuing treatment will have devastating effects in the form of cosmetic, functional and psychosocial effects. Functional effects include speech, deglutition, management of oral secretions and mastication, all of which demands well-planned and executed reconstructive procedures followed by prompt and early rehabilitation. With the introduction of free flap tissue transfers in 1970s, a broad variety of free flaps is available and also with vast improvements in biomaterials, the field of oral cavity cancer reconstruction has taken a giant leap. With the advent of free flap, it represents a major evolution in the management of head and neck cancer with a consequent limitation of pedicled flap reconstruction. Surgical free flaps have become the most preferred mode of reconstruction for oncologc defects of the head and neck region. Head and neck reconstruction with microvascular free flap transfer though complex have become a routine procedure. Microvascular free flaps have allowed greater flexibility to import composite tissues matching the requirements at the site and hence have become the method of choice in majority of head and neck cancer cases.[2]

Reconstruction of the head and neck region is a challenging discipline as it deals with critical areas of the patient throughout which he or she breathes, speaks, swallows and not disregarding the self representation to oneself and society. Reconstruction of the defect not only gives wound coverage but also attempts to restore form and function. Reconstruction of the head and neck defects especially those involving the mucosa should be appraised in terms of reinstating skin cover, bone support, soft tissue and oral lining. The expectant planned flap should be ideally able to replace 'type with type' with respect to resected tissue and also thickness, texture, mobility, sensation and function.[3-5]

Single flaps alone may not be sufficient for wound coverage in extensive oromandibular defects considering the 3D complexity of the region as some are either too huge and some others necessitate composite tissues.

Reconstruction should be aimed not only to maintain the functional integrity of the oral cavity but also aesthetically acceptable. Flap selected should replace pliable buccal mucosa allowing adequate mouth opening, provide stability for mastication and dental rehabilitation and importantly altered to patient's ability to sustain lengthy surgery. The routinely used pedicled flaps at our center for oral reconstruction include pectoralis major myocutaneous flap (PMMF) and deltopectoral fasciocutaneous flap (DPF). Free radial forearm flap (FRAFF) and free fibula osteocutaneous flap (FFOCF) are the most commonly used free flaps.

Life expectancy is good if cancer is detected early and treated early. Patients find it difficult to accept the deformity after excision and therefore do not come forward for treatment early. A firm knowledge that simultaneous reconstruction is possible will make the patients accept the treatment that may be otherwise mutilating. It is a general observation that with the option of primary reconstruction, compliance with adjuvant treatment is also good. The presence of a reconstructive surgeon in the initial discussion of the treatment plan will help to make the patient and family to comply with the treatment regime as well as allow the reconstructive surgeon to plan the reconstruction in a better way. Lesions may involve one or more anatomical structures with diverse functional impact of their ablation. Therefore, for a given defect it may be a combination of different flaps or modification of a single flap which will give optimum reconstruction restoring function with aesthetics with minimum donor area morbidity.

In these circumstances free flap surgery, with its prolonged anesthesia times and with the need of finding adequate recipient vessels in previously operated and radiated necks may rise serious concerns.[6,7] In this scenario, at our Institution, pedicled regional flaps still represent a valid alternative to free flaps for patients considered to be suboptimal for microvascular reconstruction.[8, 9]

For oral and oropharyngeal soft tissue defects that require adequate lining without the need for a bulky cover, fasciocutaneous free flaps provide excellent results enabling optimal resurface, ensuring a good motility of the preserved structures around the resected area (preserved portions of the tongue, tongue base, floor of mouth, soft palate), giving a tight separation between oral/oropharyngeal cavity and neck contents. For segmental mandibular resections a reconstruction with bone carrying free flaps (fibula, scapula, iliac crest, etc.) is considered nowadays the standard of care, and it is almost mandatory for anterior mandibular defects in order to avoid the so called Andy Gump deformity; for lateral segmental mandibular defects a bony free flap reconstruction is always preferable but in selected cases a soft tissue reconstruction with alternative pedicled flaps such as the pectoralis major or the latissimus dorsi can be considered as an acceptable option.

The objective of this study was to analyze the benefits and drawbacks of employing a combination of free flap and pedicled locoregional flap in reconstruction of extensive oromandibular defects after cancer exenteration with regards to age, gender, predisposing factor of cancer, flap type, tumor location and stage, postoperative complications, flap outcome, length of hospital stay, functional problems if any and concern for appearance, experienced following major surgery for intraoral malignancy.

METHODS

This descriptive case series was conducted in RajaRajeswari Medical College and Hospital, Bangalore from January 2016 to June 2019 for a period of 42

months. The current study analyzed the feasibility of combining pedicled flaps and free flaps to provide both an inner lining and an outer cover for major full-thickness lower jaw reconstruction after oncologic resection of extensive oral cancer. And also to assess cosmesis and functionality outcome in operated patients. Those patients presenting with primary tumor of the lower jaw, with expected extensive oromandibular defects not amenable to closure with a single planned flap either pedicled or free were included in the study. Case with recurrences, distant metastasis and those lost during follow up were excluded. These defects were reconstructed using a permutation of either FRAFF or FFOCF with same sided PMMF or DPF.

The following clinical and pathological variables were included: age, gender, predisposing factor, cancer type, tumor anatomical site, cancer stage (TNM), neck dissection, type of flap used for reconstruction, surgical margin status, length of the surgery, surgical defect, length of hospital stay, postoperative complications (flap loss and others), adjuvant therapy, follow up status and any recurrence or mortality during study period. Recurrence was evaluated as local (if involving only the oral cavity relative to the primary tumour), regional (if involving only the neck) and loco-regional (if involving both the primary site and neck). Recurrence was confirmed by tissue biopsy and or, computed tomography (CT) or magnetic resonance imaging.

All cases involved two surgical teams which one for oncoresection followed by neck dissection and the other team for free flap harvesting simultaneously. This was followed by concurrently one team heaving pedicled flap and the other giving inset to free flap and microanastomosis. Pedicled flap was reaped only after assessing defect. This approach effectively reduced anaesthesia time and length of surgery.

Cosmetic scoring at apt intervals was a subjective evaluation of surgical outcome employing a simple numerical 6-point system, developed by us, with values ranging from 0 (poor outcome) and 5 (excellent outcome with 1, 2, 3 and 4 indicating bad, satisfactory, fair and good respectively. For each patient, scores were awarded by the patient and 1 family member of which the average was considered.

Statistical analysis

For statistical analysis IBM SPSS Statistics 22.0 was used. Descriptive statistics was used to display patient characteristics, treatment details and functional outcome. Microsoft word and Excel were used to generate tables and graphs. The SPSS 22.0 software will be used for analysis of the data. Number of cases and percentages were represented for categorical variables.

RESULTS

In total 13 patients were included in this study. The mean age was 40.8 years with the eldest patient being 63 years of age and youngest being 25 yrs old. Gender distribution was mixed including1 third sex patient (male: female: third sex ratio being 10:2:1).

12 patients had squamous cell carcinoma while 1 patient was having verrucous carcinoma as tumor type. All patients except one had predisposing factor for oral cancer with tobacco consumption being the predominant causative factor seen in 12 patients. 2 patients consumed tobacco by chewing and 10 via smoking (Table 1).

Table 1: Predisposing factor.

Vices	No. of patients
Smoking	10
Alcohol consumption	4
Tobacco chewing	2

Buccal mucosa was the most common site of cancer in the study group followed by gingivobuccal sulcus and floor of the mouth (Table 2).

Table 2: Site of oromandibular cancer.

Site of tumor	No. of patients
Buccal mucosa	9
Gingivobuccal sulcus	3
Floor of mouth	1

Majority of tumor staging was T_{4a} seen in 12 patients and T_3 in one patient. Nodal staging varied but none of the case had distant metastasis. Stage grouping was as shown in Table 3.

Table 3: Cancer stage distribution.

Stage grouping	No. of patients
Stage 0	0
Stage I	0
Stage II	0
Stage III	0
Stage IVA	11
Stage IVB	2
Stage IVC	0

Out of 13 patients only one patient with verrucous carcinoma of the buccal mucosa didn't undergo neck dissection. In total 9 DPFs, 7 FFOCFs, 6 FRAFFs and 4 PMMFs were used in permutations involving one each of free and pedicled flap for reconstruction of extensive oromandibular post oncoresection of oral cavity tumors. Combination of flaps and number of times they were used for reconstruction are as shown in Table 4.

Table 4: Flap combination employed.

Flap combination	No. of patients
FFOCF and DPF	5
FRAFF and DPF	4
FFOCF and PMMF	2
FRAFF and PMMF	2

Post resection surgical margin was positive in 3 patients with 10 having tumor margin of at least 5 mm. Average operating time was 10 hrs and 33 mins with FFOCF and PMMF combination commanding longest surgery duration (mean 12 hrs 37 mins) and FRAFF and DPF pattern requiring shortest length of surgery (mean 8 hrs 50 mins).

Mean hospital stay was 18.5 days. Patients who underwent DPF required 2 periods of hospitalization, the second being for flap division and both were added to derive total days of hospitalization for these patients.

Flap loss was encountered in 3 patients- 1 (7.7%) had complete loss and 2 (15.4%) had partial loss only. Partial losses were treated with debridement and mobilization of the surviving part of the flaps to attain closure. The complete flap loss case with PMMF as mucosal lining had a recon plate and required debridement followed by forehead flap to cover exposed intraoral recon plate.

However, considering the fact that in each case 2 flaps were done, it halves the percentage of flap failure.

Table 5: Flap loss distribution.

Flap loss	No. of patients	No. of flaps
	N (%)	**N (%)**
Nil	10 (76.9)	23 (88.5)
Partial	2 (15.4)	2 (7.7)
Complete	1 (7.7)	1 (3.8)
Total	23 (100)	26 (100)

Number of patients requiring adjuvant therapy in the form of radiotherapy alone or radiotherapy along with chemotherapy is as shown in Table 5. Adjuvant therapy was given only post operatively in all cases. All three patients with positive margins received radiotherapy with chemotherapy.

Table 6: Adjuvant therapy administered.

Adjuvant therapy	No. of patients
No adjuvant	2
Radiotherapy alone	6
Radiotherapy and chemotherapy	5
Chemotherapy alone	0

Post operatively all patients were followed up for a minimum of 6 months. Two patients (7.7%) had recurrence of which one was stage IVA (tumor free margin with RT only) preoperatively and the other was stage IVB (positive margin with RT and CT). The latter also had lung metastasis at the end of 2 months postoperatively and succumbed to the disease eventually. The former was managed with chemoradiation. The other case of death in the study group was at the end of 5 months postoperatively. Patient was elderly male and undergone 3 surgeries: one for resection with reconstruction followed by debridement and closure for partial loss of FRAFF and lastly for DPF division 21 days after second surgery. The patient had a negative history for any known predisposing factor of oral cancer. But patient had a marginally low pulmonary reserve.

Cosmetic outcome of the surgery was assessed taking into account the mean of the score awarded by patients and their immediate family member on a scale of 0 to 5 with 0 being poor and 5 being excellent. This was appraised at the end of 3 months of surgery and the patient who demised at 2 months of postoperative period was excluded. FRAFF and DPF had the most favorable cosmetic scoring of 3.8 points and with 2.25 scoring FFOCF and PMMF had the least.

Table 7: Cosmetic scoring of surgical outcome.

Flap combination	Average cosmetic score
FFOCF and DPF	3.10 (5/5)
FRAFF and DPF	3.38 (4/4)
FFOCF and PMMF	2.25 (1/2)
FRAFF and PMMF	2.63 (2/2)

No functional difficulties were addressed by the patient with regards to dual flap surgery.

DISCUSSION

Radical excision of oral cancers results in complex and extensive defects and reconstruction of these following radical excisions, pose a great challenge to the reconstructive surgeon. Various procedures have been portrayed for reconstruction and the choice of method depends upon defect type, surgeon choice and proficiency in the procedure and also accessibility to microvascular surgery facility. The vast size and multinature of the tissue involved in these defects, their reconstruction poses a challenge to the reconstructive surgeon. With the availability of free flaps reconstructive surgeons have been able to expand their repertoire of reconstructive options. Further fine tuning of these techniques, have resulted in improved outcomes and thus have become a great choice among majority of reconstructive surgeons.[10] Use of combination of free and pedicled flaps in reconstruction of through and through lateral defects after resection of advanced oral cancers especially those involving large both bone and soft tissue has been followed at our center since recently. Indication for combination flaps was the requirement for bone and soft tissue/skin (both skin cover and mucosal lining) not

provided by a single flap. Also few surgeons recommend a double free flap for reconstruction of such defects but constraints have been cited pertaining to increase in technical complexity, operating and anesthesia time, and perceived risk of complications.[11-14] Other than these FFOCF can be substituted with a metal reconstruction plate, combined with soft tissue flap for resurfacing and lining. Also, other than PMMF and DPF, used in our study as pedicled flaps, latissimus dorsi myocutaneous flap can also be used.

Derisory use of single flap for coverage of complex defects associated with an alloplastic plate and a soft tissue flap there is a high chance of inadequate cover or delayed plate exposure in the highly unforgiving head and neck region leading to recourse for salvage procedures.[15] And not to overlook about aesthetic and functional disability in the long term outcome of surgery. Use of vascularised bone in the form of FFOCF was our first choice in all cases requiring mandible reconstruction, with the exception of those patients with a short life expectancy. Those with segmental or no mandiblectomy were managed with only combined free and pedicled soft tissue flaps.

We selected blend of free and pedicled flaps for lateral huge oral mandibular instead of a double free flap because of perceived advantage in being technically easier to harvest, involving shorter operating times and a more definitive blood supply of the pedicled flap. Also an apparent risk of complications associated with a second set of microanastomoses can be lowered including search for a second set of recipient vessels.

Some authors like Chen et al recommend avoiding PMMFs in lining the oral cavity due to more chance of dehiscence and resultant bone exposure.[16] This may be due to the fact that vascularity of its skin paddle tends to be less favorable as the skin islands tend to be positioned at the most distal portions and have random pattern blood supply in the most critical parts.[17] Also there is a chance that the bulky PMMF pedicle may actually compress the free flap pedicle. FFOCF is the workhorse flap for mandible reconstruction.[18] It provides up to 30 cm of straight bone that can be contoured, as well as a skin paddle for soft tissue coverage if needed. Another advantage is the presence of vessels with good diameter and length. Hence it is the flap of choice for restoring mandibular defects. The Achilles heel of the flap is the skin paddle which sometimes may not be supplied by the same vessel.[19] Those cases with no mandibular resection or those with segmental mandibulectomy not warranting additional bone support and can be managed with a reconstruction plate are covered with FRAFF as a free flap. However large composite defects cannot be provided with sufficient soft tissue coverage and merit a second skin flap. Also, when vascularity of the skin paddle of FFOCF is doubtful, pedicled regional flap can be harvested to give both skin cover and mucosal lining. The combination of the flaps we have used in our study can be harvested simultaneously as tumour excision and does not necessitate patient re-positioning. Hence, this provided an important logistical advantage in our study.

Use of two flaps simultaneously, combined free and pedicled flaps, 2 free flaps or 2 regional flaps undoubtedly poses technical difficulties, by increasing potential patient morbidity and is time-consuming. But the benefits outweigh the risk in the final outcome of these surgeries pertaining to final aesthetic and functional result otherwise ending in a suboptimal effect. However, such surgeries cannot be recommended in all oromandibular defects as a 'routine' reconstruction procedure, but surgical procedures have to be individually tailored to the needs of the patient and to an extent, comfort of the surgical team. Nevertheless, a combined free and pedicled regional flap should be first line option in treating an extensive carcinoma of the oromandibular region. Also, duration of surgery should not be a determining factor in reconstruction of such defects.[20] When patients are selected meticulously limitations such as lengthy duration of surgery, prolonged hospital stay, and associated complications should not be excessive.[21]

The aim of the reconstructive surgeon is to derive the best osseous and soft tissue elements which would yield appropriate tissue characteristics in the final reconstruction. Use of two separate flaps with ample tissue rather than a single insufficient flap will allow easier in setting and better restoration of anatomical boundaries, thus addressing both the functional and aesthetic outcomes.[22] Tissue shortage during reconstruction will lead to contractures, and poor cosmetic outcomes or functionality. Therefore, even in the absence of bone loss, a two-flap reconstruction-double free flap or double pedicled flap or combination of a free flap and pedicled flap as in our study - can be advantageous especially if soft tissue loss is substantial.

CONCLUSION

Flaps are selected to minimize donor site morbidity, including perforator-based flaps, such as the anterolateral thigh free flap. Currently, advances in head and neck reconstruction are focused in further refinement, such as use of computer-assisted design and rapid prototype modelling to plan surgery. The future will undoubtedly bring further breakthroughs in reconstructive surgery in an effort to restore normalcy and allow for more complete oncologic resection with the goal of improving cancer cure rates and quality of life.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Narayan N, Manakchand KK. Combining free tissue transfer with pedicled flap in reconstruction of extensive oromandibular malignancy defects: a clinical study. Int Surg J 2020;7:376-81.