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Original Research Article

Oromandibular reconstruction with free fibula osteocutaneous flap after oncologic resection: retrospective analysis of surgical experience and operative outcome of 56 cases

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ABSTRACT

Background: Reconstruction of post oncologic resection oromandibular defect is challenging and it provides the base for subsequent radiotherapy and oromaxillary rehabilitation for functional and aesthetic outcome. Multiple reconstructive options including different free flaps exist in the present time of greater awareness, facility and expertise in the field of free tissue transfer surgery. But free fibula osteocutaneous flap (FFOCF) has been the state of art in this area. FFOCF is technically difficult but believed to be reliable even to start with and has a progressively comprehensive surgical technique and learning curve. We are presenting here our experience of FFOCF reconstruction of 56 cases over the last 3 years.
Methods: 56 patients operated between 2015 to 2018 were assessed retrospectively for operative and surgical outcome.
Results: Flap was successful in 54 (96.43%) cases. Re-exploration was done in 4 cases and was successful in 2 cases. Jaw shape and contour was satisfactory in 70.37% and solid food tolerance was noted in 80.35% cases. Recurrence was seen in 5 cases.
Conclusions: FFOCF is a reliable reconstructive option for complex oromandibular defect with a predictable outcome. Flap harvest is reliable and contouring is comprehensive. It gives good functional and aesthetic results with high success rate. Thus this flap is truly the preferred reconstructive option for all type of oncologic oromandibular defect with micro vascular surgery facilities.

Keywords: Oromandibular, Fibula osteocutaneous flap, Free flap, Oncologic

INTRODUCTION

Management of oromandibular defect after oncologic resection is a challenging job and it involves multiple specialities for oncologic resection, radiotherapy and oro-maxillary rehabilitation. But reconstruction is most important as it covers the defect to provide the base for subsequent radiotherapy and rehabilitation for improvement of functional and cosmetic results.

Reconstuction of oromandibular defect evolved from use of reconstruction plate and screw, autogenous bone grafts, local and regional flaps to free tissue transfer. Bone grafts from iliac crest or scapula has been used for small bone defects but was found to be insufficient to reconstruct complex defects.[1]

Gradual increase in free flap reconstruction has been noted in the present time as there is increased awareness,

facility and expertise in the field of free tissue transfer surgery. Several options including separate bone and soft tissue reconstruction, multiple flaps existed. Free tissue transfer including vascularised scapula, iliac crest, or radial forearm flap has been used earlier, but Free fibula osteo cutaneous flap (FFOCF) has become the state of art after its first description by Hidalgo in1989.[2,3] FFOCF become superior among the options as it provides reliable and sufficient amount of skin and soft tissue for coverage and better quality tubular bone for use of osseointegrated dental implant.[4] Now it has been gold standard after introduction of several modifications in the flap including double barrel flap, chimeric flap, double flap and combined flap.[4-6]

FFOCF is technically complex but believed to be reliable even to start with and has a comprehensive surgical techniques and learning curve. We are presenting here our experience of FFOCF reconstruction of 56 cases over the last 3 years.

METHODS

Sample size

All the surgeries were done at Shri Ram Murti Smarak Institute of Medical Sciences, Bareilly, which is a tertiary referral and multispecialty health care providing centre. All the surgeries were performed by the senior author between January 2015 to December 2018.

Inclusion criteria

All cases with oromandibular defect after oncosurgical resection and primary reconstruction was done, where previously reconstructed with PMMC flap and patient was consulted for secondary bone reconstruction. A reconstruction was done with FFOCF and patients were included for outcome analysis.

Exclusion criteria

Following patients are excluded from our present studies in which oromandibular defect resulted from a previous flap failure, oromandibular defect covered with non-vascularised fibula graft and reconstuction was done in multiple sitting or with simultaneous two free flaps.

Overall 56 cases are included in the study.

Pre-operative preparation

All patients went for oncosurgical resection and neck dissection after preliminary work out under Surgical Oncology Department. Defect and specimen after resection were evaluated. Bone segment loss and soft tissue defect were measured. Specimen was sent for frozen section biopsy and assessment of marginal clearance subsequently. Left leg was preferably selected for flap harvest and perforators were detected and marked with a hand held Doppler. Right leg was chosen for any bone and soft tissue abnormality detected in left leg. Skin paddle was also marked. Inter maxillary fixation was done in normal occlusion with eyelets wires on the normal side. Bone defect was then measured.

Flap harvest

All flaps were harvested under tourniquet control. Anterior margin of the flap was elevated till perforators were identified and marked with methylene blue ink. Dissection continued through anterior leg compartment and interosseous membrane was incised, tibialis posterior muscle dissected and peroneal artery was identified just behind it. Anterior tibial artery and superficial peroneal nerve were preserved. Osteotomy site were marked at both end and space were created behind the bone with periosteal elevator. Osteotomies were done with Gigli's wire after protecting the pedicle with a dissector. Lower osteotomy was done 4 cm proximal to tip of lateral malleolus and proximal osteotomy was done according to requirement of bone length. Proximal fibula was removed from soft tissue with a periosteal dissector, preserving only 6 cm proximal bone and avoiding injury to peroneal nerve. Posterior skin margin was incised and flap was dissected from Soleus and FHL muscle. Perforators to muscles were ligated. Bone segment was rotated with bone holding forcep at both ends and peroneal vessels were ligated at distal end and dissected from posterior tibial artery till the bifurcation point. Now the entire osteocutaneous flap was elevated on its vascular pedicle and tourniquet was released. Skin paddle vascularity checked and flap is left in situ till recipient vessels were prepared at neck. After preparation of neck vessels, vascular ends were secured with vascular clamps.

Bone alignment

Flap was detached, vascular end were doubly ligated and flap was shifted to table. Osteotomies were made with micromotor drill and cutting burr. Fibula was refashioned with miniplates and screw fixation at sites of osteotomy. Flap was transferred to recipient site. Miniplates were used to fix transferred fibula with recipient bone. Thus fibula was fixed to the site of defect with teeth on normal side in occlusion.

Anastomoses

Few tagging sutures were placed to inset skin paddle and vascular paddle were delivered to neck. Donor artery and veins were separated and prepared for anastomoses. Arterial followed by venous anastomoses were done and clamps were left in place till completion of venous anastomoses. A single bolus 2500 unit heparin administered intravenously in between arterial and venous anastomoses. Vascular clamps were removed from venous end followed by arterial end. Preferably facial artery and both EJV and Facial vein were used for anastomoses. Superior thyroid artery and IJV or its

branches were use if suitable recipient vessel were not available at primary dissection.

Vascularity of flap was checked and soft tissue inset into defect was completed. Neck extension removed, haemostsis checked and neck closed over closed suction drain. Flap donor site closed over suction drain and skin grafted. Slab was applied to stabilise ankle. Naso gastric feeding tube was inserted after reversal from anaesthesia.

Flap was monitored every three hourly for first 24 hours, then 6 hourly for next 48 hours and drains were checked. Flap was re explored, if required. Naso-gastric feeding started from 3rd post operative day. Grafted flap donor site dressing changed on third post-operative day and drains were removed. Dressing were changed on alternate day and patients were discharged on 5th post-operative day.

Follow up

Patients were followed up on 7th post op day and weekly onwards. Naso gastric feeding was continued for 2 weeks and trial of oral feeding with liquids and semisolid diet started after that. Slab was removed after 2 weeks and patient advised for walking. Occlusion was checked and patient was encouraged for chewing movement. Patient were followed up monthly subsequently for a minimum six month period and then 6 monthly and on and off if required. Post-operative radiotherapy was given after 2 months if required. Functional and aesthetic outcome, donor site healing and recurrence were noted. Bone healing was assessed with oral pantomogram (Figure 1). Any suspicious nodule was subjected for histopathological analysis and on recurrence patient was subjected to further resection and reconstruction.

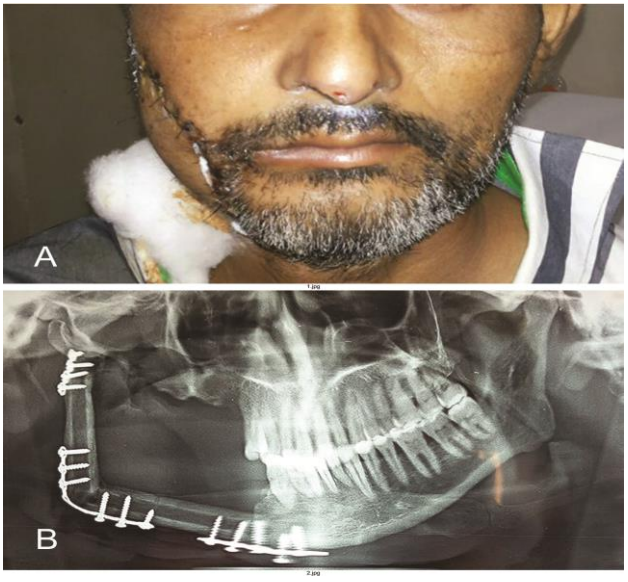

Figure 1: Oral pantomogram assessment of jaw cantour and bone healing; (A) 3rd month post-operative picture; (B) OPG at 6 month follow up of the same patient.

Data analysis

Patient related variables are collected from hospital database and were subjected to statistical analysis with SPSS Software. Frequency distribution with mean, standard deviation and standard error of mean was calculated whenever required.

RESULTS

Among the patients 42 were males and 14 were females. Mean age of the patients were 48 years. Excision and reconstruction was done in same sitting in 49 cases. Secondary bone reconstruction was done in 5 cases. These cases were reconstructed with PMMC flap with or without radiotherapy earlier and sought intervention for either bone reconstruction, defect related complications or aesthetic concern.

Surgery

Defects are classified according to bone segment and soft tissue involvement. Bone segment defect classified as 'HCL Classification' of Jewer and Boyd and Central and lateral (LC), Hemi-mandible (H), Lateral (L), Central segment (C), Lateral-central-lateral (LCL) found in 2, 23, 0, 3 and 27 cases respectively. Combined bone and mucosal defect were noted in 26 cases and through and through bone, mucosa and skin defect were found in 30 cases.

Left leg was used for flap harvest in 42 cases. Right leg was used in 14 cases due to previous trauma or defect involving skin, soft tissue or bone in left leg. Single skin paddle was used in 26 cases where as double skin paddle 30. Peroneal perforator was marked at 5 cm in 40 cases and at 10 cm in 16 cases.

Length of bone segments used were 6-12 cm. Single, double and triple osteotomy were done in 16, 30 and 10 cases respectively.

Table 1: Surgical outcome of FFOCF.

Surgical outcome	Total (n=56)
	N (%)
Re exploration	6 (10.71)
Complete Salvage	2 (3.57)
Partial flap loss	2 (3.57)
Total flap loss	2 (3.57)
Flap survival	54 (96.43)

Facial artery used as recipient in 46 cases where as superior thyroid artery in 10 cases. Double venous anastomosis was done in 45 cases with EJV and either IJV or facial vein or single to. Single end to side venous anastomoses with IJV was done in 11 cases. Pedicle length found were 6-10 cm. Vein graft for arterial or venous anastomoses were not required in any cases. All

donor sites were skin grafted. Surgical outcome is summarised (Table 1).

Follow up

Follow up period was 6 month to 3 year. All patients followed up for a minimum period of 6 months. Post op radiotherapy was required in 36 cases. Three patients expired due to age related complication and problem unrelated to disease in the follow up period. Two flaps were lost after surgery. Operative outcome in rest surviving 54 flaps is summarised (Table 2).

Table 2: Operative outcome of FFOCF.

Outcome		Total (n=54)
		N (%)
Complications	Orocutaneous fistula	1 (1.85)
	Plate infection	2(3.70)
Functional	Food tolerance	Liquid- 54 (100)
		Semisolid-50 (96.15)
		Solid- 45(80.35)
	Speech disoprder	8 (14.81)
Aesthetic	Jaw shape and contour	Good- 38 (70.37),
		Satisfactory- 15 (27.78)
		Not satisfactory- 3 (10.71)
	Soft tissue match	Good- 28 (51.85),
		Satisfactory- 20 (37.03)
		Not satisfactory- 8 (14.81)
Donor site morbidity	Healing related	6 (11.11)
	Walking	Without support- 52 (96.3)
		With support- 2 (3.7)
Recurrences		5 (9.25)

DISCUSSION

Management of oromandibular defect reaches state of art due to high rate of oromandibular malignancy worldwide. Several reconstructive options exists for oncologic oromandibular reconstruction depending upon the nature and extent of the lesion. Though surgical expertise is warranted, free flap reconstructions are gradually replacing the local flaps due to its several fold advantages.[3,7-9] Now FFOCF has become a standard reconstructive choice in the modern era of free tissue transfer.

Vascularised bone transfer has proved to be superior for oncologic oromandibular reconstruction than non-vascularised graft. More than 4 cm bone defect and discontinuity necessitates vascularised bone reconstruction.[6,10] More over vascularised osteocutaneous flap incorporates skin paddle to bridge soft tissue defect. Vascularised fibula provides enough bone to bridge mandibular discontinuity of any dimension as well as it allows comprehensive shaping and subsequent use of dental prosthesis for functional and aesthetic recovery.[11,12] Iliac crest, scapula or radius were used in earlier days but fibula proved to be superior as it provides tubular bicortical bone of maximum length and reliable substantial perforator based skin paddle to reconstruct composite defect with minimal donor site morbidity.[13-16]

Multispecialty approach for oromandibular reconstruction popularized FFOCF in the last decade. Use of pre-operative three dimensional imaging, reconstruction planning and post-operative comprehensive dental rehabilitation made this flap more useful. Several modification of FFOCF evolved like double barrel and double pedicle and chimeric flap harvest practically enables any oromandibular defect reconstruction with a single FFOCF flap.[9,17,18]

Though FFOCF flaps were criticized for poor match of height for mandible, short pedicle length, reliability of skin paddle, anatomical vascular variations and donor site morbidities in the past but successfully proves superior execution of reconstructive plan.[19] We observed that flap raising needs sound anatomical knowledge of compartments of leg. Gradually flap rising became easy due to its almost constant feature and minimum anatomical variation. Pedicle length was adequate and need for a vein graft was very rare (one out of 56 cases). Arteria peronea magna was not found in any case. Donor site morbidity in our study was in an acceptable range in accordance to previous studies.[10] Delayed healing and wound infection was found in 6 cases. No peroneal nerve injury or foot drop was noted. Walking without support at 6 month follow up was noted in 54 cases.

Success rate of FFOCF is significantly good worldwide as it offers good pedicle length and diameter, two venae comitantes offer for simultaneous anastomoses to

superficial EJV and deep IJV system to reduce vein related flap complications. Most of the studies show success rate more than 80%.[6,7,12,20] Success rate in our study was 54/56. Re-exploration rate was low (6/56). Re-exploration was done with in 6 hour in all cases and venous thrombosis was noted in all. Re do anastomoses with IJV was done. Flap was salvaged in four cases. Partial loss of skin paddle seen in 2 cases. They were treated with local tissue readjustment and local flaps. Total flap loss was seen in two cases. In both the cases defect involved bone and mucosa. The flap was debrided, bone segment was removed and the defect was reconstructed with PMMC flap. Post-operative complication was low and noted in three patients. Orocutaneous fistula was noted in one case and subsided completely over a period of 6 months with oral care, food restriction and local flap coverage of intra oral fistula site. Recurrent plate infection was noted in two cases requiring plate removal after a period of eight months in one case. Complete bone healing was noted by that time in this patient.

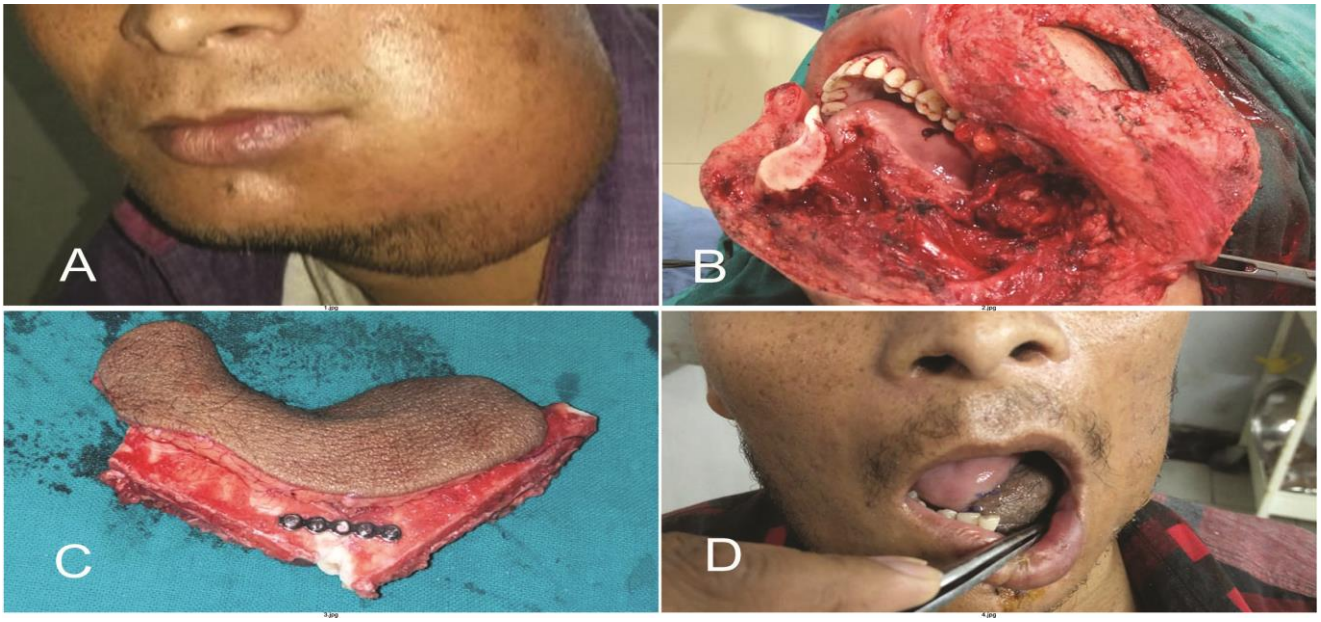

Figure 2: Operative outcome in a 26 year male with mandibular adamantinoma; (A): pre-operative picture; (B): measured defect includes hemimandibular bone and mucosal loss; (C): Contouring of flap with single osteotomy with single 5 holeminiplate and 1.5 mm screw fixation. Skin paddle was used for mucosal defect coverage and (D): first week post-operative picture.

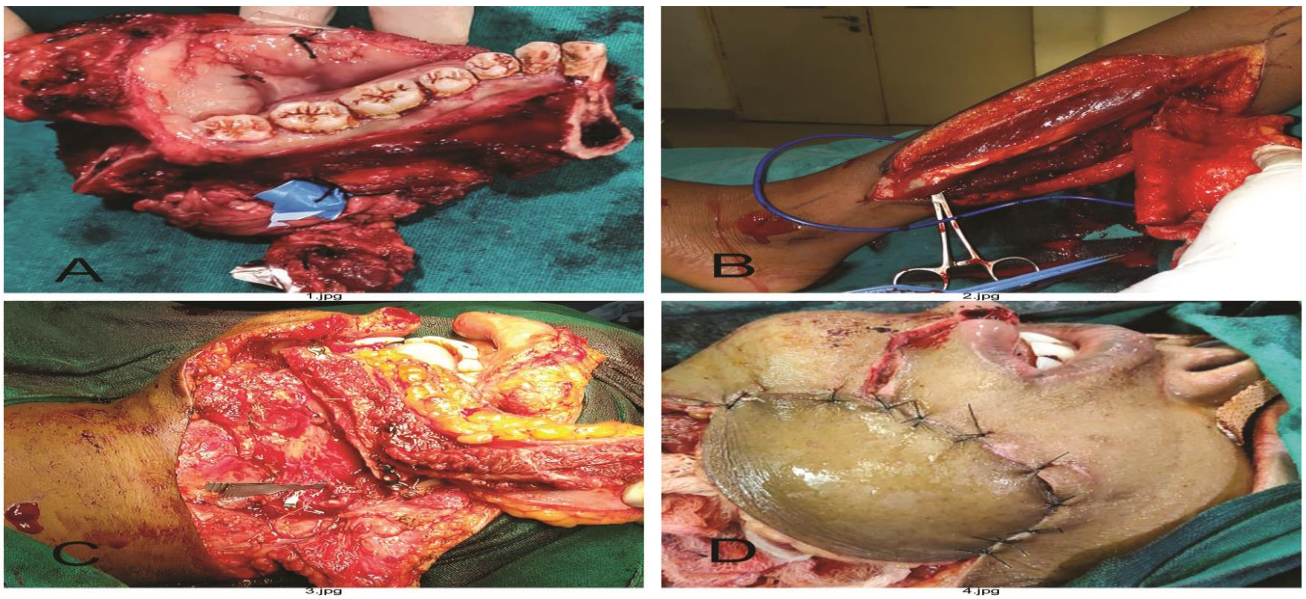

Figure 3: Planning and execution of flap in a 32 year female with squamous cell carcinoma of oral cavity; (A): excised specimen demonstrating bone and soft tissue defect; (B): double paddle osteocutenious flap harvest; (C): bone contouring and flap and anastomoses and (D): skin paddle inset.

Outcome assessment has been described in the form of functional, aesthetic result and quality of life assessment in earlier studies.[13,14,20-23] We found that bone reconstruction and shaping was comprehensive with use of miniplates and screws and osteotomy. Three dimensional reconstruction with prior imaging and specimen review and proper planning allowed us to achieve desired jaw contour and symmetry (Figure 2, 3). Overall aesthetic result was good in most patients. In our study jaw countour and symmery was classified either good, satisfactory or not satisfactory. Good results noted in 38 patients. Results were not satisfactory in 3 cases and due to asymmetry though contour was good. Bone healing in oral pantomogram was complete in all cases at 6 month follow up. In all patients intraoral skin paddle mucosalised mostly by 6 months. Skin match was not satisfactory in 8 patients. Laser epilation of extraoral skin paddle done in two patients.

Functional outcome was good as substantial soft tissue coverage was obtained in most patients. Use of double paddle in large tissue defect allowed good coverage and flap inset without tension to preserve oral competence. Solid food intolerance noted mostly due to diminished masticatory force and was noted in 9 patients. Oral competence, deglutition and liquid diet toletence was noted in all patients. Speech disorder was noted in 8 patients.

Post-operative radiotherapy was required in 36 cases due to tumor stage and margin of excision. Recurrence was noted in 5 cases. It was noticed after 6, 8, 8, 15 and 18 months follow up in these cases. They were treated with re-excision and PMMC flap and radiotherapy. No mortality related to disease was noted in the follow up period.

CONCLUSION

FFOCF is a reliable reconstructive option for complex oromandibular defect with a predictable outcome. Flap harvest is reliable and contouring is comprehensive. It gives good functional and aesthetic results with high success rate. Thus this flap is truly the preferred reconstructive option for all type of oncologic oromandibular defect with microvascular surgery facilities.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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