

## Free radial artery forearm flap reconstruction in various intraoral defects after tumour resection – Our experience

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Received: 07-12-2020 / Revised: 08-01-2021 / Accepted: 01-02-2021

### Abstract

**Background:** A free radial forearm flap popularly known as “The Chinese flap” is the workhorse flap for oral cavity reconstruction after intraoral tumour resection. The aim was to highlight the versatility of the free radial artery forearm flap in various intraoral defects. **Method:** From 2017 to 2019, a total of 24 cases were operated for intraoral defect reconstruction after tumour resection by free radial artery forearm free flap. The patients had a mean age of 48 years (range 32-70). The most common histopathological diagnosis was squamous cell carcinoma in 22 cases. The free radial artery flap was used to reconstruct defects of tongue(8 cases), buccal mucosa(8 cases), lip(3 cases), retromolar trigone(3 cases) and the floor of mouth(2 cases). The mean flap size was 33cm<sup>2</sup> and mean pedicle size was 8.7 cm. **Results:** Twenty four patients underwent intraoral reconstruction after tumor ablation with a free radial artery forearm fasciocutaneous flap. Two of the cases required immediate reexploration of which one could not be salvaged and was reconstructed with pectoralis major myocutaneous flap. The success rate of the flap survival was 95.8% with satisfactory post operative outcome. **Conclusion:** The free radial artery forearm flap is a versatile, thin, pliable and reliable option for intraoral defect reconstruction after tumour ablation. The flap is easy to harvest with predictable vascular anatomy and a reasonable size of paddle for reconstructing various oral oncologic defect.

**Keywords:** Free radial artery forearm flap, versatile, intraoral defect.

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### Introduction

The oral cavity is a common site of malignancy worldwide and is increasingly common in developing nations. Head and neck malignancies represent more than 1/3<sup>rd</sup> malignancies in India[1]. It extends from the skin – vermilion junction of the lips to the junction of hard and soft palate above and to the line of circumvallate papillae below to include the lip, anterior two thirds of tongue, buccal mucosa, floor of mouth, upper and lower gingiva, retromolar trigone and hard palate. The reconstruction of bone and soft tissue defects following oncologic resection within the oral cavity can be quite challenging for restoration of both morphology and function. Microsurgical free tissue transfer has been an option for head and neck reconstructions after oncologic resections since 1980s[2]. Several free flaps have been used, such as the radial forearm free flap (RFFF) vascularized free fibular flap, iliac crest free flap, free deltoid flap, anterolateral thigh flap, scapular osteocutaneous flap, brachioradialis forearm flap, lateral arm free flap and the rectus abdominis musculocutaneous flap[3-12]. Although all of them are of potential interest for the covering of defects within the oral cavity, the RFFF constitutes one of the preferred choice.

The RFFF was first described by Yang et al. in 1981[2] and popularized as “The Chinese Flap”. In 1983, Soutar et al.<sup>4</sup> called it a versatile

method for intraoral reconstruction. With time a free radial forearm flap has become the workhorse flap for oral cavity reconstruction. The aim of our study is to emphasize the versatile nature of the free radial artery forearm flap in various intraoral post tumour resectional soft tissue defects.

### Methods

From 2017 to 2019, a total of 24 cases were operated for intraoral defect reconstruction after tumour resection by free radial artery forearm flap. All the surgeries were conducted in a tertiary care centre, a medical college in the plastic surgery department. The study had been approved by our institutional ethical committee. All cases were reconstructed primarily in the same sitting as oncologic resection.

### Preoperative

All cases were examined and counseled preoperatively regarding the procedure, donor site healing, flap care & informed consent was taken. All patients underwent Allen’s test and Ultrasound doppler examination to ensure adequate vascularity in the donor limb. This Flap was harvested under a pneumatic tourniquet at a pressure of 220mm Hg after exsanguinating the limb. In all cases left (non dominant) forearm was utilized for the donor site.

### Flap harvest

After the proposed skin paddle is marked, flap was harvested from ulnar to radial side till flexor carpi radialis in the plane above the muscular fascia leaving the paratenon intact. Then flap was elevated from radial to ulnar side till the brachioradialis tendon. The superficial branch of the radial nerve was preserved. Cephalic vein was incorporated with the flap and the radial artery and venae comitantes were ligated distally. The flap with the vascular pedicle was elevated distal to proximal by elevating the vessels with the

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subcutaneous paddles. A lazy (S) incision extending proximally to the cubital fossa was made and sufficient pedicle length achieved. Proximally, radial artery and cephalic vein were ligated and tourniquet released, hemostasis achieved. Donor site was covered with a split thickness skin graft after distal bony and tendinous defects were closed with approximating flexor carpi radialis and brachioradialis muscles.

After partial inset of the flap, arterial anastomosis was done with the facial or the superior thyroid artery and venous anastomosis with the internal jugular, facial or superior thyroid vein in end to end or end to side fashion. Then flap inset was completed.

#### Postoperative

Close flap monitoring was done every hourly for 72 hrs and then every 4 hrly for next 3-4 days till the patient was discharged. If any change in colour or speed of bleeding on scratch was observed

suggesting vascular compromise, patient was immediately taken in operation theatre for reexploration and reanastomosis was done for the compromised vessel.

#### Results

Of these patients, 18 were male and 6 were female with a mean age of 48 years (range 32-70). The success rate of the flap survival was 95.8% with satisfactory postoperative outcome.

#### Observation table

These patients were reviewed for age, gender, location of tumour, type of tumour and pre and post operative radiation treatment. (Table 1)

**Table 1: Demographic and pathological characteristics of patients**

Characteristics		Value
Gender(n)	Male	18
	Female	6
Age (in years)	Mean	48
	Range	32-70
Diagnosis	Squamous cell carcinoma	22
	Verrucous carcinoma	2
Tumor location	Tongue	8
	Buccal Mucosa	8
	Lip	3
	Retromolar Trigone	3
	Floor of mouth	2
Radiotherapy	Preoperative	1
	Post operative	23

Twenty four patients underwent intraoral reconstruction with a free radial artery forearm fasciocutaneous flap (Table 1).

A total of eighteen (75%) male and six (25%) female patients were operated with a mean age of 48 years (range 32 -70). Twenty(83.3%) patients were chronic tobacco chewers and eighteen(75%) were chronic smokers. Twenty two (91.6%) cases were histopathologically

found to be squamous cell carcinoma and two(8.3%) had verrucous carcinoma. The versatility of the flap allowed reconstruction of defects in various locations; tongue 8 cases (33.3%), buccal mucosa 8 (33.3%), lip 3(12.5%), retromolar trigone 3 (12.5%) and floor of mouth 2 (8.33%).

**Table 2: Length and size of free radial artery forearm fasciocutaneous flap**

Characteristics		Value
Vascular pedicle(cm)	Mean	8.7
	Range	7-14.5
Size(cm square)	Mean	33
	Range	20-54

A free radial artery forearm fasciocutaneous flap was harvested in all the cases with a mean pedicle length of 8.7 cm (range 7- 14.5 cm). The mean size of the flap was 33cm<sup>2</sup>(range 20- 54cm<sup>2</sup>). (Table 2)

Two of the cases required immediate reexploration of which one could not be salvaged and was reconstructed with pectoralis major myocutaneous flap.

#### CASE 1

- 51 years ,CA tongue right side , HPE – SCC , Plan – RFFF

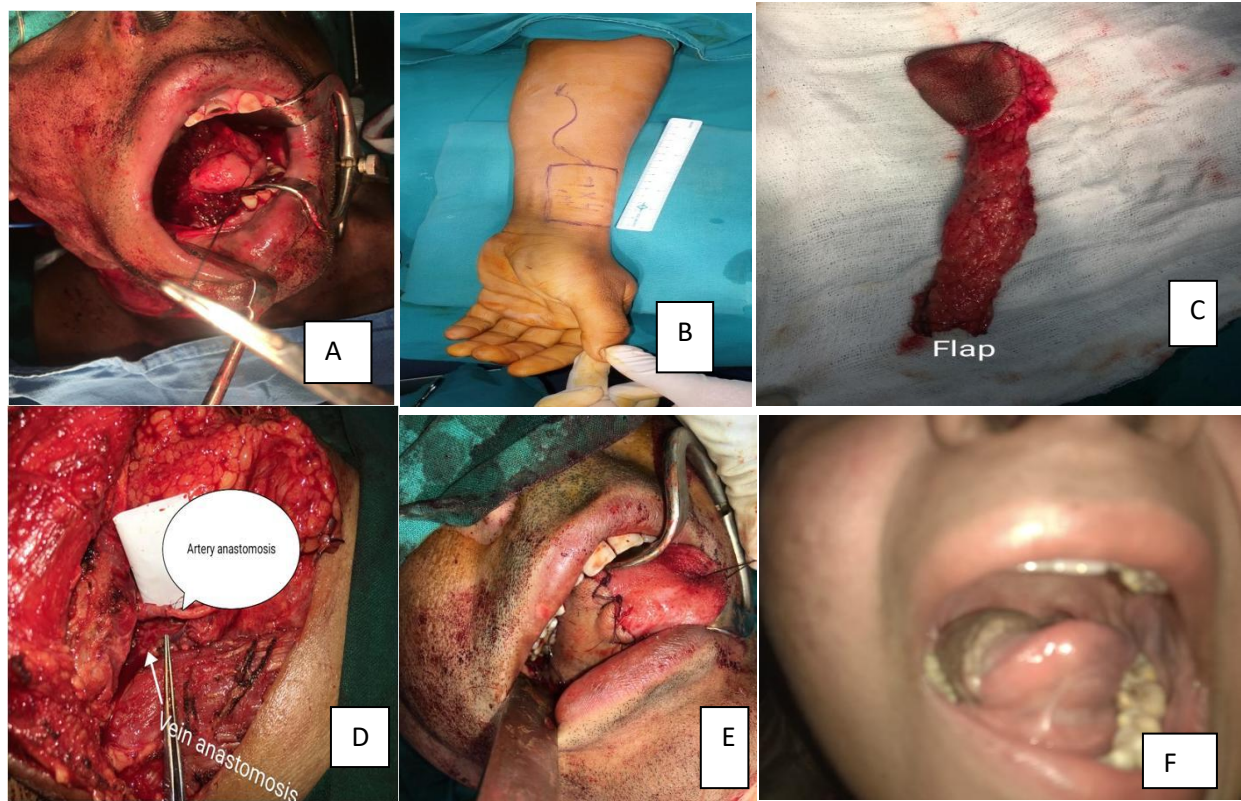


figure 1:  
A –Tongue defect, B-Flap design , C- Harvested flap, D – Anastomosis , E- Inset , F- Follow up

**CASE 2**

- 29 y female, CA right buccal mucosa, well differentiated SCC , Plan - RFFF.

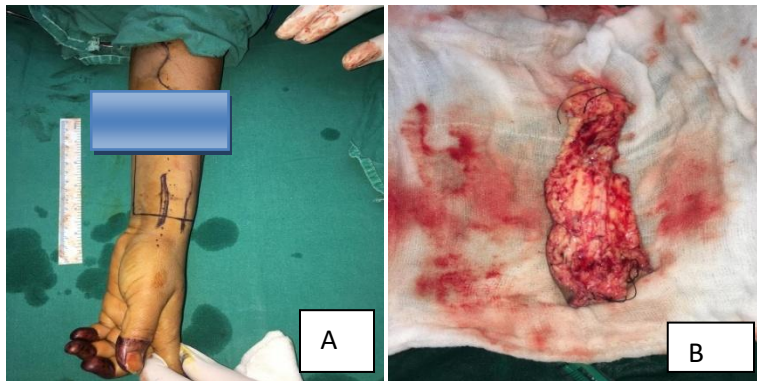






Figure 2:

A-Flap design, B- Harvested flap, C – Flap inset, D- Donor site

### Discussion

The reconstruction of defects after head and neck cancer are one of the most challenging procedures. Microsurgical techniques have revolutionized surgical reconstruction and significantly improved surgical outcomes. A free flap provides a reliable and safe method for reconstructing defects after intraoral tumour ablation.

In our study, 24 patients underwent intraoral reconstruction of which a total of 18(75%) male and 6 (25%) female patients were operated with a mean age of 48 years (range 32 -70). As per study by Gonzalez, et al<sup>3</sup>, a mean age of 55.53 years was observed (range 16-78). 39 patients (70.9%) were men and 16 (29.1%) were women. An older age group was found in studies by Jeffrey D. Suh, et al[13], Keith E Blackwell, et al[14], and Bruce H. Haughey, et al[15]. In another Indian study, Ranjan S Aiyer et al[16], the majority of patients were in the age group 41-50 with 58% males and a mean age of 42 years.

In our study, all cases underwent primary reconstruction. Eckardt A et al[17] found that immediate repair of head and neck defects using free tissue transfer is becoming the gold standard. In accord with Boyd et al[18] and Jones et al[19] we believe that primary reconstruction is preferable to secondary reconstruction. Jeremic et al [20] conducted immediate (19 patients, 90.5%) or delayed (2 patients, 9.5%) reconstruction using free flaps from the radial forearm.

In our study, twenty two (91.6%) cases were histopathologically found to be squamous cell carcinoma and two(8.3%) had verrucous carcinoma. This finding was similar to Gonzalez, et al[3], where 53 out of 55 patients ( 96.3%) had squamous cell carcinoma.

In our study, the versatility of the flap allowed reconstruction of defects in various locations; tongue 8 (33.3%), buccal mucosa 8 (33.3%), lip 3 (12.5%), retromolar trigone 3 (12.5%) and floor of mouth 2 (8.33%) cases. The majority were tongue and buccal mucosal malignancies (33.3% each) compared to study by Reinert S. et al[21] and Markkanen, et al[22], with majority of floor of mouth and tongue cancer. Another study by Ranjan G. Aiyer, et al[16] found a majority of lip and buccal mucosal malignancies. According to Jeremic, et al [20] fascio-cutaneous flaps were used in 21 patients with reconstruction of floor of the mouth (6 cases), buccal mucosa (5 cases), lip (1 case) and a retromolar triangle (2 cases) defects, or after hemiglosssectomy (7 cases).

In our study, only one case out of 24 received neoadjuvant radiotherapy in comparison to Gonzalez et al[3], three cases received preoperative chemotherapy and preoperative radiotherapy .

In this study, twenty four patients underwent intraoral reconstruction after tumor ablation with a free radial artery forearm fasciocutaneous flap (Table 1).Twenty (83.3%) patients were chronic tobacco chewers and eighteen(75%) were chronic smokers. In comparison to study by Gonzalez, et al[3] alcohol intake and smoking was present in 21 of 55 patients. Eleven cases actively smoked without alcohol

intake. Thus, smoking was present in 32 patients (58.18%) of the whole series. In our study, a free radial artery forearm fasciocutaneous flap was harvested in all the cases with a mean pedicle length of 8.7 cm (range 7- 14.5 cm).The mean size of the flap was 33cm<sup>2</sup> ( range 20- 54cm<sup>2</sup>)(Table 2). This was similar to Song et al.<sup>9</sup> where the mean size of the forearm flap was 7.5 X 14 cm, and the de-epithelialized area was 7 X 6 cm. In another study by Gonzalez et al[3], fasciocutaneous grafts were used in 98.1% of the cases, with a mean size of 7.39 X 5.17 cm for the skin paddle. The mean length of the vascular pedicle was 7.2 cm (range 5 to 16 cm).

In our study, two of the cases required immediate reexploration of which one could not be salvaged and was reconstructed with pectoralis major myocutaneous flap. The success rate of the flap survival was 95.8% with satisfactory post operative outcome. As per Gonzalez et al<sup>3</sup>, ten patients (18.2%) required revision of the vascular anastomosis in a second surgical procedure. Five of these patients recovered uneventfully, whereas 2 patients showed partial loss of the flap and 3 patients developed total loss of the flap. Jeremic et al[20] had flap failures in two (9.5%) patients, in one patient due to late ischemic necrosis, which appeared one week after the surgery, and in another patient due to venous congestion, which could not be salvaged after immediate re-exploration. Two patients required re-exploration due to vein thrombosis. The donor site healed uneventfully in all patients, except one, who had partial loss of skin graft. Jeremic et al[20] had an overall success rate of 90.5 %.

Radial forearm free flap is thin, pliable, relatively hairless with minimal bulk and has a reliable pedicle which makes it extremely suitable for intraoral defect reconstruction.

The pliability of the flap facilitates its draping over complex intraoral defects. Bulky flap would restrict tongue movements and inhibit the muscular hypertrophy of the remaining tongue musculature. e.g. the rectus abdominis musculocutaneous flap is bulky and may cause abdominal hernia as a postoperative complication.(Butler, et al)[12] Radial forearm free flap has a reliable, consistent lengthy vascular pedicle. This provides the advantage of being able to perform the anastomosis at a site distant from previously irradiated vessels.

This flap provides excellent colour match with a relatively hairless, thin pliable skin from distal forearm. With time, oral mucosalisation relieves the flap surface of the problem of hair growth.

Progressively, the success rate of microvascular reconstructions have improved. Still flap failures and compromises occur due to thrombosis, mostly venous. Slow venous flow is prone to stasis. Veins may be easily compressed or kinked with haematoma as found in another study by Jeremic et al[20].

Post operative monitoring is mandatory to minimize flap failure as emergent re exploration is imperative for flap salvage. In our experience, two flaps required emergency re exploration done within 3 hours postoperatively. Of these two re explorations, one flap was

salvaged by declotting the venous thrombosis and reanastomosis. The other flap could not be salvaged, was debrided and defect reconstructed with pectoralis major myocutaneous flap.

### Conclusion

The free radial forearm flap is easy to harvest with predictable vascular anatomy and a reasonable size of paddle for reconstructing various oral oncologic defects with minimal donor site complications. This flap is a versatile, thin, pliable and reliable for oral cavity reconstruction providing good functional restoration and excellent cosmesis.

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**Conflict of Interest: Nil**

**Source of support: Nil**