

# Comparison between Anterolateral Thigh Flap and Radial Forearm Free Flap in Head-Neck Cancer Reconstruction

Dr. Md. Jahin Tareq Bhuiyan<sup>1</sup>, Dr. Md. Shaharior Arafat Shawrave<sup>2</sup>

<sup>1</sup>Registrar, Department of Ear, Nose, Throat and Head-Neck Surgery, Dhaka Medical College Hospital, Dhaka

<sup>2</sup>Associate Professor, Department of Ear, Nose, Throat and Head- Neck Surgery, Dhaka Medical College Hospital, Dhaka

**Abstract:** ***Background:** The radial forearm flap (RFF) and the anterolateral thigh flap (ALT) are commonly used for the reconstruction of oral cavity soft tissue defects. The aim of the study was to assess and compare the flap survival, complications and postoperative functional outcomes of the patients after reconstruction of extensive oral cavity defects with ALT and RFF flap following cancer ablation. **Patients and Methods:** A retrospective study was conducted at Department of Otolaryngology- Head and Neck surgery, Dhaka Medical College Hospital, from 1st July, 2020 to July, 2022, a total of 75 patients were enrolled through non probability purposive sampling and according to the selection criteria, affected by advanced oral cavity cancer underwent microsurgical reconstruction with 23 RFF and 52 ALT procedures. The flap survival, complications and postoperative functional outcomes among these two groups were retrospectively analyzed. **Results:** Mean age of the patients was 54.4 ( $\pm$  7.9) years in RFF group and 52.8( $\pm$ 6.1) years in ALT group (range= 40-75 years). Flap survival rate was 91.3% for RFF group and 86.5% for the ALT group ( $p=0.71$ ). Postoperative complications in recipient site occurred in 17.4% of the RFF group and in 26.9% of the ALT group ( $p=0.56$ ). In donor site morbidity, cosmesis is more impaired in RFF group (82.6%) than ALT group (53.8%) ( $p=0.021$ ). Haematoma occurred only in ALT group (26.7%) ( $p=0.004$ ). Patients in the RFF group reported better scores in the swallowing, chewing and speech in domains of the University of Washington-Quality of Life (UW-QOL) scale compared with those in the ALT group but statistically not significant ( $p >0.05$ ). In other domains, both groups reported no difference. Similarly, RFF provided the same results in the understandability of speech, normalcy of diet and eating in public place of the Performance status Scale for Head & Neck (PSS-HN), compared to the ALT but statistically not significant ( $p > 0.05$ ). Statistical analysis confirmed no significant difference between the two groups regarding the variables investigated ( $p>0.05$ ). **Conclusion:** In our observation, ALT and RFF flap demonstrated analogous practicability and reliability for the reconstruction of oral cavity soft-tissue defects, with similar flap survival rate, donor-site complications and postoperative functional outcome.*

**Keywords:** Head-neck reconstruction. Free flap. Radial forearm free flap. Anterolateral thigh flap

## 1. Introduction

The incidence of oral cavity cancer has increased in the past 30 years and surgical resection is an essential strategy for the treatment of oral cancer in advanced stages (Cai, Y.C., *et al.*, 2019). Several decades have witnessed the use of free flaps in clinical science. With the advancement and refinement in the operative techniques, the survival rates of these flaps have increased. Thus, the free flaps are now gold standard in the reconstruction of the head and neck (Lamaris, G.A., *et al.*, 2017).

With the advancement in the free-flap technique, inoperable conditions like recurrent or advanced disease patients can now be operated. The most commonly used free flaps are anterolateral thigh free flap (ALT) and radial forearm free flap (RFF) for the head and neck reconstruction. There are several reasons for the current popularity of RFF: the presence of an adequate calibre vascular pedicle, the flexibility and pliability of the tissue and the anatomical location of the flap allowing simultaneous harvesting with the ablative team (Loreti, A., *et al.*, 2008).

Anterolateral thigh free flap allows the transfer of different tissues in significant amounts with a vascular pedicle of suitable length and diameter and low donor-site morbidity. In most of the cases, these residual thigh wounds tolerate direct closure, and this is hypothesised to decrease the time required for wound healing and thus decrease donor-site

morbidity (Valentini, V., 2008).

In case of oral cavity cancer, advanced disease is found in two-thirds of patients with squamous cell carcinoma and the resection of malignant tumours can result in large and complex defects. Covering these defects is crucial for restoring tissue integrity, function, and aesthetics (Yang, S., *et al.*, 2021).

However, no criteria or indications have been defined to guide a surgeon's selection between RFF and ALT flaps. This study will compare anterolateral thigh (ALT) flap and radial forearm free (RFF) flap in oral cavity reconstruction to identify and describe differences in practicability, reliability, and impact to donor as well as recipient site functionality.

## 2. Materials & Methods

This retrospective study was conducted between the time frame of July 1, 2020 to July 2022 with a sample size of 75 in the Department of ENT & Head-Neck Surgery, Dhaka Medical College Hospital, Dhaka. Patients of any age and sex diagnosed with advanced oral cavity carcinoma Stage III (T3N0-1M0) & Stage IV (T4a-bN0-3M0) who was admitted in hospital for operative procedure was included in the study. Purposive sampling was done. Patient with history of radiotherapy and chemotherapy, distant metastasis, chronic systemic illness was not included in the study. All the patients were followed up for 3 months after surgery. All data were

Volume 12 Issue 12, December 2023

[www.ijsr.net](http://www.ijsr.net)

Licensed Under Creative Commons Attribution CC BY

analyzed after thorough checking, cleaning, editing and compiling by the 25th version of SPSS. Descriptive statistics was done first; frequency tables and figures were presented accordingly. Inferential analysis was done by chi-square test and logistic correlation technique

### 3. Ethical Consideration

Prior to commencement of study the respective authority approved the research protocol. Proper permission was taken from the Department and Institution concerned for the study. All the patients included in this study will be informed about the nature, risk and benefit of the study. No data was collected without the permission of the patient. Participation in this research was fully voluntary. The respondents remained entirely free to withdraw their participation at any stage or any time of the study. Informed written consent was taken from each patient. Confidentiality was assured and anonymity was maintained. No participant was identified in any report or publication under the study. No participant was given any economic benefit for participation in this study.

**Table 1: Age distribution of the patients: (n=75)**

Age Groups (years)	Radial Forearm free flap		Anterolateral thigh flap		P- value
	Frequency	Percentage	Frequency	Percentage	
40- 49	6	26.08	12	23.0	0.37
50- 59	11	47.82	26	50.0	
60 and above	6	26.08	14	26.92	
Total	23	100	52	100	
Mean ( $\pm$ SD) 54.4 ( $\pm$ 7.9) years Mean ( $\pm$ SD) 54.4 ( $\pm$ 6.1) years					

### Site of the carcinoma: (n=75)

Three carcinoma sites were selected for reconstruction: buccal region, tongue and retromolar trigone. Radial forearm free flap was done in buccal region (43.47%), tongue (39.13%) and trigone (17.39%). Anterolateral thigh flap was done in buccal region (42.30%), retromolar trigone (32.69%) and tongue (25%).

**Table 2: Site of the carcinoma (n=75)**

Sites	Radial Forearm free flap		Anterolateral thigh flap	
	Frequency	Percentage	Frequency	Percentage
Buccal Region	10	43.47	22	42.30
Tongue	9	39.13	13	25.00
Retromolar Trigone	4	17.39	17	32.69
Total	23	100	52	100

### 2) Post-operative periods: (n=75)

Postoperative complications in recipient sites are more in anterolateral thigh flap (ALT) group (26.7%) than radial forearm free (RFF) flap group (17.6%), which was statistically not significant ( $p=0.56$ ).

Flap successfulness is more in radial forearm free (RFF) flap group (91.1%) than anterolateral thigh flap (ALT) group (86.5%), which was statistically not significant ( $p=0.71$ ).

On Donor site assessment, Seroma and infection was more in radial forearm free (RFF) flap group (21.7%) than anterolateral thigh flap (ALT) group (13.5%), which was statistically not significant ( $p=0.50$ ).

## 4. Results

In this comparative study, the total number of patients was 75 who were suffering from carcinoma of the oral cavity. This number was divided into two parts- 23 of the subjects underwent for radial forearm free flap in oral cavity reconstruction and another 52 of the subjects underwent for anterolateral thigh flap. Radial forearm free flap in oral cavity reconstruction was done more in number than the other.

### 1) Age distribution of the patients(n=75)

The mean age of the patients was 54.4 ( $\pm$  7.9) years. On the other hand, the highest number (53.3%) of patients was from the '50-59 age' group and the lowest number (20%) of patients was from the '40-49 age' group in the Anterolateral thigh flap method. The mean age of the patients was 52.8 ( $\pm$ 6.1) years. But there is no significant association between age of these two groups.

Hematoma was not found in radial forearm free (RFF) flap group, but in anterolateral thigh flap (ALT) group (26.9%), which was also statistically significant ( $p=0.004$ ). But infection was more in radial forearm free (RFF) flap group (21.7%) than anterolateral thigh flap (ALT) group (13.5%), which was statistically not significant ( $p=0.50$ ). In case of cosmesis, radial forearm free (RFF) flap group (82.6%) had more cosmetic deformity than anterolateral thigh flap (ALT) group (53.8%), which was statistically not significant ( $p=0.021$ ).

**Table 3: Postoperative periods: (n=75)**

Radial free flap	forearm thigh flap	Anterolateral	P value
Postoperative complications in recipient site	Frequency (%)	Frequency (%)	
Yes	4 (17.4)	14 (26.9)	<b>0.56</b>
No	19 (82.6)	38 (73.1)	
<b>Flap successfulness</b>			
Yes	21 (91.3)	45 (86.5)	<b>0.71</b>
No	2 (8.7)	7 (13.5)	
<b>Donor site assessment: Seroma</b>			
Yes	5 (21.7)	7 (13.5)	<b>0.50</b>
No	18 (78.3)	45 (86.5)	
<b>Hematoma</b>			
Yes	0	14 (26.9)	<b>0.004</b>
No	23 (100)	38 (73.1)	
<b>Infection</b>			
Yes	5 (21.7)	7 (13.5)	<b>0.50</b>
No	18 (78.3)	45 (86.5)	
<b>Cosmesis</b>			
Yes	19 (82.6)	28 (53.8)	<b>0.021</b>
No	4 (17.4)	24 (46.2)	

**Table 4:** University of Washington- Quality of Life Scale-Swallowing Outcome

Swallowing	Type of Flap		Total	P-value
	ALT	RFF		
I cannot swallow certain solid foods	28	11	39	0.73
	71.80%	28.20%	100.00%	
I can only swallow liquid food	23	11	34	
	67.60%	32.40%	100.00%	
I cannot swallow because it "goes down the wrong way" and chokes me	1	1	2	
	50.00%	50.00%	100.00%	
<b>Total</b>	52	23	75	
	69.30%	30.70%	100.00%	

**Table 5:** Chewing Outcome

Chewing	Type of Flap		Total	P-value
	ALT	RFF		
I can chew as well as ever	1	1	2	0.86
	50.00%	50.00%	100.00%	
I can eat soft solids but cannot chew some foods	29	13	42	
	69.00%	31.00%	100.00%	
I cannot even chew soft solids	22	9	31	
	71.00%	29.00%	100.00%	
<b>Total</b>	52	23	75	
	69.30%	30.70%	100.00%	

**Table 6:** Speech Outcome

Speech	Type of Flap		Total	P-value
	ALT	RFF		
My speech is the same as always	15	5	20	0.54
	75.00%	25.00%	100.00%	
I have difficulty saying some words but I can be understood over the phone	16	8	24	
	66.70%	33.30%	100.00%	
Only my family can understand me	21	9	30	
	70.00%	30.00%	100.00%	
I cannot be understood	0	1	1	
	0.00%	100.00%	100.00%	
<b>Total</b>	52	23	75	
	69.30%	30.70%	100.00%	

**Table 7:** Health-related quality of life compared with the month before cancer

Health related quality of life compared with the month before cancer	Type of Flap		Total	P-value
	ALT	RFF		
Much better	1	0	1	0.82
	100.00%	0.00%	100.00%	
Somewhat better	27	11	38	
	71.10%	28.90%	100.00%	
About the Same	22	11	33	
	66.70%	33.30%	100.00%	
Somewhat worse	2	1	3	
	66.70%	33.30%	100.00%	
<b>Total</b>	52	23	75	
	69.30%	30.70%	100.00%	

**Table 8:** Health-related quality of life during the past 7 days

Health-related quality of life during the past 7 days	Type of Flap		Total	P-value
	ALT	RFF		
Outstanding	1	0	1	1.00
	100.00%	0.00%	100.00%	
Very good	12	5	17	
	70.60%	29.40%	100.00%	
Fair	38	18	56	
	67.90%	32.10%	100.00%	
Poor	1	0	1	
	100.00%	0.00%	100.00%	
<b>Total</b>	52	23	75	
	69.30%	30.70%	100.00%	

**Table 9:** Overall quality of life during the past 7 days

Overall quality of life during the past 7 days	Type of Flap		Total	P-value
	ALT	RFF		
Outstanding	1	0	1	1.00
	100.00%	0.00%	100.00%	
Very good	12	5		
	70.60%	29.40%	100.00%	
Fair	38	18	56	
	67.90%	32.10%	100.00%	
Poor	1	0	1	
	100.00%	0.00%	100.00%	
Total	52	23	75	
	69.30%	30.70%	100.00%	

Quality-of-life scale (UW-QOL) showed that there was no significant difference between Radial forearm free (RFF) flap group and Anterolateral thigh (ALT) flap group in terms of swallowing, chewing and speech, There was no significant difference in terms of health-related quality of life compared with the month before cancer, health related quality of life during the past 7 days and overall quality of life during the past 7 days between ALT group and RFF

**Performance Status Scale for Head and Neck (PSS-HN)**

In case of Performance Status Scale for Head and Neck (PSS-HN), there was no statistically significant difference between Radial forearm free (RFF) flap group and Anterolateral thigh (ALT) flap group in terms of normalcy of diet, public eating and understandability of speech.

**Table 10:** Head-Neck Performance Status- Normalcy of diet

Normalcy of diet	Type of Flap		Total	P-value
	ALT	RFF		
Full diet (Liquid assist)	12	6	18	1.00
	66.70%	33.30%	100.00%	
Dry bread and crackers	7	3	10	
	70.00%	30.00%	100.00%	
Soft chewable foods	20	9	29	
	69.00%	31.00%	100.00%	
Soft foods requiring no chewing	12	5	17	
	70.60%	29.40%	100.00%	
pureed foods	1	0	1	
	100.00%	0.00%	100.00%	
Total	52	23	75	
	69.30%	30.70%	100.00%	

**Table 10:** Public Eating

Public Eating	Type of Flap		Total	P-value
	ALT	RFF		
No restriction of place, food or companion	3	1	4	0.94
	75.00%	25.00%	100.00%	
No restriction of place, but restricts diet when in public	19	8	27	
	70.40%	29.60%	100.00%	
Eats only in the presence of selected persons in selected places	27	12	39	
	69.20%	30.80%	100.00%	
Eats only at home in presence of selected persons	3	2	5	
	60.00%	40.00%	100.00%	
Total	52	23	75	
	69.30%	30.70%	100.00%	

**Table 11:** Understandability of speech

Understandability of speech	Type of Flap		Total	P-value
	ALT	RFF		
Always understandable	3	1	4	0.94
	75.00%	25.00%	100.00%	
Understandable most of the time, occasional repetition is necessary	19	8	27	
	70.40%	29.60%	100.00%	
Usually understandable, face-to-face contact is necessary	27	12	39	
	69.20%	30.80%	100.00%	
Difficult to understand	3	2	5	
	60.00%	40.00%	100.00%	
Total	52	23	75	
	69.30%	30.70%	100.00%	

**5. Discussion**

The RFF and ALT are two types of free flaps that are commonly used for large and complex defect reconstruction after tumor ablation in the oral cavity. Flap survival, donor-site morbidity and postoperative quality of life should be the important factors deeming the selection between RFF flap

and ALT flap.

In order to scale up the advantages and disadvantages of each flap type, we performed a retrospective study on 75 patients with advanced cancer in the oral cavity who underwent microvascular reconstruction with either RFF or ALT after the complete extirpation of the lesion.

In this study, microsurgical outcomes expressed as flap survival rates are in RFF group 91.3% and in ALT group 86.5%. Flap survival is more in RFF group than ALT group which was statistically not significant ( $p=0.71$ ), demonstrating that the two flaps present analogous reliability in line with the results achieved by Liu *et al.*

Many surgeons have focused on the donor sites of flaps, seeking to obtain optimal functional and an esthetic reconstruction without causing significant damage to the region of the donor flap. A remarkable number of research has recently described the advantages of the ALT donor site (Zheng P-P *et al.*, 2018). The study by Valentini *et al.*, 2008 highlighted that the donor defect can, in most cases, be closed directly, without causing a noticeable scar, with minimal morbidity. Several authors have supported the idea that the RFF is mostly associated with donor site morbidity and esthetic deformity (Oranges *et al.*, 2018)

In this study, cosmesis was impaired more in RFF group (82.6%) than ALT (53.8%), which was statistically not significant ( $p=0.021$ ).

Hematoma was found more in ALT group (26.9%) whereas absent in RFF group, which was also statistically significant ( $p=0.004$ ). Oranges *et al.*, 2018, reported no haematoma in any group in their study.

Infections were more in Radial forearm free (RFF) flap group (21.7%) than Anterolateral thigh (ALT) flap group (13.5%), which was statistically not significant ( $p=0.50$ ).

In a comparative analysis, Loreti *et al.* 2008, indicated the ALT as an ideal soft- tissue flap in oral reconstruction, with functional results comparable to those of the RFF flap at the receiving site but with the additional advantages of minimal donor- site morbidity and a high level of patient satisfaction. Others have supported the belief that there is no difference. Novak *et al.* compared the two flaps regarding donor-site morbidity, finding that the majority of patients of both groups were not bothered by scar appearance or pain, and no significant difference was found regarding donor-site morbidity. Although our series has the limitation of having only a small number of cases, unequally distributed, we support the idea that complications at the donor site cannot only indicate the selection of the best reconstructive technique between the two flaps.

Functionality after reconstruction in recipient sites like swallowing and speech got better outcomes in RFF group than ALT group. The results of the present estimation demonstrated a difference of oral function between the RFF and ALT groups. Patients with RFF reported better swallowing and speech function measured by the UW-QOL scale, although there was no significant difference ( $p<0.05$ ).

Tarsitano *et al.* (2013) found that patients reconstructed by RFF were inclined to report better speech outcome than those with ALT flap, although the difference was not significant. Our study found a similar trend. In addition, the clinical and statistical difference regarding the speech function revealed by our study might be partly attributed to the relatively large sample. A possible explanation is that

RFF is thinner and more pliable than a bulky flap like ALT, thus facilitating better recovery of speech intelligibility. This view was supported by two other studies (Su *et al.*, 2003; Matsui *et al.*, 2009).

However, some studies found no significant difference in speech outcome between RFF and ALT group (Farace *et al.*, 2007; de Vicente *et al.*, 2008; Li *et al.*, 2013; Lu *et al.*, 2015; Yuan *et al.*)

The disparity might be due to the different studied cohorts as two studies consisted of a variety of oral cancer. Another explanation could involve the difference between the objective and subjective evaluation, as objective functional status measures were used in three studies while we performed subjective QOL measurement. (Farace *et al.*, 2007; de Vicente *et al.*, 2008; Lu *et al.*, 2015)

In this study, swallowing outcomes were better in RFF group than ALT group which was statistically not significant ( $p=0.73$ ). In contrast with our results, several previous studies found similar swallowing outcomes between RFF and ALT group (de Vicente *et al.*, 2008; Lu *et al.*, 2015; Yuan *et al.*, 2016), while another study found that swallowing capacity was better when an ALT flap was employed (Tarsitano *et al.*, 2013). A possible explanation might be due to the difference of follow-up period as the abovementioned studies evaluated swallowing capacity within the first year after surgery (de Vicente *et al.*, 2008; Lu *et al.*, 2015; Yuan *et al.*, 2016). Similarly, Akashi *et al.* (2015) also found that the improvement of oral function for tongue patients with RFF reconstruction between 1 and 5 years after surgery. Therefore, the change of QOL in the long term might have contributed to the disparity between our results and other studies.

Hara *et al.* (2003) found that the posterior resection of the oral cavity reduced mobility of the base of the tongue, but did not affect mobility of the mid portion or tip, however, resection of the anterior tongue and oral floor reduced the mobility of the whole tongue and limited tip elevation to touch the palate. In the current study, it seemed that the lower scores of swallowing in the ALT group could not be attributed to the extent of tumor resection because the proportion of the base of the tongue resection was similar between the two groups. A possible explanation was that the a dynamic nature of the bulky ALT might substantially interfere with mobility of the remaining tongue, especially the anterior tongue, which in turn, intensified the swallowing disorder. Therefore, it is possible that the oral phase of swallowing can benefit from a thinner and more pliable free flap, such as RFF, which can better restore tongue-to-palate contact. The rationality of the above explanation was supported by the fact that more patients reconstructed by ALT complained in the follow-up of uncontrolled salivation due to swallowing difficulty.

There was no difference in health related quality of life compared with the month before cancer, health related quality of during past 7 days and overall quality of life during past 7 days in between the two flaps.

For estimating the difference of outcome of flap, the PSS-

HN was given as a self-administered survey, completed by the patient. The higher scores indicate better outcome.

In light of Performance Status Scale for Head-Neck (PSS-HN), Understandability of speech scored more in RFF group than ALT group but not significant ( $p=0.94$ ). This was reported similar in the study of Zhang P-P *et al.* 2018.

Normalcy of diet is better in case of RFF group than ALT group but not significant ( $p= 1$ ). Public eating was found similar in both groups ( $p=0.94$ ). Zhang P-P *et al* 2018 had reported similar.

## 6. Conclusion

Postoperative functional outcome is better in terms of speech, chewing and swallowing in radial forearm free (RFF) flap group compared to anterolateral thigh free (ALT) flap despite no significant difference. No significant difference between ALT and RFF free flaps in reconstruction of oral cavity malignant defects regarding flap survival rates and postoperative complications. ALT free flap reconstruction is superior to RFF free flap reconstruction regarding flap donor site morbidity.

**Conflict of Interest:** None

## References

- [1] AJCC Cancer Staging Manual, the eighth edition: Continuing to build a bridge from a population-based to a more "personalised" approach to cancer staging (2017): *Cancer J clin.*, 67(2):93-99.
- [2] Bhambar RS., Baliga OT., Kumar R., Jogathann K., Kommar A., Pokhrel AR. (2016): Revisit of Nasolabial flap in the reconstruction of defects involving the oral floor. *Nigerian journal of surgery*, 22(1):21-25.
- [3] Blitz A., Osterday RM. and Brodman RF. (2013): Harvesting the radial artery, *Ann Cardiothorac Surg*,2(4):533–542.
- [4] Cai Y.C., Li C., Zeng DF., Zhou YQ., Sun RH., Shui CY., Pei J., Liu W., Wang X., Jiang ZH. and Tang .Q. (2019): Comparative analysis of radial forearm free flap and anterolateral thigh flap in tongue reconstruction after radical resection of tongue cancer, *ORL*, 81(5-6):252-264.
- [5] Camaioni A., Loreti A., Damiani V., Bellioni M., Passali FM., and Viti C., (2008): Anterolateral thigh cutaneous flap versus radial forearm free flap in oral and oropharyngeal reconstruction, an analysis of 48 flaps, *Acta Otorhinolaryngol Italica*, 28 (1): 7-12.
- [6] Cha YH., Nam W., Cha IH. and Kim HJ. (2017): Revisiting radial forearm free flap for successful venous drainage, *Maxillofacial plastic and reconstructive surgery*, 39(1): 14.
- [7] Cherubino M., Berli J., Turri-Zanoni M., Battaglia P., Maggiull F., Corno M., Valdatta L. (2017): Sandwich Fascial Anterolateral Thigh Flap in Head and Neck
- [8] Reconstruction: Evolution or Revolution?. *Plastic and reconstructive surgery*, 5(1): e1197.
- [9] Copelli C., Tewfik K., Cassano L., Pederneschi N., Catanzaro S., Manfuso A., and Cocchi R. (2017): Management of free flap failure in head and neck surgery, *Acta otorhinolaryngologica Italica*, 37(5): 387–392.
- [10] Collins J., Ayeni O. and Thomas A. (2012): A systematic review of anterolateral thigh flap donor site morbidity, *Can J Plast Surg*, 20 (1): 17-23.
- [11] Coleman SS, Anson BJ. (2009): Arterial patterns in the hand based upon a study of 650 specimens, *Surg Gynecol obstet*, 113:409-424
- [12] Deganello A., Gitti G., Parrinello G., Muratori E., Larotonda G., & Gallo O. (2013):Cost analysis in oral cavity and oropharyngeal reconstructions with microvascular and pedicled flaps, *Acta otorhinolaryngologica Italica*,33(6): 380–387.
- [13] de Witt C. A., de Bre, R., Verdonck-de Leeuw IM., Quak JJ. & Leemans CR. (2007): Donor site morbidity of the fasciocutaneous radial forearm flap: what does the patient really bother?. *Head and Neck Surgery*, 264(8): 929–934.
- [14] Naumova T., Jürgen S. and Wolfgang HA. (2013): The oral mucosa surface and blood vessels: *Head Face Med*. 9: 8
- [15] Elliot D., Bardsley AF., Batchelor AG. (1998): Direct closure of the radial forearm flap donor defect, *Br J Plast Surg*,41:358-360
- [16] Fang QG., Li ZN., Zhang X., Liu FY., Xu ZF. & Sun CF. (2013): Clinical reliability of radial forearm free flap in repair of buccal defects, *World journal of surgical oncology*, 11:26.
- [17] Farace F., Fois VE., Manconi A., Puddu F., Stomeo A., Tullio G., Pisanu and Rubino C. (2007): Free anterolateral thigh flap versus free forearm flap: functional results in oral reconstruction, *Journal of plastic, reconstructive and aesthetic surgery*, 60; 583-87.
- [18] Fischer JE., Jones DB. and Ruhalter A. (2012): Anatomy of the Head and Neck, Mastery of surgery, 6th ed. Lippincott Williams; 272- 290.
- [19] Francis B., Quinn Jr. and Matthew WR. (2002): Free flap reconstruction of head and neck defects: Grand Rounds Presentation, UTMB, Dept. of Otolaryngology; 1-18.
- [20] Gadre KS., Gadre P., Sane VP., Halle R., Doshi P. and Modi S. (2013): Pectoralis major myocutaneous flap;still a workhorse for maxillofacial reconstruction in developing countries, *J Oral Maxillofac Surgery*,71(11)
- [21] Guatacara S., Renao Silva., Jean R., Andre G., Dayane R., Renata F., Ramos M., Victor R. and Andre BP. (2018): Reverse anterolateral thigh flap: a reconstructive option for the lower limbs, *Brazilian journal of plastic surgery*, 33 (4).
- [22] Haerle M., Hafner HM., Dietz K. (2003): Vascular dominance in the forearm. *Plast Reconstr Surgery*, 111: 1891-1898.
- [23] Hanasono MM., Friel MT., Klem C. (2009):Impact of reconstructive microsurgery in patients with advanced oral cavity cancers, *Head and Neck*, 31(10):1289-96.
- [24] Hara N.-C. Gellrich, J. Düker R. Schön M., Nilius O., Fakler R., Schmelzeisen S., Ozeki TH. (2003): Evaluation of swallowing function after intraoral soft

- tissue reconstruction with microvascular free flaps, *International Journal of Oral and Maxillofacial Surgery*, 32(6):593-599.
- [25] Huang SH., Hwang D., Lockwood G., Goldstein DP., O'Sullivan B. (2009): Predictive value of tumour thickness for cervical lymphnode involvement in squamous cell carcinoma of the oral cavity: a meta-analysis of reported studies. *Cancer* ; 115: 1489-1497.
- [26] Hsieh CH., Kuo YR., Huang PH. Jeng. and Seng-Feng. (2003): Free Anterolateral Thigh Perforator Flap for Reconstruction of Dystrophic Epidermolysis Bullosa-Associated Squamous Cell Carcinoma in the Foot: Case Report. *Annals of Plastic Surgery*, 50(2): 201-203.
- [27] Jeremic JV. and Nikolic ZS. (2015): Versatility of Radial Forearm Free Flap for Intraoral Reconstruction. *Srp Arh Celok*, 143(5-6):256-60.
- [28] Joo YH., Cho JK., Koo S., Kwon M., Kwon SK., Kwon SY. (2019): Guidelines for the Surgical Management of Oral Cancer: Korean Society of Thyroid Head and Neck Surgery, *Clinical and experimental otorhinolaryngology*, 12(2):107-144.
- [29] Kanatas AN., Rogers SN.(2010): A systematic review of patient self-completed questionnaires suitable for oral and maxillofacial surgery, *Br J Oral Maxillofac Surg* 48: 579-590.
- [30] Katre MI., Keche P., Dhanajkar P., Deshmukh S., Gaikwad A. (2017): Versatility of locoregional flap for reconstruction in head and neck cancer surgery, *Archives of international surgery*, 7(3): 73-81.
- [31] Kerawala CJ., Martin IC. (2003): Palmar arch backflow following radial forearm free flap harvest, *Br J Oral Maxillofac Surgery*, 41:157-160
- [32] Kim H., Jeong WJ. & Ahn SH. (2015): Results of free flap reconstruction after ablative surgery in the head and neck, *Clinical and experimental otorhinolaryngology*, 8(2): 167-173.
- [33] Kimura N. and Satoh K. (1996): Consideration of a thin flap as an entity and clinical applications of thin anterolateral thigh flap, *Plast Reconstr Surg*, 97: 985-992.
- [34] Koshima I., Inagawa K., Urushibara K. (1989): The anterolateral thigh flap: variations in its vascular pedicle, *Br J Plast Surg*, 42:260-262
- [35] Kuriakose MA., Loree TR., Spies A., Meyers S. and Hicks WL Jr. (2001): Sensate radial forearm free flaps in tongue reconstruction, *Arch otolaryngol head neck surg*; 127(12): 1463-6.
- [36] Lamaris GA., Knackstedt R., Couto RA., Abedi N., Durand P. and Gastman, B. (2017): The anterolateral thigh flap as the flap of choice for scalp reconstruction, *Journal of Craniofacial Surgery*, 28(2):472-476.
- [37] Liu WW., Li H., Guo ZM., Zhang Q., Yang AK., Liu, XK. and Song M. (2011): Reconstruction of soft-tissue defects of the head and neck: radial forearm flap or anterolateral thigh flap, *European archives of otorhino-laryngology*, 268(12):1809-1812.
- [38] Loeffelbein DJ., Al-Benna S., Steinsträßer L., Satanovskij RM., Rohleder NH., Mücke T., Wolff KD. and Kesting MR. (2002): Reduction of donor site morbidity of free radial forearm flaps: what level of evidence is available? *Eplasty*; 12:9.
- [39] Longo B., Sorotos M., Laporta R. and Santanelli di PF. (2019): Aesthetic improvements of radial forearm flap donor site by autologous fat transplantation, *J Plast Surg Hand Surg*, 53(1): 51-55.
- [40] Loreti A., Di Lella G., Vetrano S., Tedaldi M., Dell'Osso A. and Poladas G.( 2008) Thinned anterolateral thigh cutaneous flap and radial fasciocutaneous forearm flap for reconstruction of oral defects: comparison of donor site morbidity, *Journal of oral and maxillofacial surgery*, 66(6):1093-1098.
- [41] Lu M., Sun G., Hu Q., Tang E. and Wang Y. (2015): Functional assessment: Free thin anterolateral thigh flap versus free radial forearm reconstruction for hemiglossectomy defects, *Medicina oral patologia oral y cirugia bucal*, 20(6):757.
- [42] Malhotra K., Lian TS. and Chakradeo V. (2008): Vascular anatomy of anterolateral thigh flap, *Laryngoscopy*, 118(4): 589-92.
- [43] Matthew MH., (2014): Reconstructive Surgery for Head and Neck Cancer Patients, *Advances in Medicine*, Article ID 795483
- [44] Meng L., Shen J., Liu H., Zhang JC., Peng X., Mao C., Cai ZG., Zheng L., Shan XF. and Yan YB. (2019): Comparison of the subjective satisfaction of the donor site morbidity: Free radial forearm flap versus anterolateral thigh flap for reconstruction in tongue cancer patients, *Med Oral Patol Oral Cir Bucal*; 24(2): 236-242.
- [45] Minkara A., Simmons MR., Goodale A. and Patil YJ. (2019): Subjective morbidity following radial forearm free flap reconstruction in head and neck tumor patients: *J Laryngol Otol*, 133(3): 230-235.
- [46] Morita S Y., Charles MB., V.Suzanne K., Timothy MP., Mitchell CP. and Kenneth KT. (2018): Head and neck reconstruction. Textbook of complex general surgical oncology; chapter 162.
- [47] Morrissey AT., O'Connell DA., Garg S., Seikaly H. and Harris JR., (2010): Radial forearm versus anterolateral thigh free flaps for laryngopharyngectomy defects: prospective, randomised trial, *Journal of Otolaryngology--Head & Neck Surgery*, 39(4).
- [48] Naumova EA., Tobias D., Jürgen S. and Wolfgang HA. (2013): The oral mucosa surface and blood vessels, *Head Face Med*. 9: 8
- [49] Niranjan NS, Watson DP (1990): Reconstruction of the cheek using a "suspended" radial forearm free flap. *Br J Plast Surg* 43:365-366.
- [50] Oranges CM., Ling B., Tremp M., Wettstein R., Kalbermatten DF. and Schaefer DJ., (2018): Comparison of anterolateral thigh and radial forearm free flaps in head and neck reconstruction, *in vivo*, 32(4):893-897.
- [51] Orlik JR., Horwich P., Bartlett C., Trites J., Hart R and Taylor SM. (2014): Long-term functional donor site morbidity of the free radial forearm flap in head and neck cancer survivors, *J Otolaryngol Head Neck Surg*, 43(1).
- [52] Otene C., Achebe J., & Ogbonnaya I. (2011): The Radial Forearm Flap in reconstruction of upper limb injuries, A case series, *Journal of the West African College of Surgeons*, 1(1): 131-144.
- [53] Pablo HM. and Snehal GP. (2016): Cancer of the oral cavity, *Surg Oncol Clin N Am*, 24(3): 491-508.
- [54] Paul M., Glat. and Thomas ED. (2017): Current

- Techniques For Burn Reconstruction: Using Dehydrated Human Amnion/Chorion Membrane Allografts as an Adjunctive Treatment Along the Reconstructive Ladder. *Annals of plastic surgery*; 78(2): 14-18.
- [55] Porter CJ., Mellow CG. (2001): Anatomically aberrant forearm arteries : an absent radial artery with co-dominant median and ulnar arteries, *Br J Plast Surg*, 54:727-728.
- [56] Pibraz JJ., Orgill DP., Epstein MD. (1995): Anterolateral thigh free flap, *Ann Plast Surg*, 34: 585-592.
- [57] Prasetyono TO., Bangun K., Buchari FB. and Rezkini P. (2014): Practical considerations for perforator flap thinning procedures revisited, *Archives of plastic surgery*, 41(6): 693–701.
- [58] Ribbufo D., Cigna E., Gargano F., Spalvieri C. and Scuderi N. (2005): The innervated anterolateral thigh flap: anatomical study and clinical implications, *Plast Reconstr Surg*, 115(2):464-70.
- [59] Ross DA., Ariyan S., Restifo R. and Sasaki CT. (2003): Use of operating microscope and loupes for head and neck free tissue transfer, a retrospective comparison, *Arch otolaryngol head neck surg*, 129 (2):189-93.
- [60] Seng FJ. and Ngian CT. (2012): Optimising aesthetic and functional outcomes at donor sites, *Chang Gung Medical journal*, 25 (3): 219-30
- [61] Shaikh AS., Amber B., Noman S., Zara Y., and Muhammad SG. (2018): Reducing the donor site morbidity in radial forearm free flaps by utilizing a narrow radial forearm free flap, *Arch Plast Surg*, 45(4): 345-350.
- [62] Shah JP, Patel SG. and Singh B. (2012): Oral cavity: Jatin Shah's Head and Neck Surgery and Oncology, 4th edition; 232.
- [63] Skandalakis JE., Wood WC. and Staley CA. (2010): Oral cavity: Anatomic basis of tumour surgery. 2nd ed. Heidelberg: SpringerVerlag;7-17.
- [64] Song R., Gao Y., Song Y. (1982): The forearm flap. *Clin Plast Surg* 9:21-26.
- [65] Soutar DS. and Tanner NS. (1984): The radial forearm flap in the management of soft tissue injuries of the hand, *Br J Plast Surg* 37:18-26
- [66] Stoyanov GS., Kitanova M., Dzhenkov DL., Ghenev P., & Sapundzhiev N. (2017): Demographics of Head and Neck Cancer Patients: A Single Institution Experience. *Cureus*, 9(7): e1418.
- [67] Tarsitano A., Vietti MV., Cipriani R., Marchetti C.(2013): Functional results of microvascular reconstruction after hemiglossectomy: free anterolateral thigh flap versus free forearm flap, *Acta Otorhinolaryngol Ital*, 33: 374-379.
- [68] Tated S., Yaseen M. and Khurram, M.F. (2021): A comparative study between anterolateral thigh flap and radial forearm free flap in head-and-neck reconstruction. *Turkish Journal of Plastic Surgery*, 29(2): 95.
- [69] Truong MK., Puhan H., Nimer A., Rod JO., Shane T. and Iwanaga J.(2017): Clinical Anatomy and Significance of the Retromolar Foramina and Their Canals, *A Literature Review: Cureus*, 9 (10).
- [70] Valentini V., Cassoni A., Marianett TM., Battisti A., Terenzi V. and Iannetti G.(2008) Anterolateral thigh flap for the reconstruction of head and neck defects: alternative or replacement of the radial forearm flap?. *Journal of Craniofacial Surgery*, 19(4):1148-1153.
- [71] Von Kouwenberg EA., Yan A, Patel A., McLaughlin RL., Northrup P., Wolff KD and Hölzle F. (2011): Anterolateral Thigh / Vastus Lateralis Flap : Raising of Microvascular Flaps, Springer, Berlin, Heidelberg.
- [72] Wang HS, Shen JW. (1980): Preliminary report on a new approach to the reconstruction of the tongue, *Acta Acad Med Prim Shanghai*, 7 (2): 56-9.
- [73] Wei FC., Jain V., Celik N. (2002): Have we found an ideal soft tissue flap? An experience with 672 anterolateral thigh flaps, *Plast Reconstr Surg*, 109:2219-2226.
- [74] Wolff KD. and Hölzle F. (2011): Anterolateral Thigh / Vastus Lateralis Flap : Raising of Microvascular Flaps, Springer, Berlin, Heidelberg.
- [75] Wong CH., Wei FC., Fu B., Chen YA. and Lin JY. (2009): Alternative vascular pedicle of the anterolateral thigh flap: the oblique branch of the lateral circumflex femoral artery, *Plast Reconstr Surg*, 123(2): 571-7.
- [76] Woolgar JA. and Triantafyllou A. (2009): Pitfalls and procedures in the histopathological diagnosis of oral and oropharyngeal squamous cell carcinoma and a review of the role of pathology in prognosis, *Oral Oncol*, 45: 361–385.
- [77] Woolgar JA. (2006): Histopathological prognosticators in oral and oropharyngeal squamous cell carcinoma, *Oral Oncol*, 42: 229– 239.
- [78] Yang G., Chen B., Gao Y. (1981): Forearm free skin transplantation, *Nat Med J China*, 46: 321
- [79] Yang S., Hong JW., Yoon IS., Lew DH., Roh, TS. and Lee WJ. (2021): Anterolateral thigh free flaps and radial forearm free flaps in head and neck reconstruction: A 20-year analysis from a single institution, *Archives of Plastic Surgery*, 48(1):49.
- [80] Yun TK., Eul SK., Duck SA., Seung HP., Byung IL., Hyong SK and HI JY. (2015): Stabilising Morbidity and Predicting the Aesthetic Results of Radial Forearm Free Flap Donor Sites, *Archives of plastic surgery*, 42 (6): 769-775.
- [81] Zhong W., Zhang K. and Wang F. (2001): Applied anatomical study of blood supply in human palate, *Zhonghau Koi Qiang Yi Xue Za Zhi*, 36(2): 136-8.
- [82] Zhou G., Qiao Q. and Chen GY. (1991): Clinical experience and surgical anatomy of 32 free anterolateral thigh flap transplantations, *Br J Plast Surg*, 44: 91-96
- [83] Zhang PP., Meng L., Shen J., Liu H., Zhang J., Xiang X. and Yan Y.B. (2018): Free radial forearm flap and anterolateral thigh flap for reconstruction of hemiglossectomy defects: a comparison of quality of life, *Journal of Cranio- Maxillofacial Surgery*, 46(12):2157-2163.