

*Article*

## FREE FLAP EVALUATION FOLLOWING RECONSTRUCTION OF LOCALLY ADVANCED SQUAMOUS CELL CARCINOMA OF THE TONGUE

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### ABSTRACT

**Background:** Neoadjuvant chemotherapy (NAC) is a crucial component in the management of tongue-based locally advanced squamous cell carcinoma (LASCC) due to its ability to decrease tumor mass and facilitate free tissue transplantation. The utilization of adjuvant radiation and chemotherapy has been observed to decelerate the progression of post-operative tumor growth. Probability of free flap failure is elevated. Post-operative complications and the long-term functional outcomes of speaking, salivation, and swallowing determine the quality of free flaps.

**Methods:** A retrospective review of tongue LASCC patients who underwent NAC followed by glossectomy and free tissue transfer from 2015 to 2018. Tongue functional outcomes of speaking, swallowing, and salivation were assessed using FACE-Q scale in 3 times follow-up period.

**Result:** This study included 7 patients who underwent tongue reconstruction. Treatment modalities were based on tumor presentation, with 4 patients (57.1%) receiving Taxane, 5-Fluorouracil, and Paclitaxel/Doclitaxel (TPF), and 3 patients (42.1%) receiving Paclitaxel and 5-Fluorouracil (PF). Tongue reconstruction utilized the radial forearm free flap in 5 patients (71.4%) and the anterolateral thigh free flap in 2 patients (28.6%). Intraoperatively, NAC had no impact on the integrity of small and reliable donor vessels. Three patients died from tumor metastases after the second follow-up assessment, while one patient was lost to follow-up. The study found no significant association between chemotherapy dosage and free flap vitality ( $P = 0.629$ ). FACE-Q assessments revealed moderate to low scores in speaking, eating, and drinking outcomes.

**Conclusion:** Tongue reconstruction after NAC in LASCC patients remains a challenging procedure for surgeons. While the consideration of surgical difficulties due to damage of the donor vessels demands a more structured pre-operative plan. No correlation between the exposure of NAC or AR to free flap complication as well as functional outcome.

**Keywords:** Radial forearm free flap, Anterolateral thigh free flap, Tongue cancer, Locally advanced squamous cell carcinoma, Neoadjuvant therapy, Adjuvant therapy, Tongue reconstruction, Free flap compromise, Free flap complication, Functional outcome

**Latar belakang:** Kemoterapi neoadjuvan (NAC) merupakan komponen penting dalam penanganan karsinoma sel skuamosa lidah lanjut (LASCC) karena kemampuannya untuk mengurangi massa tumor dan memfasilitasi transplantasi jaringan bebas. Penggunaan radiasi dan kemoterapi adjuvan telah terbukti dapat melambatkan perkembangan tumor pascaoperasi. Kemungkinan kegagalan flap bebas meningkat. Komplikasi pascaoperasi dan hasil fungsional jangka panjang berbicara, produksi air liur, dan menelan mempengaruhi kualitas flap bebas.

**Metode:** Tinjauan retrospektif terhadap pasien LASCC yang menjalani NAC diikuti oleh glossektomi dan transfer jaringan bebas dari tahun 2015 hingga 2018. Hasil fungsional lidah dalam berbicara, menelan, dan produksi air liur dinilai menggunakan skala FACE-Q dalam 3 periode pemantauan.

**Hasil:** Penelitian ini melibatkan 7 pasien yang menjalani rekonstruksi lidah. Modalitas pengobatan didasarkan pada presentasi tumor, dengan 4 pasien (57,1%) menerima Taxane, 5-Fluorouracil, dan Paclitaxel/Doclitaxel (TPF), dan 3 pasien (42,1%) menerima Paclitaxel dan 5-Fluorouracil (PF). Rekonstruksi lidah menggunakan flap bebas lengan bawah radial pada 5 pasien (71,4%) dan flap bebas paha samping pada 2 pasien (28,6%). Secara intraoperatif, NAC tidak berdampak pada integritas pembuluh donor yang kecil dan dapat diandalkan. Tiga pasien meninggal akibat metastasis tumor setelah evaluasi pemantauan kedua, sementara satu pasien tidak dapat diikuti. Studi ini

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tidak menemukan hubungan signifikan antara dosis kemoterapi dan vitalitas flap bebas ( $P = 0,629$ ). Penilaian FACE-Q menunjukkan skor sedang hingga rendah pada hasil berbicara, makan, dan minum.

**Kesimpulan:** Rekonstruksi lidah setelah NAC pada pasien LASCC tetap merupakan prosedur yang menantang bagi para ahli bedah. Pertimbangan kesulitan bedah akibat kerusakan pembuluh donor menuntut perencanaan praoperasi yang lebih terstruktur. Tidak ada korelasi antara paparan NAC atau adjuvant radiation dengan komplikasi flap bebas maupun hasil fungsional.

**Kata Kunci:** Flap bebas lengan bawah radial, flap bebas paha samping, kanker lidah, karsinoma sel skuamosa lanjut secara lokal, terapi neoadjuvan, terapi adjuvan, rekonstruksi lidah, komplikasi flap bebas, hasil fungsional.

#### Conflicts of Interest Statement:

The author(s) listed in this manuscript declare the absence of any conflict of interest on the subject matter or materials discussed.

## INTRODUCTION

The treatment strategies for tongue carcinoma are quite challenging, especially for the patients in the stage of locally advanced squamous cell carcinoma (LASCC).<sup>1</sup> This requires neoadjuvant therapy to reduce the tumour mass to achieve the desired marginal extent of glossectomy or resection and a more feasible surgical preparation for free tissue transfer.<sup>2</sup> While post-operative tumour progression is halted by adjuvant radiation (AR) and/or chemotherapy, the risk of post-operative free flap complication following neoadjuvant chemotherapy (NAC) and AR remains questionable in head and neck.

Free flap vascular compromise due to thrombosis has been one of the most concerning complications of reconstructive microsurgery. The increased risk of post-operative free flap failure due to arterial or venous vascular compromise has been linked to the administration of chemotherapy and/or radiation prior to the reconstructive surgery.<sup>3-6</sup> This has been the most challenging situation of pre-operative strategies in managing tongue LASCC, which require neoadjuvant chemotherapy and/or ablative radiation to shrink tumor masses in order to make it advantageous for the extent of glossectomy, negative surgical margins, and free tissue transfer. However, the risk of damaged vessels due to these pre-operative multimodal strategies is increased to affect the vascular compromises post-reconstruction.

Chemotherapy and radiation agents reduce the quality of vessels by interrupting the morphological structure of the endothelial layers and the subsequent layers.<sup>3</sup> On the surgeons'

perspective, the risk of fibrosis in the vessels makes it more challenging to identify the reliable vessel for anastomosis due to the possibility of vascular spasm and embolic infarctions.<sup>3,7</sup> These problems lead to the possibility of developing vascular thrombosis in the donor vessels and is increasing the risk of flap loss and other complications, such as; wound dehiscence, surgical site infection, and fistulae formation.<sup>8</sup>

While flap loss or complications can be managed by secondary free flap harvesting or other salvaging procedures, we questioned how the situation influences the functional outcome of the tongue reconstruction. We present our experiences in reconstructing defects of the tongue by identifying the incidence of immediate and late post-operative complications with the managements and the long-term functional quality in speaking intelligibility, salivation and swallowing

## METHOD

A retrospective cohort study of tongue LASCC patients who underwent neoadjuvant therapy followed by glossectomy and free tissue transfer from 2015 to 2018 was conducted.<sup>7</sup> LASCC of the tongue patients were identified during the 3-year period, all of our patients underwent neoadjuvant chemotherapy prior to the surgery. The free flap procedure in all of the patients were performed by the same plastic surgeon (P.A.). We performed anterolateral thigh free flap (ALT FF) in 2 patients and radial forearm free flap (RFFF) in 5 patients. The primary outcomes are flap survival, immediate and late post-operative complications, speaking intelligibility, eating and drinking, and swallowing. Tongue functional outcomes of

speaking, swallowing, and salivation were assessed using FACE-Q scale in 3 times follow-up period. Functional outcome result and post-operative surgical evaluation were identified by P.A. Ethical approval was obtained from the Research Ethical Committee of the Faculty of Medicine, Universitas Indonesia.

#### *Surgical Procedure*

The extent of tumor resection was identified from the size, volume, and tumor extension by the surgical oncologists team. Our study population had one subtotal glossectomy and 6 hemiglossectomy. The type of flap and design was chosen based on the defect size and extension to the surrounding sublingual structures. The smaller defects were reconstructed using RFFF method while the larger and the deeply extended lesion involving the floor of mouth were reconstructed using the ALT FF. All of the required supporting examinations such as Ultrasonography, and vascular Doppler were done to identify the quality of donor vessels and to predict the 3-dimensional tissue loss.

After flap design and perforator identification, flaps were simultaneously harvested with the tumour resection. In RFFF, we attempted to identify the radial artery, radial vein, cephalic vein, and radial nerve in most of our cases regardless the usage of chemotherapy port in one of these blood vessels. We preferred to use cephalic vein as our third donor vein. The intraoperative identification of the quality of cephalic vein were done to observe the fibrotic condition due to exposure of chemotherapy agents to the vein. Concomitant veins were used as the primary vein if fibrotic condition was identified. Flap containing skin, subcutaneous tissue and fascia, radial vessels bundle, with or without cephalic vein is elevated proximally by following the radial vessels bundle. In ALT FF, intraoperative perforator identification was done to identify the fashion of the perforator. We identified the perforator of descending branch of lateral circumflex femoral artery as the arterial donor and the branch of lateral femoral cutaneous nerve to be anastomosed with the lingual nerve. Unroofing technique was performed if the perforator was in musculocutaneous fashion. The flap was elevated in sub-fascial level by including the fascia on the flap.

#### *Evaluation of Functional Outcome*

We adopted the FACE-Q by Memorial Sloan Kettering Cancer Centre to evaluate speaking intelligibility, swallowing, eating and drinking. We evaluate our patient in at least 2 times in a year. Patients were also asked to fulfil the questionnaire regarding their subjective satisfaction in the quality of speaking intelligibility, swallowing, eating and drinking.

The questionnaire scale was adopted to evaluate the quality of the neo-tongue both by phone and direct interview. The speaking intelligibility was scored based on the 3-point scale: 1 not at all bothered, 2 a little bothered, 3 a lot bothered. During the second and third year, our observations were amplified to identify patients' function in eating and drinking, swallowing, salivation, speaking, and swallowing. Patients' subjective satisfaction were also reviewed in speaking distress and swallowing distress and was valued in 5-point scale: 1 none of the time, 2 a little of the time, 3 some of the time, 4 a lot of the time, 5 all of the time.

#### *Statistical Analysis*

IBM SPSS Statistics Version 26 was used to analyse our data. Paired t-test was performed to compare our mean functional outcome value between the 2nd and 3rd year. Cross-tabulation was done to identify the factors associated with flap vitality.

## **RESULTS**

All of our patients had cycles of NAC, followed by adjuvant ablative radiation and chemotherapy in 1 patient (14.3%), ablative radiation alone in 4 patients (57.1%), and adjuvant chemotherapy alone in 1 patient (14.3%). All of our patients were treated with NAC and were having vital flap. No patients underwent neoadjuvant radiation. The mean age of our patients were 40.85. Five patients (71.4%) had the RFFF, 2 patients (28.6%) had the ALT (Table 1). Intraoperatively, small and reliable vessels were found (unaffected by NAC). There was no significant correlation between the amount of NAC agents exposed and free flap vitality ( $p$  0.629). The larger defect sizes in two of our patients were closed by ALT FF and one large defect was closed by the RFFF (Table 1). Our 5th patient, represented the largest defect and was

**Table 1.** Characteristic of our study population

ID	Gender	Age	Diagnosis	Excision Type	Defect Size (cm)	Flap	Skin Paddle Size (cm x cm)	Pedicle Length cm2	Recipient artery	Recipient vein	Anas-tomosis	Radi-ation (Tim es)	Chemo-therapy Agents
Patient 1	Female	28	SCC	Hemiglos sectomy	8x5	RFFF	6.5x5.5	7	Lingualis	Jugular internal	ETE	--	PF
Patient 2	Male	55	SCC	Hemiglos sectomy	7x4	RFFF	8x5	9	External carotid	External jugular, facial	ETE	35x	TPF
Patient 3	Male	35	SCC	Hemiglos sectomy	4x3	ALT FF	5x4	12	Facial	External jugular, superior thyroid	ETE	35x	TPF
Patient 4	Female	35	SCC	Hemiglos sectomy	7x5	RFFF	8x6	8	Facial	External jugular, facial	ETE	--	PF
Patient 5	Female	41	SCC	Subtotal glossectomy	9x5	ALT FF	10x6	11	Facial	External jugular, facial	ETE	35x	PF
Patient 6	Male	39	SCC	Hemiglos sectomy	5x5	RFFF	6x5.5	8	Facial	External jugular, facial	ETE	35x	TPF
Patient 7	Male	53	SCC	Hemiglos sectomy	3x3	RFFF	7x6.5	11	Facial	External jugular	ETE	35x	TPF

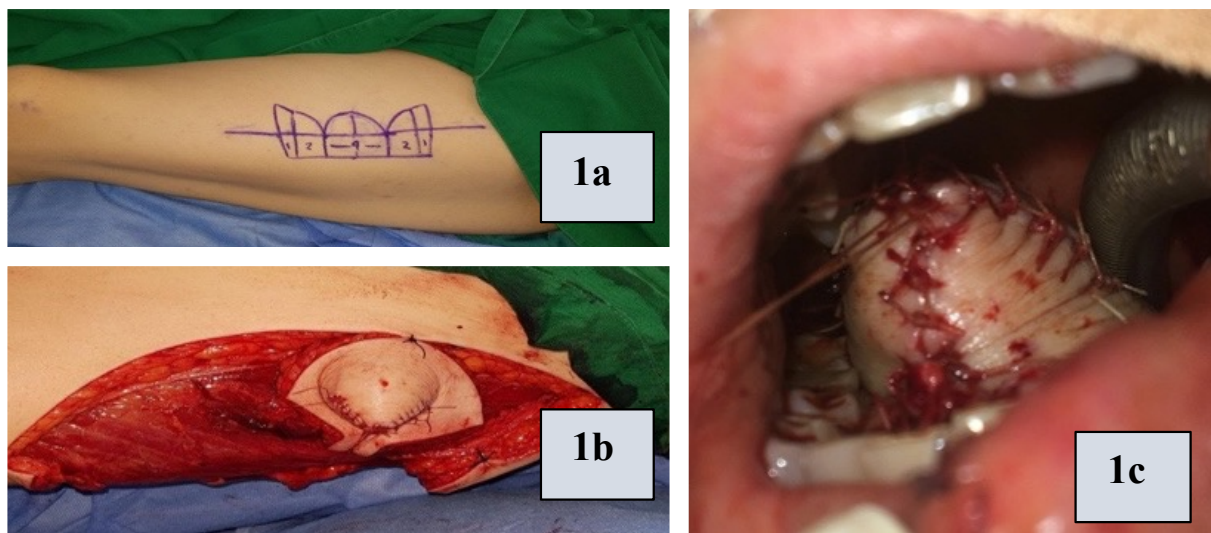
ALT: Anterolateral thigh free flap; ETE: End-to-End; PF: Platin and Fluorouracil; RFFF: Radial forearm free flap; TPF: Taxane, Platin, Fluorouraci

reconstructed with the cathedral tryptych design to resemble the full tongue formation (Figure 1a, 1b).

Our study population had one subtotal glossectomy and 6 hemi-glossectomy. The type of flap and design was chosen based on the defect size and extension to the surrounding sublingual structures. For our 5 cases of hemi-glossectomy, we performed the RFFF due to the smaller defect and were using the lip-split technique and mandibulotomy as our approach. Bilobed flap design were constructed to resemble the 3-dimensional half-tongue shape (Figure 2a). All of

the anastomoses were using the end-to-end technique (Table 1). Two patients were performed ALT FF to reconstruct the larger defect due to subtotal glossectomy and wide resection of floor of mouth. We performed lip split technique and mandibulotomy as our approach. All of the anastomoses were using the end-to-end technique (Table 1).

All of our neo-tongues were vital. The amount of chemotherapy agents exposed and flap type were not associated with the flap vitality (Table 2). The onset of complication



**Figure 1a,1b, 1c.** Cathedral Tryptych design of the ALT FF to resemble the large full tongue defect formation (1a). The design was folded to become the full-tongue shaped after the ALT was harvested (1b). After the ALT FF was inset to the oral cavity (1c).

identified was associated with the flap vitality result (p 0.03).

**Table 2.** Factors associated with flap vitality

Factors	Flap Vitality		p-value
	Vital with History of Complication n (%)	Vital n (%)	
<b>Flap Type</b>			
RFFF	4 (57.1)	1 (14.3)	0.143
ALT	0	2 (28.6)	
<b>Chemotherapy agents</b>			
TPF	2 (28.6)	2 (28.6)	0.629
PF	2 (28.6)	1 (14.3)	
<b>Complication Onset</b>			
<24 hours	2 (28.6)	0	0.03*
>24 hours	2 (28.6)	0	
None	0	3 (42.9)	

ALT: Anterolateral thigh free flap; RFFF: Radial forearm free flap; PF: Platin, Fluorouracil; TPF: Taxane, Platin, Fluorouracil

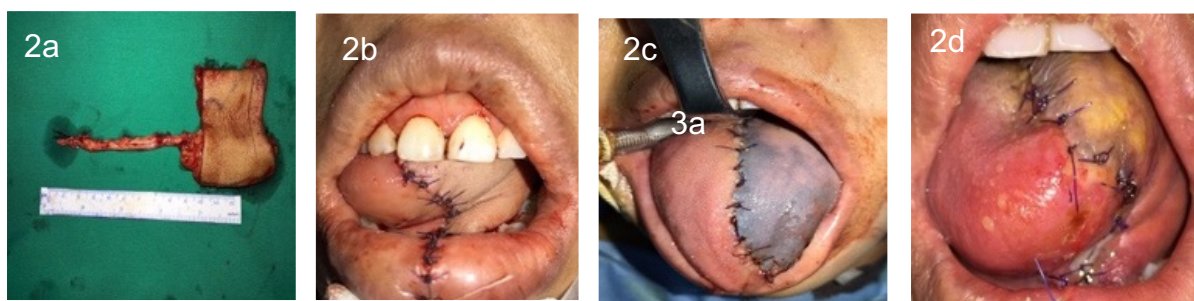
Two of our patients (28.6%) were having complications during early post-operative period. The earliest complication detected was during the 9th hour post-reconstruction of RFFF in our fourth patient due to vein compromise (Figure 2c). This cephalic vein was used as the port of adjuvant chemotherapy agents in this patient. The RFFF was inset without cephalic due to the fibrotic condition of the vein (Figure 2a). In our intraoperative salvage efforts, we identified one thrombotic concomitant vein while the other concomitant vein manifested the favorable flow when the clip was disclosed. The preferred concomitant vein was reanastomosed with the

internal jugular vein by end-to-side proximal to the previous anastomosis which resulted in a vital neo-tongue (Figure 2d). Late complication of post-adjuvant radiation wound dehiscence was observed in our second patient after his 33 episode of radiation (Figure 3). The flap was vital following the resuturing of the flap. Our seventh patient was having arterial hemorrhage >6 hours post-surgery. Bedside hematome evacuation and arterial suturing were performed to manage the bleeding and the flap was salvaged.

**Table 3.** Comparison of mean functionality score between the 2nd year and 3rd year in patients reconstructed with RFFF

	Mean		p-value
	2nd Year	3rd Year	
Speaking	50.0	60.0	0.186
Swallowing	47.5	58.5	0.5
Salivation	27.5	44.0	0.5
Eating and Drinking	42.0	51.5	0.334
Eating Distress	50.0	77.5	0.191
Speech Distress	43.0	83.5	0.086

During our first evaluation (response rate 100%), 71% of our patients were having a good subjective satisfaction review in terms of speech intelligibility and swallowing function (Figure 4). The pronunciations were satisfactory during direct conversation in the first year of evaluation. We compare the mean functional outcome of the 2nd and 3rd year in our RFFF patients (response rate 28.6%). Vast increased in all of the functionality aspects were observed with no statistically significant results (p> 0.05) and the

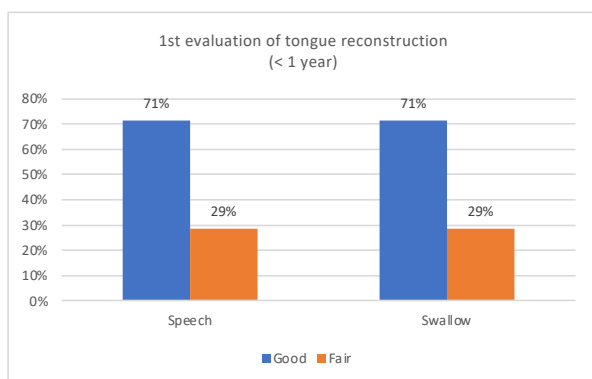


**Figure 2a, 2b, 2c.** Concomitant vein was used to become the main donor vein of the flap (2a). Immediate post-operative result of the RFFF (2b). Vein compromise detected in the first 9 hours post-reconstruction with RFFF (2c). The flap was vital following reanastomosis and additional of one more vein to the RFFF (2d).



**Figure 3a and 3b.** Wound dehiscence after 33 episode of adjuvant radiation (3a). The neo-tongue was vital following the resuturing procedure (3b).

distresses in speaking and eating of our patients were improving (Table 3).



**Figure 4.** The first evaluation of neo-tongue functionality

## DISCUSSION

Attention in tongue reconstruction has shifted in managing patients' complication, decreasing morbidity in both donor and defect area, and increasing the functionality of the neo-tongue. The most anticipated early complications are vein and arterial compromises because these are the most critical conditions affecting the survival of the flap. The earlier detection of vascular compromises leads to a higher possibility of the flap to survive.

In our experience, flap monitoring plays a pivotal role in flap survival especially to identify

vascular compromise and predict the survival of the neo-tongue with or without salvaging procedure. The clinical manifestation of the 9-hour post-operative bluish neo-tongue as observed in our patient (Figure 2c), represents an earlier process of vein congestion which possibly started by the time the reconstructive surgery had ended. Anticipated actions were planned due to the use of a single concomitant vein because of the fibrotic condition of the cephalic vein. We managed the vein compromise by end-to-side reanastomosis. The use of central vein instead of cephalic vein for NAC port is one of the preventive measures to avoid fibrosis due to exposure of NAC agents. Late complication of post-irradiation wound dehiscence were managed by resuturing and promoted to a good result of the RFFF (Figure 3a).

The use of RFFF compared to ALT FF as a donor for tongue defect remains debatable. The sacrifice of the main vessel of cephalic vein contributes to a significant morbidity to the patient while ALT FF provides a more versatile choices in terms of perforator option. The pliability and thinness of RFFF, however, has become the advantageous aspects of RFFF to specifically shape a new tongue while ALT FF needs further refinement or size adjustment to resemble a tongue, according to our experience (Figure 1). In regards to the decreased functionality, further experiences and enhanced

3-dimensional anatomical comprehension are needed in using cathedral triptych design of ALT FF to close a larger tongue defect especially in predicting the tongue size after the inseting process. In our experience, the unprecedented small size of the fasciocutaneous flap design made it difficult for our patient to adapt in eating, drinking, swallowing and speaking (Figure 1c).

Experiences in using ALT FF to various tongue defect size were done by Sun et al, musculocutaneous ALT FF which included the vastus lateralis muscle, rectus femoris muscle or tensor fascia latae is the preferred option for larger defect to provide a larger dimension of the neotongue.<sup>9</sup> The bulkiness provided by musculocutaneous ALT FF is a burden for the patient especially in the early months following reconstruction. However the total volume of the flap was decreasing in 12 months including the muscle volume, which also experienced by our patient.<sup>9,10</sup> Thinning of the bulky flap is also possible by dissecting the flap at the suprafascial plane followed by reduction of the adipose tissue.<sup>11</sup> The ideal neotongue volume should be adequately thick to sustain the tongue-to-palate contact and also thin enough to provide the desirable mobility, provided by the residual intrinsic muscles at the base of the tongue in subtotal glossectomies and by the extrinsic tongue muscles in total glossectomies.<sup>11</sup>

Several designs of ALT FF to reconstruct large tongue defect such as the mushroom-shaped ALT perforator flap, which allows the neotongue to a certain degree of free movement while others who also experienced with the cathedral triptych design was encountered with the subsequent limited neotongue mobility.<sup>11,12</sup> The pentagonal-shaped of ALT myocutaneous flap for total glossectomy experienced by Engel et al resulted in the desirable functional and aesthetic outcome with manageable complications such as partial flap loss, arterial insufficiency, and infection.<sup>13</sup>

In other cases, reconstruction for tongue LASCC is feasible and promotes to a good quality in terms of speaking, eating and drinking, and swallowing. The ideal concept of RFFF's pliability made it easier for our patient to learn to speak, eat, and drink. Most recent studies found no statistically significant difference in the quality of life after reconstruction using RFFF or other free flap methods.<sup>5,6</sup> However, most studies were having different experiences compared to our study due to the limited tumor extension of their patients. We experienced a different situation

since we were dealing with a larger defect which needed to be shrunked by NAC.

Harvested nerve is transplanted to the lingual, inferior alveolar, or the other frequent recipients are cervical plexus, hypoglossal, and posterior auricular nerve.<sup>11,14,15</sup> While regaining the taste function remains challenging for microsurgeon, the improvement in regaining two-discrimination point and temperature sensation results in satisfactory outcomes.<sup>12,14,16</sup> In terms of sensibility of the neo-tongue, the cathedral triptych design ALT flap reported by Leymarie et al provides a satisfactory result compared with the sensate RFFF, with most of their cases recovered the sensitivity of the neo-tongue in temperature differences, two-point discrimination, and monofilament test.<sup>11</sup> Some studies agree that a sensate flap to reconstruct subtotal or total glossectomy improves swallowing and speech function.<sup>11,14-18</sup>

However, the limited number of clinical studies showing the impact of NAC to head and neck reconstruction, especially in causing damaged or fibrotic vessels that lead to flap loss. A number of studies in breast reconstruction shows no statistically significant effect of NAC to flap loss and complications.<sup>19,20</sup> The differences are in the amount of chemotherapy agents with one or two agents of Anthracycline and or Taxane and the lower stages of breast cancer.<sup>19</sup> Azzawi et al used a total of 8 cycles of NAC with exchanging agents between epirubicin / cyclophosphamide and paclitaxel with or without gemcitabine which resulted in low complication of flap loss or partial flap loss, but this study has other reconstruction methods other than free flap to be included, which are pedicled flap with implants, pedicled flap only, and implant alone.<sup>20</sup>

The integrated treatment in managing LASCC remains a challenging subject for surgeons. The desired functionality in tongue reconstruction must be accompanied by an adequate tumor control. However, the tendency of LASCC to metastasize has become the most challenging aspect for a surgeon to plan the treatment and to asses patient's progression in functionality due to late complication or metastasis-related comorbidities. In our 2nd and 3rd year of evaluation, two of our patients were having the desired cancer progression control by adjuvant radiation treatment and were showing improvements in functional outcomes. Our study limitation includes the unavailability of sensibility test during our follow-up periods and

no patients were administered with neoadjuvant radiation, therefore, we did not examine the direct influence of irradiated tissue and recipient vessels to flap vitality.

## CONCLUSION

This study confirmed the increment in functional outcome of neo-tongue in speaking, eating, drinking, salivation and swallowing in LASCSC patients. The patients distress in speaking and eating were also improved by the end of our follow-up periods. All of our patients were observed to have vital flap and vital flap with history of complication. The complications were manageable without the need of secondary flap as a salvaging surgery. The amount of NAC agents were not statistically significant in affecting the vitality of the neo-tongue.

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## REFERENCES

1. Ow TJ, Myers JN. Current management of advanced resectable oral cavity squamous cell carcinoma. *Clin Exp Otorhinolaryngol*. 2011;4(1):1-10.
2. Sittitrai P, Reunmarkkaew D, Chaiyasate S. The role of induction chemotherapy followed by surgery in unresectable stage IVb laryngeal and hypopharyngeal cancers: a case series. *J Otolaryngol Head Neck Surg*. 2018;47(1):62.
3. Paderno A, Piazza C, Bresciani L, Vella R, Nicolai P. Microvascular head and neck reconstruction after (chemo)radiation: facts and prejudices. *Curr Opin Otolaryngol Head Neck Surg*. 2016;24(2):83-90.
4. Herle P, Shukla L, Morrison WA, Shayan R. Preoperative radiation and free flap outcomes for head and neck reconstruction: a systematic review and meta-analysis. *ANZ J Surg*. 2015;85(3):121-7.
5. Arce K, Bell R, Potter J, Buehler MJ, Potter BE, Dierks EJ. Vascularized free tissue transfer for reconstruction of ablative defects in oral and oropharyngeal cancer patients undergoing salvage surgery following concomitant chemoradiation. *International journal of oral and maxillofacial surgery*. 2012;41:733-8.
6. Fujioka M. Factors Predicting Total Free Flap Loss after Microsurgical Reconstruction Following the Radical Ablation of Head and Neck Cancers. *ISRN Plastic Surgery*. 2013;2013.
7. De Wilde R, Boeckx W, Van Der Schueren E, Guelinckx P, Gruwez J. A scanning electron microscopic study of microvascular anastomoses on irradiated vessels: Short-term effect of irradiation. *Microsurgery*. 1983;4(3):193-200.
8. Kwon D, Genden EM, de Bree R, Rodrigo JP, Rinaldo A, Sanabria A, et al. Overcoming wound complications in head and neck salvage surgery. *Auris Nasus Larynx*. 2018;45(6):1135-42.
9. Sun G, Lu M, Tang E, Yang X, Wen J, Wang Z. Clinical application of free anterolateral thigh flap in the reconstruction of intraoral defects. *Oral surgery, oral medicine, oral pathology, oral radiology, and endodontics*. 2011;112(1):34-41.
10. Yamaguchi K, Kimata Y, Onoda S, Mizukawa N, Onoda T. Quantitative analysis of free flap volume changes in head and neck reconstruction. *Head Neck*. 2012;34(10):1403-7.
11. Longo B, Pagnoni M, Ferri G, Morello R, Santanelli F. The Mushroom-Shaped Anterolateral Thigh Perforator Flap for Subtotal Tongue Reconstruction. *Plastic and Reconstructive Surgery*. 2013;132(3):656-65.
12. Leymarie N, Karsenti G, Sarfati B, Rimareix F, Kolb F. Modification of flap design for total mobile tongue reconstruction using a sensitive antero-lateral thigh flap. *J Plast Reconstr Aesthet Surg*. 2012;65(7):e169-74.
13. Engel H, Huang JJ, Lin CY, Lam W, Kao HK, Gazyakan E, et al. A strategic approach for tongue reconstruction to achieve predictable and improved functional and aesthetic outcomes. *Plast Reconstr Surg*. 2010;126(6):1967-77.



14. Vincent A, Kohlert S, Lee TS, Inman J, Ducic Y. Free-Flap Reconstruction of the Tongue. *Semin Plast Surg.* 2019;33(1):38-45.
15. Baas M DL, Corten EM, Mureau MA. A systematic review on the sensory reinnervation of free flaps for tongue reconstruction: Does improved sensibility imply functional benefits? *J Plast Reconstr Aesthet Surg.* 2015;68(8):1025-35.
16. Biglioli F, Liviero F, Frigerio A, Rezzonico A, Brusati R. Function of the sensate free forearm flap after partial glossectomy. *J Craniomaxillofac Surg.* 2006;34(6):332-9.
17. Chang EI, Yu P, Skoracki RJ, Liu J, Hanasono MM. Comprehensive analysis of functional outcomes and survival after microvascular reconstruction of glossectomy defects. *Ann Surg Oncol.* 2015;22(9):3061-9.
18. Ozkan O, Ozkan O, Derin AT, Bektas G, Cinpolat A, Duymaz A, et al. True functional reconstruction of total or subtotal glossectomy defects using a chimeric anterolateral thigh flap with both sensorial and motor innervation. *Ann Plast Surg.* 2015;74(5):557-64.
19. Narui K, Ishikawa T, Satake T, Adachi S, Yamada A, Shimada K, et al. Outcomes of immediate perforator flap reconstruction after skin-sparing mastectomy following neoadjuvant chemotherapy. *Eur J Surg Oncol.* 2015;41(1):94-9.
20. Azzawi K, Ismail A, Earl H, Forouhi P, Malata CM. Influence of neoadjuvant chemotherapy on outcomes of immediate breast reconstruction. *Plast Reconstr Surg.* 2010;126(1):1-11.