

## The Extended Lateral Forehead Flap: Today as Was 50-years Ago

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**Background:** In the era of surgical advances where institutional pride and status resonates with their progress in the minimal invasives, latest technologies, stem cells, and supermicrosurgeries; some things in plastic surgery never change. The extended lateral forehead flap (ELFF) was first introduced by Ian McGregor in 1963 to reconstruct an intraoral defect, he called it the temporal flap. Gillies and Millard each modified and utilized the flap for patching various facial and intraoral defects and published their experience a year later. Until today in 2012, the ELFF is still largely useful for the reconstruction of wide defects post neoplasms ablation in the face or oral region, which would otherwise require distant flaps or free flaps.

**Patients and Methods:** Three cases of oral and perioral carcinoma were resected and reconstructed using the ELFF to cover for: a full-thickness cheek defect including the lip commissure, an inner oral lining, and a hemipalatal defect.

**Results:** In all, the flaps were tunneled subcutaneously, and donor area grafted by full-thickness skin. All flaps survived and functional outcomes are attained in all patients, with acceptable aesthetic results.

**Summary:** A flap once introduced 49 years ago, is today as consistent and applicable in plastic surgery. This article is an appraisal to the ELFF, and a reminder to the general plastic surgeons, of the simple yet versatile role of ELFF in the reconstruction of facial and intraoral defects.

**Keywords :** *Extended lateral forehead flap, temporal flap, intraoral, reconstruction*

**Pendahuluan:** Di era modern dimana sebagian besar institusi berlomba mengembangkan teknologi, minimal invasif, sel punca, dan supermicrosurgery; beberapa hal dalam bedah plastik tidak berubah. Extended lateral forehead flap (ELFF) diperkenalkan pertama kali oleh Ian McGregor tahun 1963 untuk rekonstruksi defek intraoral, dan disebut sebagai temporal flap. Gillies dan Millard memodifikasi penggunaan flap tersebut untuk berbagai defek wajah dan intraoral. Hingga sekarang ELFF masih sering digunakan untuk menutup defek luas pasca ablasi tumor daerah wajah atau oral.

**Pasien dan Metodologi:** Tiga kasus karsinoma pada daerah oral dan perioral direseksi dan direkonstruksi dengan ELFF: defek full-thickness pada pipi termasuk komisura bibir, lining intra oral, dan defek hemipalatal.

**Hasil :** Pada semua kasus dilakukan *tunneling flap* secara subkutan dan area donor ditutup dengan FTSG. Semua flap vital dan memiliki hasil secara fungsional dan estetik yang cukup baik.

**Ringkasan:** Pada semua kasus dilakukan tunneling flap secara subkutan dan area donor ditutup dengan FTSG. Semua flap vital dan memiliki hasil secara fungsional dan estetik yang cukup baik.

**Kesimpulan:** Suatu flap yang pertama diperkenalkan 50 tahun lalu, hingga sekarang tetap dapat digunakan dalam bedah plastik. Artikel ini bertujuan untuk melakukan penilaian ulang kegunaan ELFF, dan sebagai pengingat bagi ahli bedah plastik secara umum mengenai kegunaan ELFF yang banyak untuk menutup defek wajah dan intra oral.

**Kata Kunci :** *Extended lateral forehead flap, temporal flap, intraoral, reconstruction*

The advent of knowledge and skills in plastic surgery have introduced what is viewed as the more-exciting novel procedures such as micro- and supermicro-surgeries, minimal invasives, and stem cells. They are certainly

useful and beneficial in some cases. In the field of reconstructive surgery however, the applicability of minimal invasive procedures and stem cells are very limited. And although microsurgery offers many benefits, such is not

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always the case, some older and simpler reconstructive options are still dependable today. Not because we do not evolve or advance, but because the basic principles of plastic surgery stays. It is luring how latest technologies and techniques help upgrade institutional pride, but be sure that a reconstructive decision is not merely based on trying to catch up with the common hype among other surgical specialties in which some has progressed to include even the robotic technologies.

Reconstruction of postablation defects of tumor on the facial and intraoral regions is challenging as the demand of aesthetic and functional outcomes is high. Several options including skin grafts, regional flaps, distant flaps, and free tissue transfers can be employed. This article discusses the use of a local flap, the extended lateral forehead myocutaneous flap (ELFF). It is a versatile method to reconstruct defect on the face and mouth. The use of paramedian forehead flap particularly applicable for the construction of defected nose is not discussed here and is a separate subject of its own. The ELFF was first introduced as temporal flap by Ian McGregor in 1963 to patch for an intraoral defect.<sup>1</sup> Within the next year, D. Ralph Millard and Sir Harold Gillies, two historical and influential plastic surgeons, each modified and published the use of similar flap for patching various facial and intraoral defects.<sup>2</sup> The increasingly popular option for head and neck reconstruction by microsurgery commonly utilizes the radial forearm or anterolateral thigh free flaps. Their drawbacks include poor skin color match, donor site morbidity, excessive tissue bulk, the need for a specially trained microsurgeon, and requirement of specific equipments.

The forehead is supplied by four vascular networks or angiosomes: the left and right superficial temporal arteries, and the left and right ophthalmic arteries each consisting of the supraorbital and supratrochlear arteries (Figure 1).<sup>3</sup> The extended lateral forehead flap is an axial myocutaneous flap supplied by these vessels. At first, surgeons were worried of raising forehead flaps beyond the midline, fearing that by severing two or more successive

territories would cause a distal flap compromise. However, a vascular study using micropaque injections on the superficial temporal artery in cadavers shows that rich anastomotic plexus exists between the major forehead angiosomes linked by the smaller caliber "choke" vessels.<sup>4,5</sup> This allows the elevation of an extended forehead muscle and skin, without the need for flap delay or prefabrication, with no risk of flap necrosis. Elevating the whole unit of forehead such as in ELFF instead of partially will also give a better conceal of resultant donor defect, as the design follows the forehead aesthetic units (Figure 2).<sup>6</sup>

The flap is raised based on either the right or left superficial temporal artery transversely across the forehead. Upon elevation, the ELFF design should encompass the whole forehead area just below the hairline up to the upper edge of eyebrows, from one pedicle reaching the full contralateral forehead (Figure 3). This is done in order to leave a donor defect which suits the forehead aesthetic unit. The flap is elevated just above the pericranium layer, then shaped as necessary into the dimensions needed to cover the primary defect. If any hairbearing part of the flap will be transferred intraorally, the area should be epilated otherwise the hair will continue to grow in the mouth.

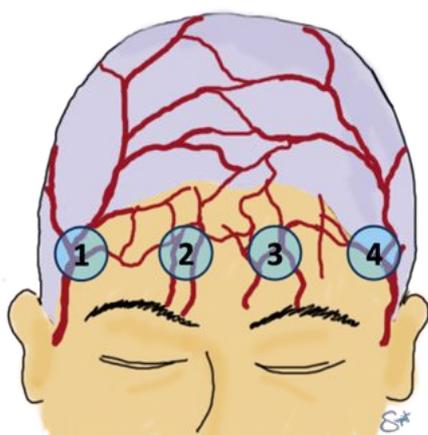
For the tunnel, no extra incision is made other than the flap design. Flap is tunneled on the loose connective tissue plane beneath the base of pedicle. The remaining tunnel is bluntly dissected in the general direction of the upper buccal sulcus to reduce the chance of injury to the facial nerve, until it reaches the defect. There is generally no risk of strangulation if the tunnel is made with adequate width. Project the flap through the tunnel onto the defect. Area of the flap which will lie within the tunnel must be marked. Flap is then returned onto a flat surface and buried area deepithelialized, before it is finally insetted onto the defect (Figure 4).

It is best to cover the donor defect by full-thickness skin graft obtained from the lower abdominal crease, harvested as a single one-piece skin to cover the whole defect surface. Fixation sutures may be done

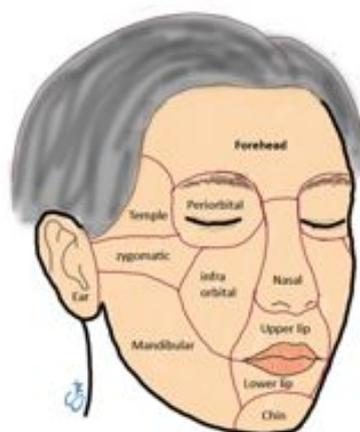
pericranial base serves as a rigid and immobile graft bed. To maintain pressure, tie-over dressing may be applied. Allow 5 days before the first dressing change.

Similar to non-extended or paramedian forehead flap, the base of the pedicle is to be divided three weeks after flap elevation when engraftment already occurred. The inner surface of the folded flap base was not deepithelialized hence will not attach onto the

surrounding tissue in the tunnel. This folded part of pedicle on the temporal area is incised, skin excess excised, and sutured primarily (Figure 5). Note the blurry picture of Figure 5, left: this picture was obtained using a camera wrapped in a sterile transparent plastic bag. Compare picture quality to the standard picture-taking on its right with the same camera.



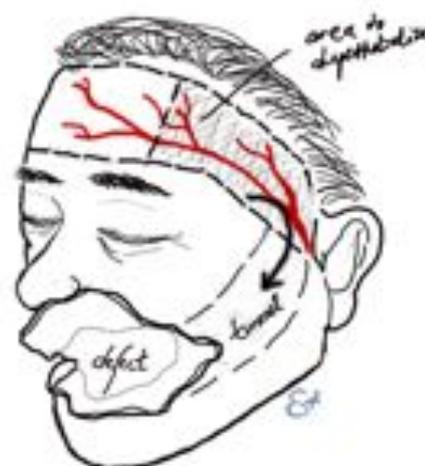
**Figure 1.** Vascular network of the forehead: (1 and 4) The right and left superficial temporal arteries, (2 and 3) the right and left ophthalmic arteries.



**Figure 2.** The facial aesthetic units. The forehead is made of one single unit, encompassing an area which inadvertently suits the design of extended lateral forehead flap.



**Figure 3.** Red lines indicate the design of the extended forehead flap. Upper border: below hairline. Lower border: above eyebrows.



**Figure 4.** Illustration of tunneled left cheek area, and the deepithelialized part of forehead flap to lie within the tunnel



**Figure 5.** Three weeks after flap elevation, base of pedicle divided, skin excess excised and sutured primarily. The 'new skin' over the forehead shows excellent take of full-thickness graft, which typically happens to the forehead donor area.

## PATIENT AND METHODS

### Case 1

55-year-old man with squamous cell carcinoma on the left lip commissure (Figure 6a). Lesion was widely excised, leaving a full thickness anterior cheek defect including half of the left upper and lower lips (Figure 6b). An ELFF raised with a left temporal pedicle, was tunneled through the cheek, deepithelialized on the proximal part to lie within the tunnel (Figure 6c), folded on the distal side to form both the inner and outer lining of cheek, as well as shaped into a new lip commissure (Figure 6d).

### Case 2

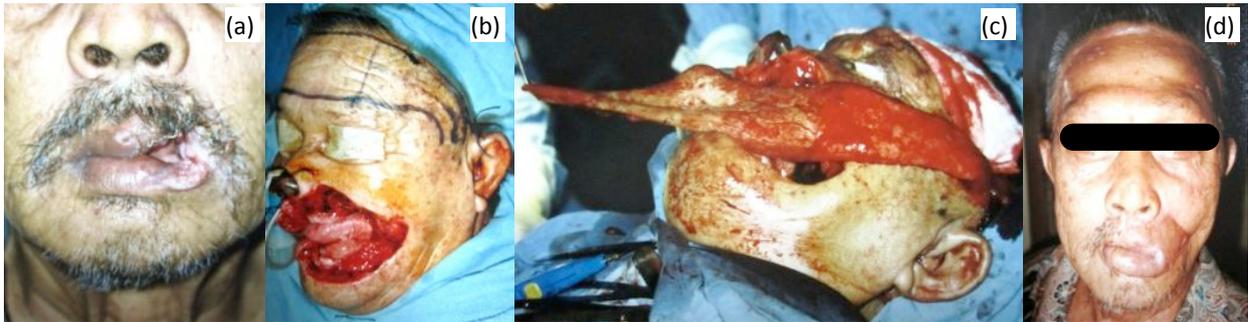
50-year-old male had a left buccal squamous cell carcinoma and underwent a wide excision which left an intraoral defect of the left cheek limited to the mucosa. Defect was reconstructed using a left pedicled ELFF tunneled through its base and passed along the cheek to form the buccal inner lining (Figure 7, left). Flap and grafted donor area healed satisfactorily (Figure 7, middle). The missing intraoral mucosa was restored, and ELFF adapted well to the surrounding tissue (Figure 7, right).

### Case 3

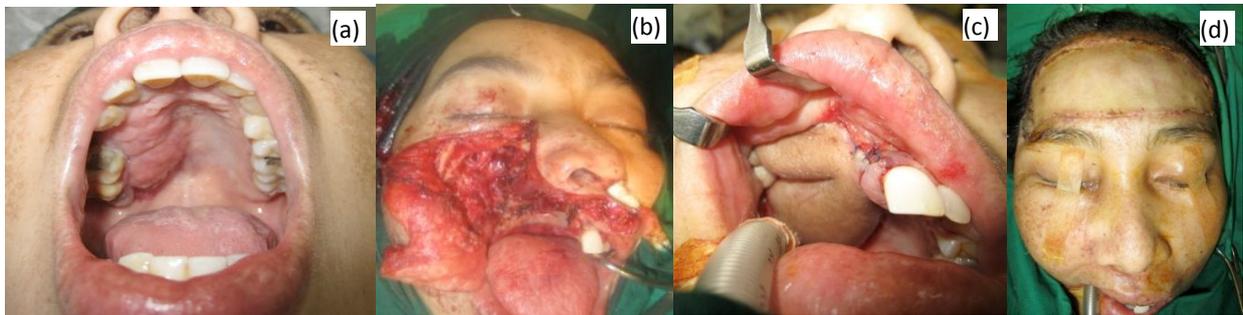
Female aged 46 years suffered from mucoepidermoid cancer of the right maxilla which infiltrated the right palate (Figure 8a). Hemimaxillectomy was performed, facial muscles and skin were spared (Figure 8b). A right pedicled ELFF was used to patch the palatal defect (Figure 8c), the remaining length was deepithelialized and used to pack the maxillary sinus. A coastal bone graft was also used as a framework to replace the inferior orbital bone. Functional and aesthetic results were acceptable (Figure 8d).

## DISCUSSION

The extended forehead flap, a flap once introduced 49 years ago, is today as consistent and applicable in plastic surgery as it was back then. Many years prior to McGregor's 1963 publication on the ELFF, Gillies and Millard stated in their book *The Principles and Arts of Plastic Surgery*, that "the tint of forehead skin so exactly matches that of the face and nose that it must be first choice. With some plastic juggling, the forehead defect can be camouflaged effectively."<sup>7</sup> This quote brilliantly summarizes our points of discussion.



**Figure 6.** Case 1, (a) squamous cell carcinoma of the left commissure, (b) excised, (c) reconstructed using a proximally deepithelialized and distally folded ELF flap. (d) Final defect and donor appearance 1 after second stage surgery.



**Figure 8.** Case 3, (a) mucoepidermoid cancer infiltrating the right palate, (b) the right maxilla excised, (c) ELFF used to pack the right maxillary defect and to form the right palate, (d) forehead donor 3 weeks after grafting during pedicle base division.



**Figure 7.** Case 2: (left) intraoral squamous-cell carcinoma excised and the inner lining reconstructed using a tunneled ELFF, (middle and right) end results of donor and flap.



As illustrated in the three cases above (Summarized in Table 1) and some case reports from overseas,<sup>8-10</sup> ELFF has been shown to adequately provide tissue cover for various single to multi structural tissue loss of the face and oral region, which would otherwise require distant flaps or free flaps. This relatively simple local flap is specifically useful in cases of post tumor ablation where immediate straightforward reconstruction is warranted, and the tissue must survive through a series of adjuvant therapies to follow shortly after. Microsurgery and distant flaps are alternative options. The advantages and disadvantages of microsurgery over ELFF are mentioned in Table 2. Distant flaps are technically less complicated than microsurgery, but still require more planning and more diversified in anatomy than local flap. Therefore it is wise to adapt the *Occam's razor* philosophy: Other things being equal, a simpler choice is better than a more complex one.<sup>11</sup>

All ELFF flaps in the case examples survived with no partial compromise. Structures to be reconstructed are adequately covered with satisfactory restoration of function. All donor area had a 100 percent graft take with acceptable aesthetic results. Patients lost sensation of the forehead, and unable to perform the expression of raising eyebrows, but none expressed concerns over these matters. No facial palsy nor salivary fistula developed, and skin flaps within the mouth adapted well into the adjacent mucosa.

Donor site appearance is easily camouflaged by hair style, hood, or scarf. Because the flap design follows the forehead aesthetic unit, even at bare sight without cover, the face does not seem greatly deformed except a slight skin step-off above the eyebrows. An alternative surgical planning is to apply a tissue expander prior to flap elevation, which will minimize donor morbidity and leave only a single-line fine scar near the hairline.<sup>12</sup>

**Table 1.** Summary of case series

	<i>Reconstructed Defect</i>	<i>Flap</i>	<i>Donor</i>	<i>Complication</i>
<b>Case 1</b>	Full-thickness cheek, and lip commisure	Proximally deepithelialized, tunneled, folded on the distal to form inner and outer oral lining	FTSG, 100% take	None
<b>Case 2</b>	Inner cheek lining	Proximally deepithelialized, tunneled, placed intraoral	FTSG, 100% take	None
<b>Case 3</b>	Right palate soft tissue padding of maxilla	Proximally deepithelialized, tunneled, placed intraoral	FTSG, 100% take	None

**Table 2.** Advantages and disadvantages of ELFF

<i>Advantages of ELFF (compared to distant flap or free flap)</i>
1. True replace "Like-with Like"
2. Less bulky than free flap
3. Smaller risk of vascular compromise
4. Quicker to perform
5. No microsurgery training, equipments, or facility required
6. Reliable in postradiation/palliative reconstructive cases
<i>Disadvantages of ELFF</i>
1. Obvious donor site location
2. Loss of forehead sensation and eyebrow-raise expression
3. Requires a two

## SUMMARY

This article reappraises the extended lateral forehead flap. It is a reminder to the general plastic surgeons of a simple yet versatile role of ELFF for the reconstruction of facial and intraoral defects, especially in cases of post tumor ablation where microsurgery, tissue expansion, and distant flaps seem like a heftier choice.

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