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Assessment of Local Freestyle Perforator Flaps for Face Defects Reconstruction

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ABSTRACT

Background: Freestyle perforator-flap surgery allows for more versatility in selecting a donor location by basing flap selection on the specific quality and quantity of soft tissue needed at the recipient site.

Objective: The aim of the current work was to evaluate the role of freestyle perforator flaps in reconstruction of small to medium-sized facial defects in plastic and reconstructive surgery.

Subjects and methods: This interventional study included a total of 18 patients with small to medium-sized facial defects reconstructed with freestyle local perforator flaps, attending at Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Zagazig University Hospitals. Preoperative perforator detection and its markings was done by hand-held Doppler and was confirmed by intraoperative exploration before raising a suitable flap. Patients were followed up 6 months or more postoperatively after discharge from the hospital.

Results: Postoperative histopathology indicated that all the margins of the resected tissue were free of cancerous cells. Most cases had defects on the nose (33.3%), cheek (22.2%) and Lower lip (11.1%). 6 Flaps were based on facial artery perforators to cover nasal, cheek, and upper lip defects. 2 flaps were based on infraorbital artery perforators. Also, Superficial temporal artery and supra-trochlear artery represented a good donor of perforator flaps in our work. Congestion occurred in 4 patients. In only two patients, flaps showed ischemia. Regarding patient satisfaction with the aesthetic result, 6 of them were excellent, 6 were good, four were fair and two were poor.

Conclusion: Because of their adaptability, wide range of motion, similar texture, and color match, the freestyle local perforator flaps could be used successfully to rebuild complex face deformities for cosmetic purposes.

Keywords: Local Freestyle Perforator Flaps, Face Defects.

INTRODUCTION

Reconstructive outcomes in the face are more heavily influenced by aesthetic and functional considerations than in any other body part. The color and texture matching of local face flaps makes them a great choice. Facial skin has great vascularity, therefore pedicled or islanded local flaps don't have to worry about getting enough blood. Some disadvantages of local pedicled flaps include restricted motion and increased bulk at the pedicle site, both of which may necessitate additional surgery [(1)].

Single-stage surgery that involves harvesting tissue that is the same color and texture as the face is necessary for successful repair of facial deformities [(2)].

Taylor's thorough description of human angiosomes led to the development of a fundamental anatomical concept that paves the way for novel methods of elevating soft tissue flaps that rely on a single terminal vessel for skin nutrition. The "new generation" of skin flaps only have a single little artery entering the dermal anastomotic vascular plexus for blood supply. The vascular region of these tiny terminal arteries is unexpectedly enormous and is always sufficient to cover any gap in the oral cavity because of the opening of choke vessels. If the perforators are large enough, these flaps might theoretically be raised anywhere in the body [(3)].

In 2004, Hofer's free-form approach to face reconstruction was popularized by Mardini and Wei., The freestyle idea allows for the harvesting of a skin flap from any location on the body based on a single perforator found intraoperatively and considerably detected by a portable Doppler equipment, regardless of the course of the parent vessel [(4)].

Local flaps based on freestyle principles offer more versatility than conventional local alternatives, permitting single-stage restorations using more similar tissue and reducing donor-site morbidity [(5)].

The flaps of a freestyle perforator can be collected according on the strength of Doppler signals in a given area. The narrow pedicle permits the flaps to rotate widely, allowing them to access a variety of defect locations on the face. The extent of the defect that can be repaired with these flaps is limited by the need for primary closure of the harvesting site and pedicle position [(1)].

Even though perforator arteries were researched by Taylor and Palmer on cadavers in 1987 and perforator vessels in the face were studied more recently [(6)]. However, there is a lack of research on the clinical applications of local perforator flaps for facial reconstruction. In contrast to its cosmetic modification or problems, the surgical benefits of local perforator flaps have been thoroughly characterized [(1)].

This study was aimed to evaluate the role of freestyle perforator flaps in reconstruction of small to medium-sized facial defects in plastic and reconstructive surgery.

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SUBJECTS AND METHODS

This interventional study included a total of 18 patients with small to medium-sized facial defects, attending at Department of Plastic and Reconstructive Surgery, Faculty of Medicine, Zagazig University Hospitals.

Inclusion criteria: Patients in all ages and both sexes with small to medium-sized facial defects due to any cause like tumor excision, trauma or burn.

Exclusion criteria: Patients with very large face defects that may need free flaps, patients with multiple co-morbidities like uncontrolled DM, Liver cirrhosis, patients with congenital anomalies and defects of the facial skin like xeroderma pigmentosa, and irradiated face and neck.

Pre-operative assessment:

1) Clinical assessment:

- Complete history taking: Names, ages, genders, addresses, and phone numbers were recorded. The patient's current medical history was recorded, including details regarding the appearance and progression of the skin lesion.
- Full clinical examination

2) Laboratory investigations:

- Full lab investigations were done including CBC, Coagulation profile, liver and kidney function tests and viral markers (HCV and HBV).

3) Radiological assessment:

In some cases, we performed:

- Ultrasonography on neck
- CT scan on neck

4) Tissue diagnosis:

- Tissue diagnosis for the lesions before (incisional biopsy) and after (excision with safety margin) the operation.

I. Patient preparation:

1) Pre-operative photography.
2) Pre-operative marking of the resection of the lesion with suitable safety margins.
3) Pre-operative marking of the available options for reconstruction.
4) Anesthesia: general or local
5) Chemoprophylaxis: One preoperative dosage of a broad-spectrum antibiotic was given to all patients.

II. Operative technique:

- ***Preoperative perforator detection and its markings:***

Patients were placed in a supine posture, and the most audible signals of the perforators in for feeding the skin flap were located using a HADECO Bidop ES-100 V3 handheld Doppler equipped with an 8 MHz probe and ultrasonic transmission gel. When a signal was found to be strong, the probe was moved in all directions to rule out the possibility that the signal was still present elsewhere. This identifies the perforator as the target of this signal. A bright red dot indicating the precise location of each perforator was etched onto the surface of each wall.

- ***Surgical Technique:***

All patients had either general or local anesthesia, and the treatment was carried out in a sterile environment. The entire face was sterilized, and sterile towels were used to protect the skin around it. The skin lesions were removed from all patients with a sufficient margin of safety around the tumors. Damaged skin and other soft tissues were debrided until healthy tissue with pinpoint hemorrhage was seen after trauma. The bleeding at the defect bed was staunched meticulously. The size of the flap was considered, and the defect was measured.

Final adjustment of the chosen flap to the defect was based upon:

a) Aesthetic zone in which the defect is present.
b) Amount of the healthy tissue available for reconstruction.
c) Presence of suitable perforators.
d) Relaxed skin tension lines “static rhytids of the face”.

Exploration of the perforator was performed either an incision along the side of the proposed flap or with subcutaneous, vertically oriented, precise blunt dissection from the border of the neighboring defect. The flap was cut and lifted after a perforator was located. To avoid leaving superfluous bulk at the pedicle that may need further thinning and ensure a satisfactory transposition into the defect, the pedicle was only dissected to the extent necessary.

The pedicle of the flap was formed of clearly identifiable perforator with cuff of soft tissue to ensure sufficient venous return from the flap. The flap was rotated into the defect either as a freestyle perforator, as a propeller or even as an advancement perforator flap Finally, the flap was inset into the defect with the least tension. The donor site was closed primarily after doing limited local undermining of the surrounding skin. Light dressing was applied to the flap.

- ***Post-operative care and follow-up:***

Patients were sent home 48 hours following surgery, given an antibiotic to take for the next 5 days, and checked in again on day 14 for suture removal.

After patients were discharged from the hospital, they were checked in on a monthly, quarterly, and annually thereafter.

***Ethical Consideration*:**

This study was ethically approved by Zagazig University's Research Ethics Committee. Written informed consent of all the participants was obtained. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human testing.

Statistical analysis

IBM SPSS was used, namely version 27.0. The range of values, from minimum to maximum, as well as the

central and quartile values, were employed to describe numerical information. The acquired results were deemed statistically significant at the 5% level. This study made use of a Chi-square test.

RESULTS

Table (1) shows that patients' ages ranged from 30 to 77, with mean ±SD 60.2 ± 11.6 years. There was a total of 20 patients: 10 men (55.6%) and 8 women (44.4%). Patients included one with no comorbidities, 6 (33.3%) smokers, 10 (55.6%) hypertensive, and 6 (33.3%) diabetics.

Table (1): Demographic data in all studied patients.

		Studied patients (N = 18)	
Age (years)	**Mean ±SD**	60.2 ± 11.6	
	Min - Max	30 – 77	
Sex	**Male**	10	55.6%
	Female	8	44.4%
Co-morbidities	**Nil**	1	5.6%
	Smoking	6	33.3%
	HTN	10	55.6%
	DM	6	33.3%

Table (2) shows that zone 1 (forehead) was affected in 1 patients (5.6%), zone 2 (nose) was affected in 6 patients (33.3%), zone 3 (lower eyelid) was affected in 1 patient (5.6%), zone 4 (cheek) was affected in 4 patients (22.2%), zone 5 (upper lip) was affected in 3 patients (16.7%), zone 6 (lower lip) was affected in 2 patients (11.1%) and zone 7 (metnum) was affected in 1 patient (5.6%).

Table (2): Site among all studied patients.

		Studied patients (N = 18)	
Site	**Zone 1 (forehead)**	**1**	**5.6%**
	Zone 2 (nose)	**6**	**33.3%**
	Zone 3 (lower eyelid)	**1**	**5.6%**
	Zone 4 (cheek)	**4**	**22.2%**
	Zone 5 (upper lip)	**3**	**16.7%**
	Zone 6 (lower lip)	**2**	**11.1%**
	Zone 7 (metnum)	**1**	**5.6%**

Table (3) shows the description of size in all studied patients. It was < 10 cm^2 in 9 patients (50%), 10 - 15 cm^2 in 7 patients (38.9%) and > 15 cm^2 in 2 patients (11.1%).

Table (3): size among all studied patients.

		Studied patients (N = 18)	
Size	**< 10 cm^2**	9	50%
	10 - 15 cm^2	7	38.9%
	> 15 cm^2	2	11.1%

It was neoplastic lesion in 15 patients (16.7%) and post-traumatic lesion in 3 patients (16.7%). The neoplastic lesions were BCC in 11 patients (73.3%), SCC in 3 patients (20%) and melanoma in 1 patient (6.7%) (Figure 1).

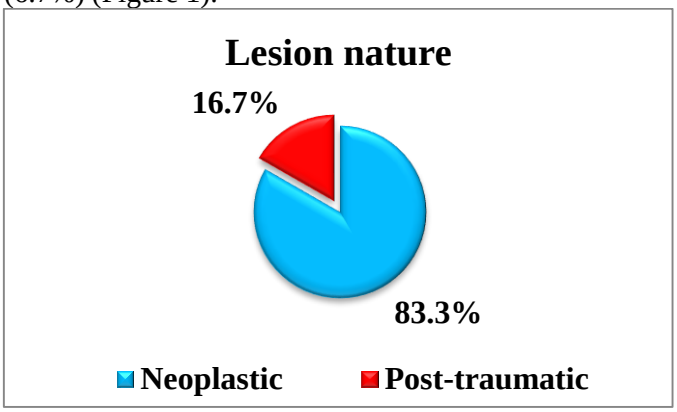

Figure (1): Description of lesion nature in all studied patients.

General anesthesia was done in 15 patients (83.3%) and local anesthesia in 3 patients (16.7%) (Figure 2).

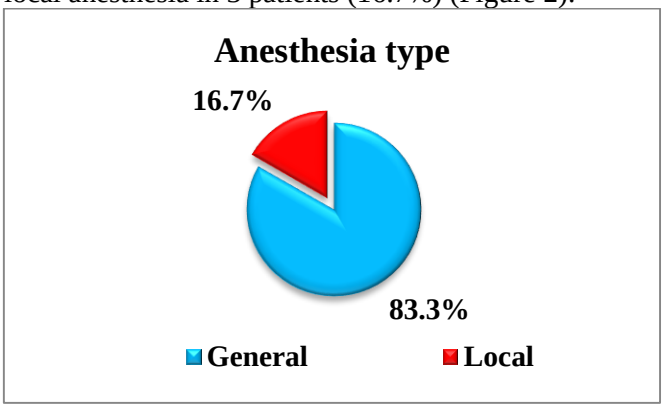

Figure (2): Description of anesthesia type in all studied patients.

Table (4) shows that no hematoma or seroma were detected, there was congestion in 4 patients (22.2%), ischemia in 2 patients (11.1%), flap necrosis in 1 patient (5.6%) and wound infection in 3 patients (16.7%) while there were no complications in 9 patients (50%).

Table (4): complications among studied patients.

		Studied patients (N = 18)	
Complications	**Nil**	9	50%
	Hematoma	0	0%
	Seroma	0	0%
	Congestion	4	22.2%
	Ischemia	2	11.1%
	Flap necrosis	1	5.6%
	Wound infection	3	16.7%

Table (5) shows that there were 2 patients (11.1%) with poor satisfaction, 4 patients (22.2%) with fair satisfaction, 6 patients (33.3%) with good satisfaction and 6 patients (33.3%) with excellent satisfaction in the studied patients.

Table (5): Patient satisfaction among studied patients.

		Studied patients (N = 18)	
Patient satisfaction	**Poor**	2	11.1%
	Fair	4	22.2%
	Good	6	33.3%
	Excellent	6	33.3%

Table (6) shows that there were 1 patient (5.6%) with poor committee satisfaction, 5 patients (27.8%) with fair committee satisfaction, 4 patients (22.2%) with good committee satisfaction and 8 patients (44.4%) with excellent committee satisfaction in the studied patients.

Table (6): Description of committee satisfaction in all studied patients.

		Studied patients (N = 18)	
Committee satisfaction	**Poor**	1	5.6%
	Fair	5	27.8%
	Good	4	22.2%
	Excellent	8	44.4%

		
(A): Shows the site of the lesion	(B): Shows preoperative marking of the flap (facial artery perforator flap) and feeding perforator	(C): Shows defect after excision of the lesion
		
(D): Shows flap elevation with perforator demonstration (arrow).	(E): Shows flap insetting with primary closure of the donor site	(F): Early post-operative result (after 2 weeks).
		
(G): Late post-operative result (after 3 months).	(H): Late post-operative result (after 9 months)	

Figure (3): Case Female patient, 42 years old, had Basal cell carcinoma (morphea type). Safety margins are free, Zone 4; cheek (para-nasal; beside right nasal ala).

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DISCUSSION

Facial reconstruction provides unique surgical challenges because of the importance of both functional and cosmetic outcomes. Because of the perfect tissue color and texture match, local face flaps provide a great reconstructive option. Facial skin's high vascularity guarantees a steady blood supply to local flaps, whether they are pedicled or islanded. However, local flaps do not have total freedom of mobility to get to the flaw. In addition, effective results from cutaneous or subcutaneous pedicled flaps are not always achievable without a two-stage surgical procedure with additional revisions [(7)].

Damage to the face from an accident or tumor removal in the operating room can be repaired using a skin graft, a local flap, or a free flap. Inadequate color and texture matching, scarring, and contractures are some of the challenges associated with facial skin transplantation. For cosmetic purposes, small to moderate lesions are best repaired using local flaps collected from surrounding tissue. However, this approach has significant limitations, including movement restrictions and a lack of available overlaying skin and soft tissue. Fixing the problems may need a follow-up or supplementary process [(2)].

Hofer pioneered the use of the perforator technique, in which the facial artery is used to restore perioral abnormalities, in 2005. Researchers have published several articles on the topic of employing face perforators for repair of facial deformities since then. The initial perforator flap for the face was based on the facial artery. With this method, the length-to-width ratio that was once thought to be essential for a successful one-stage reconstruction is no longer a constraining factor [(8)].

This study included 18 patients. Their ages ranged between 30 and 77 years old. Most of our cases were above the age of 60 years. This goes well with other studies like; **Aksam *et al.*** [(9)] and **Moio *et al.*** [(7)] in which their age ranges were 48-82 years, and 29-84 years respectively. This confirms the fact that skin tumors occur more in the elderly patients more than 60 years old.

As regard the patients' **sex**, 55.6% of our patients were males and 44.4% were females. In the study of **Aksam *et al.*** [(9)], 69.1% were males and 30.9% were females. **Moio *et al.*** [(7)] operated on 58% male patients and 52% females. This means that more than 50% of operated patients in all studies were males.

In our work, no **co-morbidities** were documented in 5.6% of cases. Hypertension was documented in 55.6% of cases, 33.3% of them were smokers and 33.3% were diabetic. **Aksam *et al.*** [(9)] reported that all patients had some kind of comorbidity: hypertension 28.5%, diabetes 21.4%, and smoking history 83.3%.

The present study showed that 73.3 % of the patients had **BCC**, 20 % had **SCC**, 6.7% had **Melanoma** and 16.7% were post traumatic defect.

Our results were supported by study of **Moio *et al.*** [(7)] as they revealed that their 31 patients were treated. Basal cell carcinoma (BCC) was in 51.6% of cases, squamous cell carcinoma (SCC) 45.1% and melanoma 3.2%.

This confirms that neoplastic lesions are the most common reasons for facial skin defects especially (BCC)**.** Furthermore, **Kokkoli *et al.*** [(10)] demonstrated that the majority of their studied patients had basal cell carcinoma (BCC).

In the current study most of cases (33.3%) had **defects** on the **nose** (Zone 2). While, 22.2% of them had lesion on the **cheek** (Zone 4). **Lower lip** (Zone 6) lesions represented 11.1% of cases. **Forehead** (zone 1) lesions represented 5.6%.

In the study of **Kokkoli *et al.*** [(10)]**,** 28% of patients had defects on the **nose** (Zone 2), 25% of them had defects on the **cheek** (Zone 4) and 7.2% had lesions on the **lower lip** (Zone 6).Also the study of **Gunnarsson *et al.*** [(1)], 57% of patients had defects on the **nose** (zone 2) .While 9.5% of them had defects on the **cheek** (zone 4).

This gives us an idea that the **nose** (zone 2) is the most common site liable to skin and soft tissue defects.

The size of the defect after excision of lesion is an important factor in determining the flap size, movement, and site of feeding perforators. In our work, we were able to cover a maximum defect surface area of about 17 cm^2, and most of the defects were between 10-15 cm^2.

Brunetti *et. al.* [(11)] were able to reconstruct face defect surface area up 16 cm^2, and most of the defects subjected to reconstruction were between 5-15 cm^2. **D'Arpa *et al.*** [(12)] have successfully used facial artery perforator flaps as big as 24 cm^2 for lip reconstruction without any vascular insufficiency, which coincides well with our work.

In the study, as regard anesthesia, 83.3% of patients had general anesthesia and 16.7% of them had local anesthesia.

Two studies had supported our study. **Lee *et al.*** [(13)] who operated all patients (100%) under general anesthesia. **Elmelegy *et al.*** [(14)] demonstrated that general anesthesia was used in 66.6% of patients, while the other 33.3% of them were operated under local anesthesia.

In our study regarding the **post-operative complications**, 50% of cases had no complications, and no **hematoma** or **seroma** were documented. **Congestion** occurred in 4 cases (22.2% of flaps); two cases based on ophthalmic artery perforators used for nasal coverage, one case based on submental artery, and one based on facial artery perforator, So removal of

some stitches, application of nitroderm patch were done. As a result, the four flaps improved and survived. Two flaps (11.1%) subjected to **ischemia**, so warming and lidocaine 2% injection were done. As a result, one improved totally and the other one had full thickness necrosis in the distal 1/5 .3 flaps subjected to wound infections so good drainage was done under LA, culture and sensitivity was sent for good adjustment of the proper antibiotic.

In the study of **Lombardo *et al.* [8]**, eight cases (80%) had no complications, while only one case (10%) presented with venous congestion which improved by conservative treatment. On the other hand, in the study of **Aksam *et al.* [9],** six cases only (14.2%) underwent venous congestion which improved by heparin injection without any further surgical interventions.

Furthermore, **Elmelegy *et al.* [14]** reported that there was no recurrence during the period of observation. Three (10%) had venous congestion that healed on its own within 2 days, 3 (10%) had a distal 1/3 superficial necrosis, and 2 (6.6%) had hematomas that required evacuation under local anesthetic. Twenty-two (73.3%) cases were complication-free.

The present study showed that as regard **patient satisfaction** with the aesthetic result, half of them (33,3%) were excellent, (33.3%) were good, (22.2%) were fair and (11.1%) were poor. As regard **colleague satisfaction** with the aesthetic result, (44.4%) were excellent, (22.2%) were good, (27.8%) were fair and (5.6%) were poor.

In the study performed by **Elmelegy *et al.* [14],** patients' perceptions of their care were assessed using a variety of standardized instruments (PROMs). The results showed that 19 patients, or 55.9%, had outstanding outcomes; 9 patients, or 26.5%; 6 patients, or 17.6%; and none had bad outcomes.

In addition, three external plastic surgeons rated the clinical effectiveness on a 4-point scale. Twenty-two patients, or 64.7%, were deemed to have achieved exceptional outcomes, while 7.3% had achieved good results, 14.7% had achieved acceptable results, and 0% had achieved bad results.

These results are also nicely comparable to our results. This may be referred to the similarity in population and culture in our community. Also, could be attributed to the similarity in the lesions presented, the methods used for reconstruction.

CONCLUSION

Because of their adaptability, wide range of motion, similar texture, and color match, the freestyle local perforator flaps could be used successfully to rebuild complex face deformities for cosmetic purposes.

In the new reconstructive era, both form and function beside the target of defect coverage, are very important requirements in the demanding face region. In this context, the advent of the **freestyle concept** for local procedures is not only reliable but also a valuable, versatile first-line option in the toolkit of the plastic surgeon. This technique provides a more robust, defect-tailored, tissue-sparing, and cosmetically superior single-stage reconstruction of all small and medium-sized defects in the face region.

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