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Comparative Study between Perforator Based Island Flaps and Fasciocutaneous Flaps in Reconstruction of Lower Extremities

Wael Mohammad Sakr, Wael Mohammad El Shaer, Adel Mayhoub Mahmoud, Gamal Mohammad Ali El Ziady, Omar Mahmoud Nasser*

Department of Plastic and Reconstructive Surgery, Faculty of Medicine - Beni-Suef University

*** Corresponding author:** Omar Mahmoud Nasser, **Mobile:** (+20) 01226664107, **E-mail:** omarnasser199@gmail.com

ABSTRACT

Background: Open wound of the lower limb is one of the common health problems that have a significant economic and social burden. It has a risk of osteomyelitis of the underlying bone and even necrosis can occur.

Objective: To evaluate the difference between the perforator-based island flaps and fasciocutaneous flaps in reconstruction of lower extremities regarding; functional, aesthetic outcome, size of the flap, degree of rotation, technical difficulties, percentage of flaps survival, flap loss, operative time and donor site morbidity.

Patients and Methods: The study was conducted on 40 patients with soft tissue defects in lower extremities which were equally distributed into two groups. Group 1 consisted of 20 patients that were treated by perforator based island flap and group 2 that consisted of 20 patients treated by fasciocutaneous flap.

Results: The two techniques had similar results when evaluated by the Likert scale. The results of both procedures had no significant statistical differences as regards any of the Likert score components namely, color, texture, appearance, and shape. The main finding of the current study was the comparable postoperative outcome for both techniques. The number of patients that had necrosis was 7 in perforate based island flap and 4 in fasciocutaneous flap which represented 35% and 20% respectively of each studied group and this was statistically insignificant.

Conclusion: Any flap can be used as a perforator-based island flap in which the source vessel is completely preserved. Perforator flaps have multiple advantages over Fasciocutaneous flaps as allowing increased diversity and versatility in the design and composition of flaps.

Keywords: Perforator Based Island Flaps; Fasciocutaneous Flaps in Reconstruction; Lower Extremities.

INTRODUCTION

Lower extremity reconstruction is an essential part of plastic surgery and focuses on the treatment of wounds and defects secondary to trauma, cancer, or chronic disease processes. During the last 25 years, advances in plastic surgical techniques and improved wound care technologies have revolutionized this field, allowing the salvage of limbs that would have otherwise been amputated[(1)].

The goal of lower extremity reconstruction is the coverage of defects and open wounds of the lower extremity to give patients a healed wound and to let them resume their life, ambulate, and go back to work while preventing amputation [(2)]. The reconstructive ladder guides our efforts in lower extremity reconstruction and describes levels of increasingly complex management of wounds [(3)].

Closure by secondary intention is the simplest method of reconstruction and focuses on allowing the wound to naturally granulate and contract by the use of good local wound care [(4)].

Many wounds can be closed by directly opposing the skin edges as long as there is minimal tension on the wound and the skin edges are non-traumatized and have good blood supply [(1)].

Full-thickness or split-thickness skin grafts can be used for lower extremity reconstruction. Skin grafts best used to cover exposed muscle or soft tissue [(1)].

Fasciocutaneous flaps are tissue flaps that include skin, subcutaneous tissue, and the underlying fascia. Including the deep fascia with its prefascial and subfascial plexus enhances the circulation of these flaps [(5)].

Perforator flap surgery is a technique used in reconstructive surgery where skin and/or subcutaneous fat are removed from a distant or adjacent part of the body to reconstruct the excised part. The vessels that supply blood to the flap are isolated perforator derived from a deep vascular system through the underlying muscle or intermuscular septa. Some perforators can have a mixed septal and intramuscular course before reaching the skin [(6)].

Microvascular free tissue transfer has revolutionized the treatment of high energy lower extremity injuries with associated bone, soft tissue, and muscle loss and with exposure of bone and vital structures [(7)].

The concept of perforator-based island flaps becomes simple, providing more options in the selection of an appropriate design and resolves the problems that previously required a free flap as by using perforator-based island flaps, the source vessels can be preserved and the donor site can be closed without the need of a skin graft [(6)].

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AIM OF THE STUDY

The aim of this work was to evaluate the difference between the perforator-based island flaps and fasciocutaneous flaps in reconstruction of lower extremities regarding; functional, aesthetic outcome, size of the flap, degree of rotation, technical difficulties, percentage of flaps survival, flap loss, operative time and donor site morbidity.

PATIENTS AND METHODS

This study was conducted in the period between February 2017 to February 2019 on 40 patients with soft tissue defects in lower extremities from the outpatient Clinic and Emergency Department of Plastic Surgery, Faculty of Medicine, Beni-Suef University. The patients were classified randomly into 2 equal groups each involve 20 patients. Group (A) were various perforator-based island flaps and group (B) with fasciocutaneous flaps.

Ethics: The study was performed in accordance with the Helsinki Declaration. After approval of the Local Ethical Committee of Beni-Suef University Hospital. Written consent was obtained from all patients.

Management Protocol:

A. History: Admission information was collected concerning the type and the time of injury, magnitude and extent of the injury, time and type of trauma, history of previous surgical procedures and history of concomitant medical and surgical disorders.

B. Primary Management in the Emergency Department: Initial evaluation of the Airway, Breathing, and Circulation according to ATLS (Advanced Trauma Life Support) principles. Antibiotic prophylaxis (ampicillin-sulbactam) and anti-tetanus measures were provided in the emergency room. Examination of the local condition of the wound was done to detect whether this limb is salvageable or not.

Pre-operative Preparations:

- Routine laboratory investigations.
- Plain X-ray to detect the presence of fractures or osteomyelitis.
- Arterial Duplex and angiography were used in suspected vascular problems.

Debridement:

After induction of anesthesia, the limb was cleaned using a soap solution for removal of particulate debris on the surface of the limb. The limb prepped and draped in the standard manner with an antiseptic chlorhexidine skin preparation solution applied over the entire limb. Non-viable skin, fat, muscle and bone are excised, with irrigation of the wounds with large amounts of saline. Skin margins were excised, with a generous extension of wounds with exploration through all layers, and excision of damaged muscles. Muscles are assessed for color (pink not blue), contraction, consistency (devitalized muscle tears in the forceps during retraction) and capacity to bleed. If the soft tissue damage is difficult to assess. A second look was undertaken 24-48h later. At the time of the first debridement, ampicillin-sulbactam was administered.

Management of bone fracture:

Suitable exposure of the fracture surfaces was done through wound extensions along the line of a fasciotomy incision to preserves the fasciocutaneous perforator vessels that supply angiosomes of skin on medial and lateral sides of the pretibial surface. Delivery of bone ends through the wound with care taken to avoid further periosteal stripping through injudicious use of retractors and clamps. Visible dirt and particulate debris were removed. Stabilization was achieved through spanning external fixators with attempts to preserve access for plastic surgical procedures. In open injuries which after debridement, can be closed by simple suture of the wound (typically Gustilo grades I and II), internal fixation can be used safely.

Temporary wound dressings:

Following excision of all non-viable tissues, if the soft tissue reconstruction was not performed immediately, the Negative pressure wound therapy (NPWT) device was applied with the application of negative pressure. Dressings were changed every 48 h with continuous sub-atmospheric pressure at 125 mmHg.

Flap Design and Surgical technique:

Before operation, the perforators were identified and marked on the skin using a hand-held 8 MHz Doppler probe on the medial side of the leg with initial design of the flap. Before rotating the flap the defect to be covered should be revised and if possible reduced in size with the aid of split skin grafts. In many of these cases, it may be necessary for conjunction with the orthopedic surgeons to chisel off the bone, remove sequestra and occasionally insert bone graft.

Perforator based island flap:

Firstly the distance between the perforator and the distal edge of the defect was measured. This value was then transposed proximally, again measured from the perforator, and one centimeter was added forming the proximal limit of the flap.

The width of the defect was measured. This value was then used to determine the width of the base of the flap, adding half a centimeter to allow for tissue contraction and to facilitate easy closure without tension. The lateral dimensions of the flap, at the point where the perforator pedicle enters the flap, were equidistant. The largest suitable distal perforator (nearest to the defect) was selected and microclamps were placed on all other perforators. A soft non-crushing clamp could be placed across the base of the flap and perfusion within the flap was evaluated. If flap perfusion was reliable, the other perforators were ligated and the proximal incision was made. The flap was only islanded if bleeding at the tip could be demonstrated. After islanding, the septum around the perforator was gently released with the division of all side muscular branches and facial strands at a minimum of 2 cm diameter around the perforator to allow rotation of the flap up to 180 degrees in both directions choosing the smaller angle of rotation without occluding the pedicle.

Fasciocutaneous flap :

The flap was planned with the base proximally, distally or bi-pedicled.

The flap was designed to avoid tension on the pedicle, with careful attention to the relaxed skin tension lines, the elastic properties of the skin, and the flap's pivot point. The flap often was designed longer and wider than expected to be necessary.

The incision was carried right through the skin, subcutaneous tissue and fascia, a couple of sutures or hooks in the fascial margin can then be used to hold the flap. The dissection was best carried out from one of the long incisions and the surgeon should avoid damaging the delicate and often thin layer of loose connective tissue between the fascia and the underlying structures. This tissue should be left 'undisturbed. It has a rich vascular supply, provides a good base for a split-skin graft and can also very quickly produce a layer of healthy granulation tissue.

When rotating very large flaps a "dog's ear" was unavoidable and should be left for correction later. A tourniquet not be used

Donor site:

The secondary defect was covered immediately with a split-skin graft or closed by direct sutures.

Post-operative care:

A light bulky dressing was prepared to keep the flap warm, preventing the spasm of the perforating artery. A slab could be used to secure the position especially if there is an orthopedic problem or bad compliance of the patient, and the slap was carefully designed to avoid compressing the flap. Close monitoring of the flap in the first 48 hours was done, to observe the edema and the vascularity of the flap. Stitches that caused tightness and stretching of the flap were removed.

Any complications as complete or partial flap failure, flap tip necrosis, infection, hematoma or donor site problems in cases of venous congestion and edema were monitored. Anticoagulants (low molecular Heparin), antiplatelets (aspirin) and anti-edematous (alpha chymotrypsin) drugs were used with limb elevation. Skin graft has been used over the donor site, the graft take was inspected after 5-7 days and if this is satisfactory then mobilization of the patient is recommended.

Statistical analysis

Recorded data were analyzed using the statistical package for social sciences, version 20.0 (SPSS Inc., Chicago, Illinois, USA). Quantitative data were expressed as mean± standard deviation (SD). Qualitative data were expressed as frequency and percentage.

The following tests were done:

Independent-samples t-test of significance was used when comparing two means. Chi-square (x^2) test of significance was used in order to compare proportions between two qualitative parameters. The confidence interval was set to 95% and the margin of error accepted was set to 5%. The p-value was considered significant as the following: Probability (P-value): P-value <0.05 was considered significant. P-value <0.001 was considered highly significant. P-value >0.05 was considered insignificant.

RESULTS

Table (1) demonstrates the age and sex distribution of the studied population where the age was ranged from 8 to 50 years old with an average of 32.52 ±11.8 (SD). The majority of the studied patients were males (92.5%) and the study included only 3 females.

Both studied groups were matched regarding age and sex distribution without statistically significant differences; (p-values > 0.05).

Table (1): Age and sex distribution of the studied population; (N= 40):

	Perforator Based Island Flaps (n= 20)	Fascio-cutaneous Flaps (n= 20)	TOTAL	p-value*
Age (years);				
Mean ±SD	32.25 ±11.6	32.80 ±12.3	32.52 ±11.8	0.885[a]
Minimum	8	13	8	
Maximum	50	49	50	
Sex; N (%)				
Male	17 (85%)	20 (100%)	37 (92.5%)	0.115[b]
Female	3 (15%)	0 (0.00%)	3 (7.5%)	

*p-value ≤ 0.05 is considered significant.

[a] analyzed by the Mann-Whitney-U test, [b] analyzed by Chi-Square (χ^2) test.

Table (2) illustrates the different etiology in studied patients. Post-Operative infection was the most common cause among patients who underwent a Fascio-cutaneous Flaps procedure where their number was 15 out of 20 patients (75%) with a statistically significant difference as compared with the Perforator Based Island Flaps procedure, (p-value= 0.004).

For patients who have undergone Perforator Based Island Flaps procedure; etiologies were more diverse.

Table (2): Distribution of the studied patients by etiology; (N= 40):

	Method			
	Perforator Based Island Flaps(n= 20)	Fascio-cutaneous Flaps(n= 20)	TOTAL	p-value
RTA	7 (35%)	3 (15%)	10 (25%)	**0.004***
Infection post operative	3 (15%)	15 (75%)	18 (45%)	
Chronic ostomalities	2 (10%)	1 (5%)	3 (7.5%)	
Bed sores	4 (20%)	0 (0.00%)	4 (10%)	
Heal ulcer	3 (15%)	0 (0.00%)	3 (7.5%)	
Amputated stump ulcer	1 (5%)	0 (0.00%)	1 (2.5%)	
Diabetic	0 (0.00%)	1 (5%)	1 (2.5%)	

*p-value ≤ 0.05 is considered significant by Chi-Square (χ^2) test.

Table (3) illustrates the distribution of site defect in the studied patients; Lower 1/3 of the right was the most common site among patients who underwent perforator passed or Fascio-cutaneous Flaps procedures where their number was 5 out of 20 patients (25%) in Group (A) and was 7 out of 20 patients in group (B).

Table (3): Distribution of the studied patients by the site of the defect

	Method		
	Perforator Based Island Flaps (n= 20)	Fascio-cutaneous Flaps (n= 20)	TOTAL
Rt. leg lower 1/3	5 (25.0%)	7 (35.0%)	12 (30.0%)
Lt. leg lower 1/3	2 (10.0%)	3 (15.0%)	5 (12.5%)
Rt. Knee	1 (5.0%)	0 (0.0%)	1 (2.5%)
Rt. gluteal	4 (20.0%)	0 (0.0%)	4 (10.0%)
Rt. foot	3 (15.0%)	1 (5.0%)	4 (10.0%)
Lt. foot	1 (5.0%)	0 (0.0%)	1 (2.5%)
Rt. heal	2 (10.0%)	0 (0.0%)	2 (5.0%)
Lt. heal	2 (10.0%)	1 (5.0%)	3 (7.5%)
Rt. leg middle 1/3	0 (0.0%)	3 (15.0%)	3 (7.5%)
Lt. leg middle 1/3	0 (0.0%)	2 (10.0%)	2 (5.0%)
Rt. leg upper 1/3	0 (0.0%)	2 (10.0%)	2 (5.0%)
Lt. leg upper 1/3	0 (0.0%)	1 (5.0%)	1 (2.5%)

Table (4) illustrates the patient position during the operation in the studied patients. Prone position was the most predominant among patients who underwent Perforator Based Island Flaps procedure where their number was 15 out of 20 patients (75%) with a statistically significant difference as compared with the Fascio-cutaneous Flaps procedure, (p-value= 0.016).

Table (4): Patient position during the operation in the studied patients

	Method			
	Perforator Based Island Flaps (n= 20)	**Fascio-cutaneous Flaps (n= 20)**	**TOTAL**	**p-value**
Supine	2 (10.0%)	10 (50.0%)	12 (30.0%)	**0.016***
Prone	15 (75.0%)	7 (35.0%)	22 (55.0%)	
Lateral	3 (15.0%)	3 (15.0%)	6 (15.0%)	

*p-value ≤ 0.05 is considered significant by Chi-Square (χ^2) test.

Table (5): Comparison between two procedures regarding operative time

		Perforator Based Island Flaps (n= 20)	**Fascio-cutaneous Flaps (n= 20)**	**TOTAL**	**p-value**
Age (years);	Mean ±SD	2.22 ±0.3	1.12 ±0.1	1.67 ±0.6	0.001*
	Minimum	1.50	1	1	
	Maximum	3	1.30	1.30	

*p-value ≤ 0.05 is considered significant by the Mann-Whitney-U test.

As demonstrated in Table (5); Operative duration was significantly shorter among Fascio-cutaneous Flaps procedures as compared with Perforator Based Island Flaps procedures where the mean duration was 1.12 vs. 2.22 hours in the two procedures respectively with a statistically significant p-value.

Table (6): Assessment of aesthetic outcome using the Likert scale for evaluation of aesthetic results in free flaps

	Minimum	**Maximum**	**Mean**	**SD**	**p-value**
Appearance					
Group (A)	1	5	3.60	1.1	0.863
Group (B)	2	5	3.65	0.6	
Shape					
Group (A)	1	5	3.30	1.0	0.403
Group (B)	2	4	3.05	0.8	
Color					
Group (A)	1	4	2.90	0.7	0.723
Group (B)	1	4	3.00	1.0	
Texture					
Group (A)	1	4	2.85	0.8	0.426
Group (B)	2	4	3.05	0.6	
Total Score					
Group (A)	4	16	12.60	2.8	0.857
Group (B)	7	16	12.75	2.3	

group (A): **Perforator Based Island Flaps,** group (B): **Fascio-cutaneous Flaps**

*p-value ≤ 0.05 is considered significant by the Mann-Whitney-U test.

As demonstrated in Table (6); the aesthetic outcome was assessed using the Likert scale for evaluation of aesthetic results flaps, in which four main factors were assessed on a numerical scale. There were no detected statistically significant differences between the two surgical procedures in our study regarding the four main factors (general appearance, shape, color, and texture) as well as the total score of evaluation. P-values > 0.05.

Table (7): Outcome Evaluation Categories of the Studied Patients

	Method			
	Perforator Based Island Flaps(n= 20)	**Fascio-cutaneous Flaps(n= 20)**	**TOTAL**	**p-value**
Poor	1 (5.0%)	0 (0.0%)	1 (2.5%)	0.501
Bad	1 (5.0%)	1 (5.0%)	2 (5.0%)	
Regular	7 (35.0%)	11 (55.0%)	18 (45.0%)	
Good	11 (55.0%)	8 (40.0%)	19 (47.5%)	

*p-value ≤ 0.05 is considered significant by Chi-Square (χ^2) test.

The combined numerical score of the Likert scale for evaluation of aesthetic results in free flaps was classified as four categories; as illustrated in table (7); the studied patients in both groups had good outcome 55% in Perforator Based Island Flaps procedure and 40% Fascio-cutaneous Flaps procedure respectively with no statistically significant differences between both groups. Only one patient in each group had a bad outcome and only one patient in the study in the Perforator Based Island Flaps procedure had a poor outcome.

Table (8): Distribution of the studied patients by postoperative outcome:

	Method			
	Perforator Based Island Flaps n= 20	**Fascio-cutaneous Flaps n= 20**	**TOTAL**	**p-value**
No complications	13 (65.0%)	16 (80.0%)	29 (72.5%)	0.240
Necrosis	7 (35.0%)	4 (20.0%)	11 (27.5%)	

*p-value ≤ 0.05 is considered significant by Chi-Square (χ^2) test.

Table (8) demonstrates the postoperative outcome for the studied patients in both groups. The number of cases who had post-operative necrosis was higher among Perforator Based Island Flaps group (7 cases vs. 4 cases) but without a statistically significant difference between both groups.

In Perforator Based Island Flaps group; the percentage of necrosis was ranged from 24% to 100% with an average of 41.78 ±26.5 (SD). The time from operation to necrosis was ranged from 12 to 72 hours post-operative with an average of 41.1 ±23.8 (SD) hours.

In the Fascio-cutaneous Flaps group; the percentage of necrosis was ranged from 16% to 40% with an average of29.25 ±11.2 (SD). The time from operation to necrosis was ranged from 6 to 48 hours post-operative with an average of 31.5 ±20.4 (SD) hours.

DISCUSSION

Our study aims to evaluate the difference between the perforator-based island flaps and fasciocutaneous flaps in the reconstruction of lower extremities regarding functional, aesthetic outcome, size of the flap, degree of rotation, technical difficulties, percentage of flaps survival, hospital stay and donor site morbidity.

The first finding of our study was that the mean duration of the procedure was 2.22 ±0.3 and 1.12 ±0.1for perforated based flap and fasciocutaneous flap respectively which reflects the statistically significant short duration of the fasiocutanous flap when compared to perforator based flap. This was in complete accordance with the recent study of **Magliano *et al.*** [8] as they demonstrated that perforated based islands flap required longer operational time than the fasciocutaneuos flap technique (2.0 and 1.3 hours respectively).

Although the study of **Stone *et al.*** [9] did include different parts than lower limb defects in their study, they also agreed to our findings in that fasciocutaneous based flaps required less operational time than perforated based island flaps. They reported an operation time of 2.4 and 1.3 hours respectively.

The explanation of the similar findings in these studies, as well as the present study, may be due to the fact that perforator based island flap is a more difficult and sophisticated technique than the fasciocutaneus based flap which will require significantly longer time for the operator to complete the procedure.

The second finding of our study was that the two techniques had similar results when evaluated by the Likert scale. The results of both procedures had no significant statistical differences as regards any of the Likert score components namely; color, texture, appearance, and shape.

When the results of the Likert score were combined into four categories, the results of the two procedures still had no significant statistical differences. The number of patients scored well was 11 and 8 for the perforated based island flap and fasciocutanous flap respectively while the number of patients scored regularly was 7 and 11 respectively and bad score represented by only one patient in both techniques.

Our results were not far from the results of **Torres-Ortíz Zermeño and, López Mendoza** [10] who found that the results of both techniques were similar when evaluated by Likert score. Their results were also consistent with the present study in that most of the patients in both techniques scored Good. Nevertheless, Torres-Ortíz Zermeño and López Mendoza differed from our study in that they added another evaluation method as they five evaluators consisted of three specialists, a second-year resident and a relative for aesthetic evaluation and they also find no significant statistical differences between the two groups.

The main finding of our study was the comparable postoperative outcome for both techniques. The number of patients that had necrosis was 7 in perforate based island flap and 4 in fasciocutaneous flap which represented 35% and 20% respectively of each studied group and this was statistically insignificant.

This was not far from the results reported by **Gupta *et al.*** [11] that tried to evaluate the role of the perforated based flap and fasciocutaneous flap in the treatment of flexion contracture of the knee. They found an overall complication rate of 25%. The complications included tip necrosis, minor flap loss, and wound infection.

The study of **Morris *et al.*** [12] found that early complications were minimal, with only one patient (wound dehiscence) requiring a further procedure and all patients achieved a good final outcome, so they concluded that both techniques were simple and reproducible technique to perform. They also reported that by islanding local flaps on perforator/fascial feeder vessels, greater mobility is achievable, when compared with conventional flaps.

In our study; Donor sites were covered by skin grafts. Patients were satisfied by results except for 2 cases (10%) developed hypertrophic scars which managed by silicon sheets. According to **Teo** [13] and **Schaverien *et al.*** [14]; the donor site was closed primarily in V-Y and small propeller flaps while the majority needed covering by split skin grafts. Skin graft appearance was not accepted by some young females and in this case, free flaps were preferred.

In our study; the flap was used in 21 cases of active infection (chronic osteomyelitis and infected wounds). The infection subsided within 2 weeks after proper debridement, coverage by the flap and course of proper antimicrobial in 19 cases. Total necrosis occurred in 7 cases (in group A) and 4 cases of the group (B) due to ischemia, persistent venous congestion or persistent infection.

Yaremchuk *et al.* [15] and **Nanchahal *et al.*** [16], believed that serial wound debridement is very important in controlling the local infection. In recent studies; when fasciocutaneous flaps are based on perforator vessels, they have enhanced perfusion properties, proved by infrared spectroscopy and Dopplex ultrasonography. This could explain that perforator flaps can survive in infected and contaminated wounds [17, 18].

In our study, 18 flaps were pedicled on a single posterior tibial artery perforator with propeller design. The mean angle of rotation was 146.5°±27 (90 to170 °) giving us a very good range of movement to reach different sites. Two flaps were islanded on 2 perforators and this didn't affect the range of flap rotation to reach the defect site.

Authors prefer the perforator based flap islanded on a single perforator with propeller design giving the flap a very good range of movement up to 180° to reach difficult sites in the leg and the foot [13, 19, 20]. Another study that was concerned with the outcome of the perforator based flap was the recent study of **Chih-Hsun and Ma**[21]. They aimed to determine whether a single-perforator-based flap or a multiple-perforator-based flap is better for pressure sore reconstruction. They found that two patients had total flap necrosis and one had partial flap necrosis in the single-perforator-based flap group. They found also that none of the flap necrosis was noted in the multiple-perforator-based flap group; however, no significant differences in major complications were noted between the two groups. All donor sites underwent primary closure.

Chang et al.; 2018 is the most recent study that was concerned with the outcome of the perforated based island flap. After a 21 month follow up which considered being a very long period, they observed a minor complication in 2 cases. In 1 case, temporary flap congestion was seen and was treated with a short period of leech therapy, and the other case was partial necrosis on the flap margin, which was completely treated with conservative treatment and minimal debridement and. No major problems have occurred, especially on the de-epithelized part of the flap and in the occupied space.

it worth mention that the perforator-based island flap is one of the most successful clinical applications of the perforator concept: the same size of the flap can be elevated based on a perforator, without requiring the sacrifice of the source vessel. The elevation of more challenging island flaps is made possible by their simple design and easy dissection, and the straightforward closure of the donor site [22].

Moreover, a reliable flap can be harvested that can be rotated sufficiently to cover the defect. Based on multiple perforators available adjacent to a defect, a PBIF can be harvested quickly and reliably, and more efficient transfer of harvested tissues to the defect is possible [23].

The use of flaps in reconstructive surgery has progressed from the use of musculocutaneous flaps to fasciocutaneous flaps, then to perforator flaps, and finally to perforator-based island flaps. Random pattern flaps were a misnomer since their blood supply was preserved by the presence of tiny perforators that surgeons were unaware of, and such flaps are in fact now considered to be perforator-based island flaps [24].

CONCLUSION

The introduction of perforator flaps represented a significant advance in the field of microsurgical reconstruction. perforator dissection is a tedious procedure involving a long learning curve and requiring both a lot of experiences in tiny pedicle dissection and confidence in anatomical knowledge.

The perforator concept is not new but is an idea that evolved from the concept of Fasciocutaneous flaps.

Any flap can be used as a perforator-based island flap in which the source vessel is completely preserved.

Perforator flaps are not very different from Fasciocutaneous flaps, but they do replace some Fasciocutaneous flaps. Therefore the long-held idea of a "flap of choice" in a given reconstruction is no longer valid. However, misconceptions concerning perforators have caused surgeons to avoid using the technique in favor of Fasciocutaneous flaps. Because many of the challenging reconstructions carried out before the introduction of the perforator concept involved flaps similar to perforator flaps.

The perforator concept allows flaps to be harvested and manipulated with more reliability and confidence, even in challenging cases.

Perforator flaps have multiple advantages over Fasciocutaneous flaps as allowing increased diversity and versatility in the design and composition of flaps.

REFERENCES

1. **Brian MP, Julian JP (2010):** Lower extremity reconstruction. Rev. Med. Clin. Condes., 21:66- 75.
2. **Harris AM, Althausen PL, Kellam J *et al.* (2009):** Lower Extremity Assessment Project (LEAP) Study Group. Complications following limb-threatening lower extremity trauma. J. Orthop. Trauma, 23:1-6.

3. **Heller L, Levin LS (2001):** Lower extremity microsurgical reconstruction. Plast. Reconstr. Surg., 108:1029-1041.
4. **DeFranzo AJ, Argenta LC, Marks MW (2001):** The use of vacuum-assisted closure therapy for the treatment of lower extremity wounds with exposed bone. Plast. Reconstr. Surg., 108:1184-1190.
5. **Hashimoto I, Abe Y, Ishida S *et al.* (2016):** Development of skin flaps for reconstructive surgery: random pattern flap to perforator flap. J. Med. Invest., 63: 159-162.
6. **Kim JT, Kim SW (2015):** Perforator Flap versus Conventional Flap. J. Korean Med. Sci., 30(5): 514–522.
7. **Thorne CH (2007):** Techniques and Principles in Plastic Surgery. In: Thorne et al. (eds.). Grabb and Smith's Plastic Surgery (6th edition), Pp.1: 3-14.
8. **Magliano J, Falco S, Agorio C *et al.* (2016):** Perforated based island flap for extremity defects after Mohs surgery. Int J Dermatol.,55:1391–5.
9. **Stone JP, Webb C, McKinnon JG *et al.* (2015):** Avoiding Skin Grafts. The keystone perforated based islands flap in defects. Plast. Reconstr. Surg., 136:404–8.
10. **Torres-Ortíz Zermeño CA, López Mendoza J (2014):** Aesthetic and functional outcomes of the innervated and thinned anterolateral thigh flap in reconstruction of upper limb defects. Plast. Surg. Int., 2014:489012.
11. **Gupta M, Pai AA, Setty RR (2013):** Perforator plus fasciocutaneous flaps in the reconstruction of post-burn flexion contractures of the knee joint. J. Clin. Diagn. Res., 7(5):896–901.
12. **Morris SF, Miller BJ, Taylor GI (2005):** Vascular anatomy of the integument. In: Blondeel *et al.* (eds). Perforator Flaps: Anatomy, Technique and Clinical Applications. www.publicatie-online.nl › files › assets › basic-html
13. **Teo TC (2006):** Perforator local flaps in lower limb reconstruction. Cir. Plas. Iberolatinoam. scielo.isciii.es › pdf › cpil.
14. **Schaverien MV, Quaba AA, Hamilton SA *et al.* (2010):** Lower Limb Reconstruction Using the Islanded Posterior Tibial Artery Perforator Flap. Plast. Reconstr. Surg., 125: 1735-1743.
15. **Yaremchuk MJ, Brumback RJ, Manson PN (1982):** Acute and definitive management of traumatic osteocutaneous defects of the lower extremity. Plast. Reconstr. Surg., 80:1-14.
16. **Nanchahal J, Nayagam S, Khan U *et al.* (2009):** Standards for the management of open fractures of the lower limb. British Association of Plastic, Reconstructive and Aesthetic Surgeons, BAPRAS and British orthopedic Association, guidelines for open fracture management of lower limb (1st edition). Published London, Pp. 1-23.
17. **Rubino C, Coscia V, Cavazzuti AM *et al.* (2006):** Haemodynamic enhancement in perforator flaps: The inversion phenomenon and its clinical significance. A study of the relation of blood velocity and flow between pedicle and perforator vessels in perforator flaps. J. Plast. Reconstr. Aesthet. Surg., 59: 636-643.
18. **Gravvanis A, Tsoutsos D, Karakitsos D *et al.* (2007):** Blood perfusion of the free anterolateral thigh perforator flap: Its beneficial effect in the reconstruction of infected wounds in the lower extremity. World. J. Surg., 31:11-18.
19. **Ozdemir R, Kocer U, Sahin B *et al.* (2006):** Examination of the skin perforators of the posterior tibial artery on the leg and the ankle region and their clinical use. Plast. Reconstr. Surg., 117:1619-1630.
20. **Pignatti M, Pasqualini M, Governa M *et al.* (2007):** Propeller flaps for leg reconstruction. J. Plastic. Reconst. Aesth. Surg., 60: 898-903.
21. **Chih-Hsun L, Ma H (2016):** Use of Perforator-Based Fasciocutaneous Flaps for Pressure Sore Reconstruction: Single-Perforator-Based Versus Multiple-Perforator-Based Flaps. Aesthetic Plast. Surg., 40(4):540-8.
22. **Kim JT (2003):** Latissimus dorsi perforator flap**.** Clin. Plast. Surg., 30:403–431.
23. **Yang J, Ko SH, Oh SJ *et al.* (2013):** Reconstruction of a perineoscrotal defect using bilateral medial thigh fasciocutaneous flaps. Arch. Plast. Surg., 40:72–74.
24. **Pribaz JJ, Chan RK (2010):** Where do perforator flaps fit in our armamentarium? Clin. Plast. Surg., 37:571–579.