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Free-Style Perforator Flaps for Acute Reconstruction of Large Soft-Tissue Defects in Patients Presenting to the Emergency Department

Acil Servise Başvuran Hastalarda Geniş Yumuşak Doku Defektlerinin Erken Rekonstrüksiyonunda Serbest Stil Perforatör Fleplerin Kullanımı

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ABSTRACT

Aim: This study aimed to systematically evaluate the efficacy and safety of freestyle perforator flaps in the acute setting and to analyze predictors of postoperative complications.
Methods: This retrospective study included patients aged 18 years and older who presented to the emergency department of a university hospital between February 1, 2023, and November 30, 2023, with acute traumatic injuries or non-healing wounds. Patients who were identified during initial emergency department evaluation and management as having extensive soft tissue defects and subsequently underwent reconstruction using a freestyle perforator flap were included in the analysis.
Results: The study included 20 patients who underwent reconstruction with freestyle perforator flaps. No statistically significant associations were found between age, sex, etiology, or flap size and complication occurrence. There was no significant difference in complication rates between single-perforator and double-perforator flaps. Complications were most common after nasal reconstruction. All cases requiring secondary skin grafting for donor-site closure occurred in patients who underwent lower extremity reconstruction.
Conclusion: Freestyle perforator flaps may be considered a fast, versatile, and reliable option for the acute management of large soft-tissue defects requiring emergency reconstruction across different anatomical regions.

Keywords: Acute reconstruction; Freestyle perforator flap; Large defect reconstruction; Soft tissue defects

ÖZ

Amaç: Bu çalışma, akut dönemde serbest stil perforatör fleplerin etkinlik ve güvenliğini ve komplikasyon belirleyicilerini sistematik biçimde değerlendirmeyi amaçlamaktadır.
Yöntemler: Bu retrospektif çalışmaya, 1 Şubat 2023 ile 30 Kasım 2023 tarihleri arasında bir üniversite hastanesinin acil servisine akut travmatik yaralanmalar veya iyileşmeyen yaralar nedeniyle başvuran, 18 yaş ve üzerindeki hastalar dahil edildi. Acil servisteki ilk değerlendirme ve tedavi sürecinde geniş yumuşak doku defekti saptanan ve rekonstrüksiyon amacıyla serbest stil perforatör flep uygulanan hastalar analiz edildi.
Bulgular: Çalışmaya serbest stil perforatör flep ile rekonstrüksiyon yapılan toplam 20 hasta dahil edildi. Yaş, cinsiyet, etyoloji veya flep boyutu ile komplikasyon gelişimi arasında istatistiksel olarak anlamlı bir ilişki saptanmadı. Tek perforatör kullanılan olgular ile iki perforatör kullanılan olgular arasında komplikasyon oranlarında anlamlı bir fark yoktu. Komplikasyonlar en sık nazal rekonstrüksiyonlarda gözlendi. Sekonder greft ile kapatma gerektiren tüm olguların alt ekstremite rekonstrüksiyonları olduğu saptandı.
Sonuç: Serbest stil perforatör flepler, farklı anatomik bölgelerde acil rekonstrüksiyon gerektiren geniş yumuşak doku defektlerinin akut yönetiminde hızlı, çok yönlü ve güvenilir bir seçenek olarak değerlendirilebilir.

Anahtar kelimeler: Akut rekonstrüksiyon, Geniş defekt rekonstrüksiyonu, Serbest stil perforatör flep, Yumuşak doku defektleri

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Introduction

Complex soft-tissue defects encountered in the emergency department such as traumatic wounds, diabetic foot lesions, burns, pressure ulcers, and tumor-related defects often require early plastic and reconstructive surgery consultation. Prompt reconstructive planning facilitates optimal coverage, functional preservation, and improved clinical outcomes [1]. In patients evaluated in the emergency department for acute traumatic wounds, pressure ulcers, and defects following tumor excision, early definitive surgical closure has been associated with faster wound healing, reduced infection rates, and lower overall complication rates compared with delayed reconstruction, underscoring the importance of timely plastic surgical intervention in this high-risk patient population [2–4].

Conventional free flaps usually require microvascular anastomosis and, due to the need for meticulous planning and specialized surgical teams, may not be feasible in the early post-traumatic period, often resulting in prolonged preparation and hospitalization. In contrast, pedicled perforator-based approaches that do not necessarily require microvascular anastomosis may shorten operative time and allow prompt wound coverage when an appropriate local perforator is available. Free-style perforator flaps are designed by identifying suitable perforators adjacent to the defect without reliance on predefined flap templates, enabling the creation of a perforator-based island flap. Owing to their tissue similarity, low donor-site morbidity, reduced or absent microsurgical requirements, and feasibility in the early phase of trauma management, free-style perforator flaps represent a practical and effective reconstructive option during emergency management [5–7].

In emergency department–initiated care, patient selection, defect classification, and perforator choice for freestyle perforator flaps remain poorly standardized. This study evaluates the safety and efficacy of freestyle perforator flaps, identifies predictors of flap-related complications, and proposes a defect-oriented reconstructive algorithm.

Methods

Study design and patient selection

The study protocol was approved by the ethics committee of the university. The essential approval was obtained from university hospital to use the hospital database. All patients provided written informed consent for the use of their clinical photographs for publication. This retrospective study included patients who presented to the emergency department between February 1, 2023 and November 30, 2023. The study included patients who presented to the emergency department due to non-healing wounds or acute trauma and were found to have extensive soft-tissue defects during the initial emergency evaluation, leading to referral to the plastic surgery department for reconstructive management. Patients who subsequently underwent reconstruction using a free-style (free random) perforator flap in the plastic surgery clinic were included in the analysis. Patients younger than 18 years of age, defects amenable to primary closure, and cases in which a skin bridge was intentionally preserved during dissection to prevent compromise of vascular circulation were excluded from the study. In addition, patients with incomplete medical records or insufficient perioperative documentation were not included in the final analysis.

Demographic variables, including age and sex, were extracted from institutional medical records. Defect-related parameters, such as etiology, anatomical location, and surface area, were systematically recorded based on preoperative assessments and operative documentation. In addition, flap-related variables including harvested flap dimensions, the source artery of the identified perforators, and the number of preserved perforators were meticulously documented. Postoperative outcomes and complications were retrieved from follow-up records and analyzed retrospectively. Perforator selection in the cases included in this study was guided by an algorithmic approach based on our clinical experience, integrating the anatomical location of the defect with the availability of adjacent perforators and their corresponding source vessels. The algorithm was developed to support clinical decision-making

in clinical practice (Figure 1).

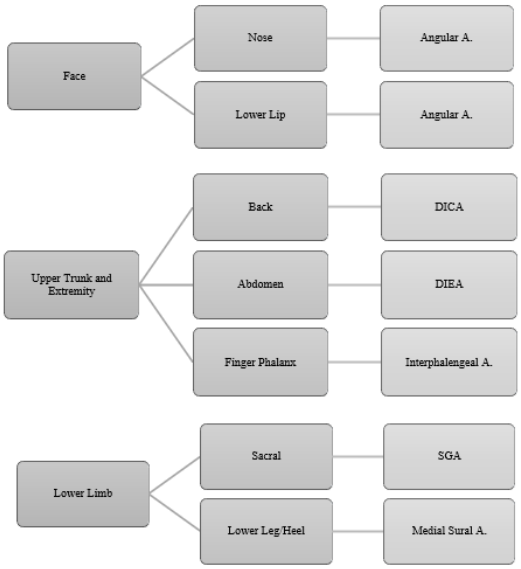

Figure 1. Algorithm for perforator selection according to defect location and adjacent perforators. DICA: Dorsal intercostal artery DIEA: Deep inferior epigastric artery SGA: Superior gluteal artery.

Perforator selection and surgical technique

Preoperative localization of perforator vessels was routinely performed using a portable Doppler ultrasonography device equipped with an 8-MHz vascular probe. Identified perforators were marked on the skin on the operating table with the patient positioned in the definitive surgical position. Based on these markings, source arteries supplying angiosomes appropriate for the defect site were selected and incorporated into the surgical plan according to standard institutional practice. The selection process was guided by established anatomical knowledge of potential donor arteries, taking into account the anatomical variations commonly encountered during perforator flap elevation. Details regarding Doppler findings and perforator selection were retrospectively retrieved from operative notes and surgical documentation.

The flaps were dissected in accordance with the preoperative planning and skin markings documented in the medical records. Incisions were carried down to the level of the deep fascia. In extremity reconstructions, subfascial dissection was performed to allow identification and dissection of perforators. In facial reconstructions, prefascial dissection was used to avoid injury to the mimetic muscles, whereas in trunk reconstructions it was applied to prevent elevation of excessively bulky flaps.

Following identification of all perforators, their intraflap location, diameter, and pulsatility were evaluated intraoperatively and recorded. Perforators selected to facilitate flap advancement were dissected for approximately 2–3 cm by gently separating the surrounding muscle fibers. During flap dissection, perforator vessels were intermittently irrigated with a heparinized solution. Extensive intramuscular dissection was performed only in cases where additional pedicle length was required to improve flap mobility. To enhance vascular safety, the contralateral skin bridge was preserved until completion of the dissection. After confirmation of the presence of perforators with adequate quality, the skin island was either redesigned based on intraoperative findings or elevated according to the original preoperative markings. When the flap reached the defect without tension, all dissected perforators were preserved; however, perforators restricting flap advancement were selectively sacrificed when deemed necessary. In cases in which the perforators were found to have small diameter or weak pulsation at the end of dissection, the skin bridge was preserved, the flap was not elevated, and these cases were excluded from the analysis. After flap elevation, the flaps were transferred to the defect site. The donor site was closed primarily when feasible; otherwise, coverage was achieved using split-thickness skin grafts.

Statistical analysis

All collected data were entered into SPSS (version 26.0; IBM Corp., Armonk, NY, USA) for statistical analysis. Due to the small sample size, the assumption of normality could not be reliably assessed; therefore, nonparametric statistical methods were used. Continuous variables are presented as median (range). Comparisons between two independent groups for continuous variables were performed using the Mann–Whitney U test. Categorical variables were analyzed using the Fisher exact test for 2×2 contingency tables and the Fisher–Freeman–Halton exact test for tables with more than two categories. A p-value <0.05 was considered statistically significant.

Results

A total of 20 patients were included in the study. The mean age of the patients was 54.0 ± 18.9 years. Eight patients (40%) were female, and twelve (60%) were male. The etiology of the soft tissue defects was tumor excision in 10 patients (50%), pressure sores in 6 patients (30%), and trauma-related defects in 4 patients (20%). Among patients with defects secondary to tumor excision (basal cell carcinoma, n =5; squamous cell carcinoma, n = 4; melanoma, n = 1), defect localization was the back in 2 patients (10%), the abdomen in 1 patient (5%), the nose in 4 patients (20%), the lip in 2 patients (10%) and the upper extremity in 1 patient (%5). Pressure sore–related defects were exclusively localized to the sacral region and were observed in 6 patients (30%) (Figures 2, 3, and 4). All trauma-related soft tissue defects were localized to the lower extremity, specifically involving the heel region, and were identified in 4 patients (20%). Defect sizes ranged from 3 × 2 cm to 25 × 20 cm. The smallest flap size was 3 × 3 cm, while the largest measured 30 × 22 cm. In five cases, the flap was elevated including two perforators (n = 5), whereas in the remaining cases a single perforator was incorporated (n = 15). Venous congestion without flap necrosis was observed in three patients (15%). In these cases, venous congestion was mild and transient, and none progressed to partial or total flap necrosis during the follow-up period. Clinical resolution was achieved with conservative management alone. Partial flap necrosis was observed in one patient (5%) following lower extremity perforator flap reconstruction. The necrotic area was limited in extent and did not compromise overall flap viability. Complete wound healing was achieved by secondary intention, and no additional surgical procedures were required (Table 1).

No statistically significant differences were observed between patients with and without complications in terms of age, sex, etiology, or source artery. In contrast, anatomical location was significantly associated with the development of complications (p = 0.025). The majority of complications occurred in nasal reconstructions (n = 3), whereas lower complication rates were observed in other anatomical regions. Complication rates were similar between cases reconstructed with a single perforator and those with two perforators (Table 2). Likewise, flap size did not differ significantly according to the number of perforators used. When analyzed by complication status, the median flap size was 89 cm² (range, 12–660 cm²) in patients without complications and 25 cm² (range, 9–99 cm²) in those with complications; however, this difference was not statistically significant.

Table 1. Patient demographics, defect characteristics, flap parameters, and complication rates in freestyle perforator flap reconstructions.

Variables	Value
Etiology, n (%)	Tumor excision: 10 (50%)
	Pressure ulcer: 6 (30%)
	Trauma: 4 (20%)
Tumor type, n	Basal cell carcinoma: 5
	Squamous cell carcinoma: 4
	Malignant melanoma: 1
Anatomical region, n (%)	Face (nose/lower lip): 6 (30%)
	Sacral region: 6 (30%)
	Lower extremity: 4 (20%)
	Back: 2 (10%)
	Upper extremity: 1 (5%)
	Abdomen: 1 (5%)
Defect size, cm	Range: 3 × 2 – 25 × 20
Flap size, cm	Range: 3 × 3 – 30 × 22
Source artery, n (%)	Angular artery: 6 (30%)
	Superior gluteal artery: 6 (30%)
	Medial sural artery: 4 (20%)
	Dorsal intercostal artery: 2 (10%)
	Deep inferior epigastric artery: 1 (5%)
	İnterfaringeal artery: 1 (5%)
Number of perforators, n (%)	Single perforator: 15 (75%)
	Multiple perforators: 5 (25%)
Donor-site closure, n (%)	Primary closure: 16 (80%)
	Skin grafting: 4 (20%)
Complications, n (%)	Venous congestion without necrosis: 3 (15%)
	Partial flap necrosis: 1 (5%)
	Total flap loss: 0

A statistically significant association was observed between the donor-site closure method and the anatomical region (p = 0.002). Notably, all cases requiring graft closure (n = 4) involved reconstructions of the lower extremity (Table 3).

Table 2. Comparison of complication rates according to etiology, anatomical location, source artery, and number of perforators.

Variables	No Complications (n = 16)	Complications (n = 4)	P Value
Sex			
Female	7	1	0.619
Male	9	3	
Etiology			
Pressure ulcer	6	0	0.115
Trauma	3	1	
Basal cell carcinoma	2	3	
Squamous cell carcinoma	4	0	
Malignant melanoma	1	0	
Anatomical location			
Nose	1	3	0.025
Lower lip	2	0	
Upper extremity	1	0	
Abdomen	1	0	
Back	2	0	
Sacral region	6	0	
Lower extremity	3	1	
Source artery			
Angular artery	3	3	0.406
Dorsal intercostal artery	2	0	
Deep inferior epigastric artery	1	0	
Medial sural artery	3	1	
Superior gluteal artery	6	0	
Inferior pharyngeal artery	1	0	
Number of perforators			
1	12	3	1.000
2	4	1	

Discussion

Determining the most appropriate reconstructive strategy in patients referred from the emergency department who require acute reconstruction for various indications is a crucial component of clinical decision-making. In this context, reconstructive options must address the need for rapid wound coverage while maintaining reliability and minimizing patient morbidity. Freestyle perforator flaps have emerged as a valuable alternative in acute settings, particularly when early reconstruction and a shortened recovery period are desired [8,9].

Table 3. Comparison of donor-site closure methods according to anatomical location.

Anatomical Location	Primary Closure (n = 16)	Skin Graft (n = 4)
Nose	4	0
Lower lip	2	0
Upper extremity	1	0
Abdomen	1	0
Back	2	0
Sacral region	6	0
Lower extremity	0	4

Figure 2. A 55-year-old man with malignant melanoma of the back reconstructed using a dorsal intercostal artery–based single-perforator flap. A. Post-excisional defect following tumor excision. B. Elevation of the flap based on a single perforator arising from the dorsal intercostal artery. C. Postoperative appearance at 1 month.

Figure 3. A 75-year-old man patient with squamous cell carcinoma of

the lower lip reconstructed using an angular artery–based perforator flap. A. Preoperative view of the lower lip tumor. B. Post-excisional defect following tumor resection with elevation of the perforator flap based on a single perforator arising from the angular artery. C. Inset of the flap into the defect. D. Postoperative appearance at approximately 1 month.

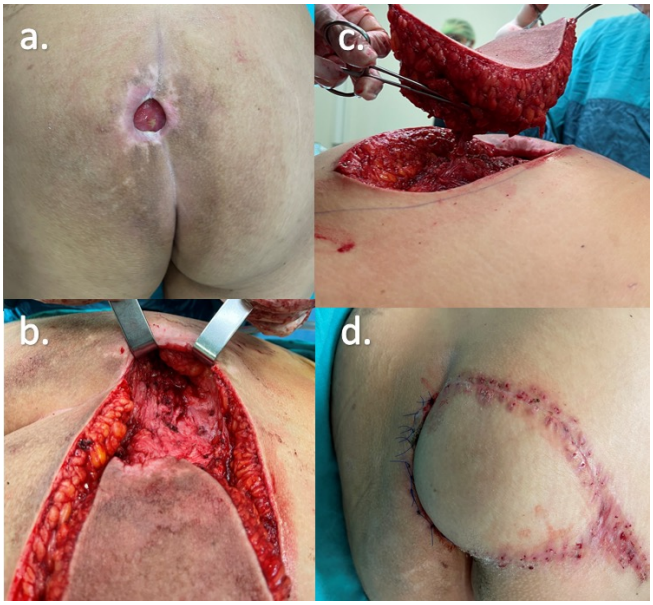

Figure 4. A 42-year-old woman with a sacral decubitus ulcer reconstructed using a superior gluteal artery perforator flap. A. Pre-debridement view of the decubitus ulcer. B. Post-debridement defect. C. Flap elevated on a single perforator without skeletonization. D. Postoperative view at 3 weeks.

In cases of extensive soft-tissue defects, local donor tissues are frequently insufficient or compromised due to their inclusion within the zone of injury. For this reason, microsurgical free flap reconstruction has traditionally been regarded as the preferred method for managing large defects. However, free flap surgery is associated with longer operative times, the requirement for specialized microsurgical expertise, and the need for intensive postoperative monitoring. These factors may limit its applicability in the acute setting or in patients with significant comorbidities or suboptimal general condition. Consequently, there has been increasing interest in alternative reconstructive approaches that can provide effective coverage with reduced technical complexity [10].

The ideal reconstructive option should be technically straightforward, minimize donor-site morbidity, and adhere to the principle of replacing “like with like.” These attributes are particularly important in patients who are not suitable candidates for microsurgical reconstruction. Freestyle perforator flaps allow flexible flap design based on the identification of reliable perforators adjacent to the defect, enabling reconstruction with tissue that closely matches the defect in terms of texture, thickness, and color. This tailored approach facilitates functional and aesthetic restoration without the need for microvascular anastomosis [8].

Although freestyle perforator flaps represent an intelligent and versatile reconstructive tool, they are not exempt from technical challenges or complications. Nevertheless, major complications requiring secondary surgical intervention have been reported to be relatively uncommon [9,11]. In our series, partial flap necrosis was observed in a single patient with a lower extremity defect and was managed conservatively without the need for additional surgery. Likewise, venous congestion occurred in some flaps but did not progress to tissue loss. When evaluated statistically, complication rates did not differ significantly with respect to flap size, etiology, or anatomical location, suggesting a consistent safety profile across different clinical scenarios.

Donor-site management remains a key consideration in perforator flap surgery. In the present study, skin grafting was required only for donor-site closure in extensive lower extremity reconstructions, which can be attributed to limited skin elasticity, regional anatomical characteristics, and defect size. In contrast, donor sites in other anatomical regions were predominantly closed primarily. This finding underscores one of the practical advantages of freestyle perforator flaps, namely the potential for primary donor-site closure and reduced donor-site morbidity in appropriately selected cases.

Limitations

The single-center and retrospective design of this study constitutes a limitation. In addition, the relatively small sample size further limits the generalizability of the findings.

Conclusion

This study suggests that freestyle perforator flaps may serve as a fast, versatile, and reliable reconstructive option for the acute management of large soft-tissue defects requiring emergency

reconstruction, across various anatomical locations. The proposed algorithm, tailored to different anatomical regions, aims to standardize decision-making and facilitate perforator selection and flap planning in time-sensitive settings. To the best of our knowledge, a comparable algorithm-based approach focusing on emergency reconstruction with free-style perforator flaps has not been previously reported in the literature. Nevertheless, larger prospective and comparative studies are warranted to further validate these findings and to refine the proposed reconstructive strategy.

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REFERENCES

1. Topkara A, Serinken M, Uyanık E, Dagli B, Ozcan RH. Retrospective Analysis of Patients Whose Plastic Surgery Consultations Requested were in a University Hospital Emergency Room. JAEM. 2014;13(1):18–21. doi: 10.5152/jaem.2014.016.
2. Wood T, Sameem M, Avram R, Bhandari M, Petrisor B. A systematic review of early versus delayed wound closure in patients with open fractures requiring flap coverage. J Trauma Acute Care Surg. 2012;72(4):1078–85. doi: 10.1097/TA.0b013e31823fb06b.
3. Prevaldi C, Paolillo C, Locatelli C, Ricci G, Catena F, Ansaloni L, et al. Management of traumatic wounds in the Emergency Department: position paper from the Academy of Emergency Medicine and Care (AcEMC) and the World Society of Emergency Surgery (WSES). World J Emerg Surg. 2016;11:30. doi: 10.1186/s13017-016-0084-3.
4. Tadiparthi S, Hartley A, Alzweri L, Mecci M, Siddiqui H. Improving outcomes following reconstruction of pressure sores in spinal injury patients: A multidisciplinary approach. J Plast Reconstr Aesthet Surg. 2016;69(7):994–1002. doi: 10.1016/j.bjps.2016.02.016.
5. Saint-Cyr M, Wong C, Schaverien M, Mojallal A, Rohrich RJ. The Perforasome Theory: Vascular Anatomy and Clinical Implications. Plast Reconstr Surg. 2009;124(5):1529–44. doi: 10.1097/PRS.0b013e3181b98a6c.
6. Schmidt M, Cristofari S, Al Madani O, Romano G, Qassemyar Q, Pascal-Moussellard H, et al. Bipedicled dorsal intercostal artery propeller flaps for reconstruction of extensive cervicothoracic midline defects. Microsurgery. 2020;40(6):656–62. doi: 10.1002/micr.30595.
7. Gentileschi S, Servillo M, Garganese G, Fragomeni S, De Bonis F, Scambia G, et al. Surgical therapy of vulvar cancer: how to choose the correct reconstruction? J Gynecol Oncol. 2016;27(6):e60. doi: 10.3802/jgo.2016.27.e60.
8. Matarazzo S, Corsini B, Cozzi S, Tellarini A, Valdatta L, Paganini F. et al. Propeller Flaps for Acute Lower Limb Reconstruction After Trauma: Evidence from a Systematic Review. J Clin Med. 2025;14(17):6288. doi: 10.3390/jcm14176288.
9. Gatto A, Giacomini G, Cavalli EM, Pajardi GE, Marchesi A. Immediate Soft Tissue Reconstruction in Lower Limb Traumas Using Propeller Perforator Flaps. Ann Plast Surg. 2023;91(5):590–6. doi: 10.1097/SAP.0000000000003696.
10. Abdorrazzaghi H, Hajibarati B, Mohammadi F. Reverse Sural Fascio-Cutaneous Flap for Management of Patients with Distal Third of Lower Limb Soft Tissue Defects Referring to the Emergency Department Following Traumatic Events; A Review of 13 Cases. Frontiers in Emergency Medicine 2021;5(3):e33. doi: 10.18502/fem.v5i3.5895.
11. Gupta S, Gupta P, Khichar P, Mohammad A, Escandón JM, Kalra S. Perforator propeller flaps for lower extremity soft-tissue defect reconstruction: Shortening the learning curve. J Clin Orthop Trauma. 2022;27:101831. doi: 10.1016/j.jcot.2022.101831.