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Using Superiorly Located Perforator-Based Parasacral Perforator Flaps for Reconstruction of Sacral Defects

Alp Ercan[1], Leman Damla Ercan[2], Can Ege Yalçın[1], Suat Morkuzu[3]

[1]Department of Plastic, Reconstructive and Aesthethic Surgery, İstanbul University-Cerrahpaşa, Cerrahpaşa Faculty of Medicine, İstanbul, Türkiye
[2]Department of General Surgery, İstanbul Provincial Directorate of Health, Sultan Abdul Hamid Khan Educational and Research Hospital, İstanbul, Türkiye
[3]Department of Plastic, Reconstructive and Aesthethic Surgery, Houston Methodist Hospital, Houston, Texas, USA

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Abstract

Objective: Despite the advances, reconstruction of the sacral region remains a challenge due to the nature of this area. Parasacral perforator flaps can be useful for small to moderate defects of the sacral area, and with the standard design, their skin paddle can overlap with the skin paddle of the superior gluteal artery perforator (SGAP) flap, forcing us to sacrifice one flap in order to use the other. In this retrospective study, we aim to present our experience with superiorly designed parasacral perforators as a single unit and their combined use with SGAP flaps.

Methods: A retrospective review of 25 patients with sacral area defects reconstructed with a parasacral perforator flap or a parasacral perforator flap combined with a SGAP flap was presented in this study, and the results are discussed.

Results: In our series, all flaps survived uneventfully except one. In 21 cases, a single superiorly designed parasacral perforator flap was used for coverage of a small to moderate sacral defect. In 2 cases, a combination of a parasacral flap and a SGAP flap was used simultaneously, and in 2 cases, a multi-stage approach was used with a SGAP flap in the initial stage and a parasacral flap in the second stage. We did not encounter any end result-altering major complications, and all patients were functionally satisfied.

Conclusion: With its quick learning curve and simplicity, the parasacral flap should be an essential tool in sacral reconstruction. When designed superiorly, their skin paddle would not overlap with the SGAP flap's skin paddle, and a combination of these 2 flaps can be utilized.

Keywords: Gluteal flaps, hidradenitis suppurativa, parasacral perforator flap, perforator flap, sacral decubitus ulcer

Introduction

Reconstruction of the sacral and lower back areas is a challenge. This region has tight skin that is firmly fixed to the underlying structures, and it lacks usable bulky muscle underneath.[1] Defects in this area commonly result from pressure sores, but they can also be caused by resection of hidradenitis suppurativa or tumor ablation. These defects are primarily reconstructed with randomized local flaps or muscle flaps with well-documented vascular pedicles. In this recent era of perforator surgery, we try to use muscle-sparing flaps with designated vascular support more often to fill in sacral region defects.[2] Perforator flaps have many advantages in terms of donor morbidity and flap mobility. By using the "free-style flap" concept introduced by Wei and Mardini, we were able to design many different shapes of flaps in any area as long as there was at least 1 perforator.[3] This approach lets us use the ample tissue and abundant perforators around the gluteal area, such as superior gluteal artery perforators, inferior gluteal artery perforators, and parasacral artery perforators, to design flaps unbound to any shape or design.[4] Numerous parasacral perforators are located bilaterally close to the spine and nourish skin flaps similar to superior gluteal artery perforators, but they are more medially located.[5] They can be found in the superior lumbar region, and using these superiorly located perforators enables us to design flaps that will not overlap with the main workhorse flap of the gluteal region, which is the SGAP flap. In this study, we aim to present our experience with superiorly designed parasacral perforator flaps for the reconstruction of this region.

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Corresponding author: Alp Ercan, Department of Plastic, Reconstructive and Aesthetic Surgery, Cerrahpaşa Faculty of Medicine, İstanbul University-Cerrahpaşa, İstanbul, Türkiye
e-mail: alpercan_autf@yahoo.com
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Methods

For this retrospective cohort study, ethical approval was obtained from the institutional review board of İstanbul-University Cerrahpaşa (Approval Number: 2023/29, Date: October 10, 2023). Twenty-five patients who underwent reconstruction with a superiorly designed parasacral perforator flap between September 2014 and January 2018 were included in this study. All patients underwent wound debridement for sacral pressure sores, hidradenitis suppurativa, or negative margin ablation of a malignant tumor. Broad-spectrum antibiotics were prescribed, and the antibiotics were changed to specific ones if a specific organism was isolated from the wound culture. Perforators were identified and marked by an acoustic doppler with the patient in a prone position during the operation.

Patients' sex, age, cause of the defect, size of the flap, and complications were analyzed using data obtained from medical records and clinical photographs. All procedures were performed in accordance with the Helsinki Declaration of 1975, and written

Figure 1. A suitable perforator neighboring the superior side of the proposed defect was chosen.

informed consent was obtained prior to any surgical procedure and inclusion into the study.

Surgical Procedure

Preoperatively, a portable Doppler assessment was conducted in the prone position, and the locations of parasacral perforators were marked. The parasacral perforators were searched along the paraspinal and parasacral lines, and the most suitable located perforator bordering the superior edge of the proposed defect was chosen (Figure 1). Usually, the proposed area for excision was marked first, and the flap was planned "in reverse" or after the defect was created. If the patient was diagnosed with hidradenitis suppurativa, the disease extent was determined by injecting sinus openings with methylene blue dye. This provides valuable insight perioperatively to visualize the depth and extent of the disease in the subcutaneous planes.

The emerging point of the perforator was designed as the rotation pivot point, and a circle with a diameter of 2-3 cm is drawn with the marked perforator at the center (Figure 2). The rotation

Figure 2. A 2-3 cm cuff was marked around the perforator and the flap was designed with the perforator as a pivot point. The flap border was designed to include the superior edge of the wound.

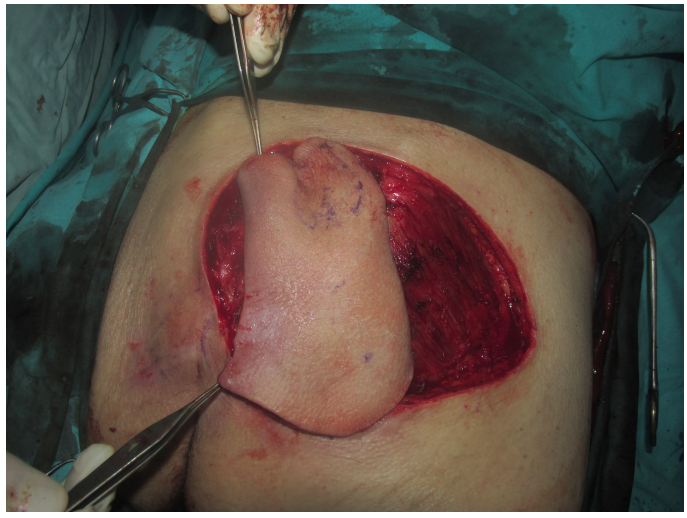

Figure 3. The flap should be long enough to reach the contralateral wound edge after rotation.

angle could be up to 180° but was usually between 45° and 90°, which is considered sufficient considering the position of the defect with respect to the desired flap and the perforators. The border of the flap was designed to include the defect edge, and the lateral border of the flap should be long enough to reach the contralateral wound edge with ease after rotation (Figure 3). We tried not to transect the skin area nourished by perforators of the superior gluteal artery and preserve the skin paddle of the SGAP flap for a possible salvage operation.

The incisions were made and deepened to the fascia of the underlying muscle, after which the flap was elevated in the subfascial plane. Dissection in this plane proceeds until the subcutaneous counterpart of the previously drawn circle around the perforator is reached. This soft tissue cuff of 2-3 cm is preserved under the circle drawn around the marked perforator, and the whole remaining flap was detached from the muscle without any further skeletonization of the perforator. or intramuscular dissection (Figure 4). The perforator of the flap is therefore not visualized, and it remains inside the soft tissue cuff. Hence, there is no need to skeletonize the perforator and its source vessel. After the flap is solely attached through this circular soft tissue cuff

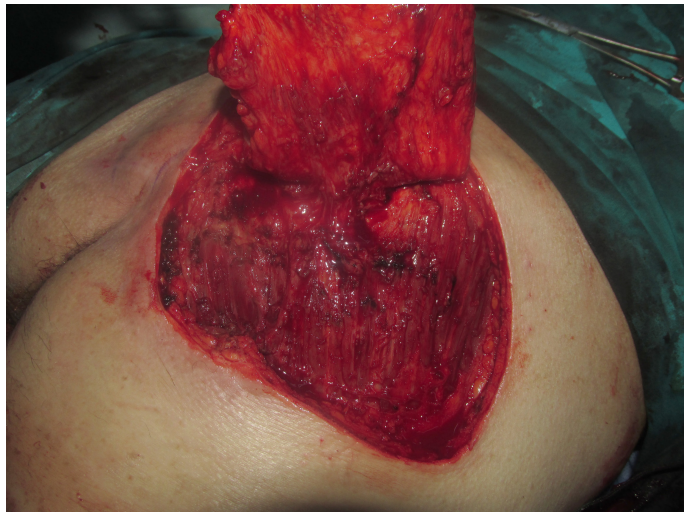

Figure 4. No intramuscular dissection or isolation of the perforator.

with a perforator inside, it can be transposed to the defect. The donor sites were primarily closed. Closed suction drainage was placed at the donor site and under the flap. The drainage amount was recorded once per day, and the drain was removed when the amount was less than 30 mL/d.

Results

All the patients underwent reconstruction of a sacral defect with a superiorly designed parasacral perforator flap or a parasacral perforator flap combined with an SGAP flap. Our series included 14 men and 11 women (Table 1). Their ages ranged from 31 to 79 years (mean, 62.2 years). There were 17 patients with the diagnosis of sacral pressure sores, 7 with hidradenitis suppurativa, and 1 with squamous cell carcinoma (SCC). The dimensions of the flap ranged from 5 × 8 to 9 × 11 (mean, 76.4 cm²).

All of the flaps survived uneventfully except for 1 with partial distal necrosis, which was managed by re-elevation and advancement of the same flap 4 weeks later. There were no major complications, but 3 minor complications of partial donor area dehiscence. Two of them were closed secondarily after a couple of weeks of open wound treatment, and in the last case, separated edges were revitalized with conservative wound treatment alone.

Table 1. Demographic Information of Cases Included in the Study

Case	Age	Sex	Etiology	Flap Size (cm × cm)	Complications
1	31	M	SCC	9 × 11	
2	58	F	Pressure sore	8 × 10	
3	72	M	Pressure sore	12 × 8	
4	67	M	Pressure sore	12 × 7	
5	62	F	Pressure sore	12 × 8	Donor area dehiscence
6	55	F	Pressure sore	9 × 8	
7	76	M	Pressure sore	11 × 5	
8	61	F	Pressure sore	8 × 10	
9	74	M	Pressure sore	11 × 6	
10	79	M	Pressure sore	8 × 11	Partial distal necrosis
11	69	F	Pressure sore	8 × 7	
12	73	M	Pressure sore	10 × 8	
13	40	M	Hidradenitis suppurativa	11 × 7	Donor area dehiscence
14	68	F	Pressure sore	10 × 7	
15	65	F	Pressure sore	6 × 11	
16	64	M	Pressure sore	5 × 8	
17	33	F	Hidradenitis suppurativa	8 × 10	
18	51	M	Hidradenitis suppurativa	8 × 11	Donor area dehiscence
19	42	F	Hidradenitis suppurativa	6 × 8	
20	70	M	Pressure sore	8 × 11	
21	75	F	Pressure sore	7 × 11	
22	34	M	Hidradenitis suppurativa	6 ×× 8	
23	57	M	Pressure sore	12 × 6	
24	60	F	Hidradenitis suppurativa	6 × 11	
25	32	M	Hidradenitis suppurativa	9 × 11	

F, female; M, male; SCC, squamous cell carcinoma.

Case Presentation

Case 5

This ambulatory 62-year-old female sustained a non-healing sacral pressure sore for 5 months after her treatment at the cardiac ICU. A parasacral perforator flap was designed to adjoin the defect from the superior side. After debridement of the wound and bursa underneath, a 12 × 8 cm flap was raised. The rotation angle was about 45°. After reconstructive surgery, the sacral defect was well covered, and the flap showed good results at the follow-up visit 2 weeks and 2 months later (Figure 5).

Case 13

A 40-year-old male had a recurring abscess and fistula due to hidradenitis suppurativa. After the injection of methylene blue dye, all the diseased tissue is resected. An 11 × 7 cm parasacral perforator flap was designed to reconstruct the defect. One perforator was included in the flap, and there was no intramuscular dissection. The flap was transposed to the defect in a rotational fashion at an angle of 45°. The flap demonstrated a good aesthetic outcome and no recurrence after 5 months (Figure 6).

Case 18

A 51-year-old male with extensive hidradenitis suppurativa of the sacral region presented to our clinic. He had 2 unsuccessful resections with primary closure and a quick recurrence of the disease. A 2-stage definitive resection was planned with a 3-month interval. At the first stage, the lower segment of the diseased sacral area was resected and then reconstructed with a SGAP flap. At the second stage, the upper diseased segment was resected, and a superiorly designed parasacral perforator was designed adjacent to the defect. The flap was raised with a thin skin cuff attached to the surrounding tissue for improved venous return (Figure 7). The flap survived uneventfully.

Discussion

In the current era of micro- and supermicrosurgery, free flaps are usually the first choice and gold standard for coverage of many regions of the body, mainly due to their advantages like the transfer of a high volume of tissue to a deficient area and the chance for a better inset. But unlike many regions of the body, the gold standard for reconstruction of sacral defects is still local flaps.[6] The main reasons for this are the abundance of perforator flaps around the region and the difficulty of identifying appropriate recipient vessels for free flaps.

Forcing primary closure of a defect due to a sacral pressure wound or hidradenitis suppurativa almost always leads to wound

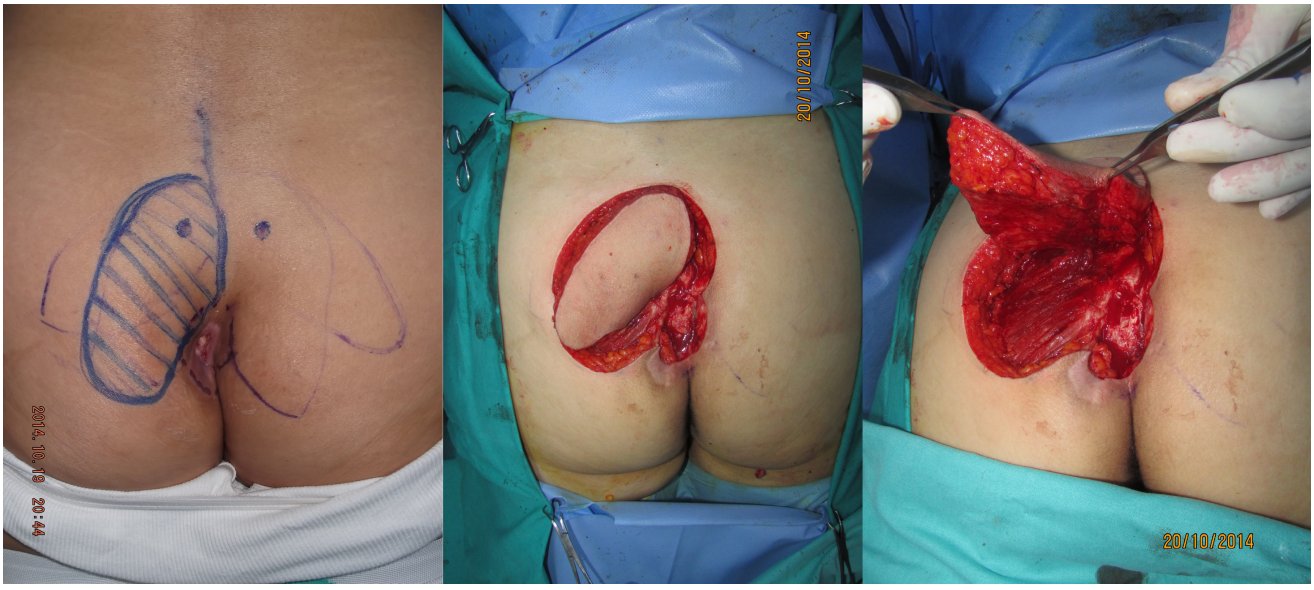

Figure 5-1. A) Paraspinal perforators are highly symmetrical and can be double-checked with the contralateral side. B) Flap should be long enough to reach the contralateral edge of the wound without tension. If there is flap excess, distal part can be deepithelialized to fill in the dead space. C) No isolation of the perforator.

Figure 5-2. A) Immediately after the surgery B) appearance after 2 weeks C) appearance after 2 months.

Figure 6-1. A) Recurrent abscess and discharge due to hidradenitis suppurativa B) An 11 × 7 cm flap was designed for centralized defect with significant dead space C-D) A 2-3 cm soft tissue cuff was preserved around the perforator detected with an acoustic doppler.

Figure 6-2. Appearance after 4 months. No discharge or pain was noted.

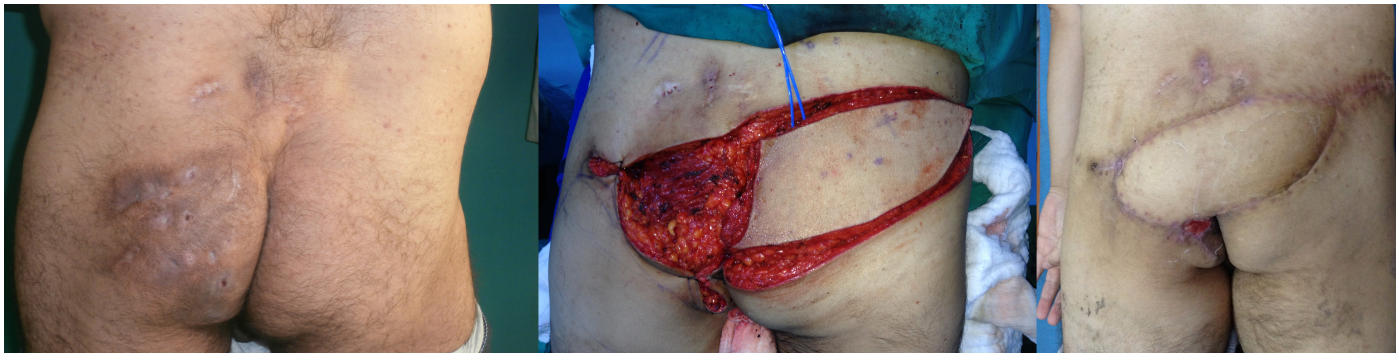

Figure 7-1. A) Extensive hidradenitis suppurativa with frequent abscess formation. B-C) Lower part of the disease was resected and a SGAP flap was used to reconstruct the defect.

Figure 7-2. A) After resection of the remaining diseased tissue, a paraspinal perforator flap was designed for the defect. B-C) A skin bridge of 2 cm was preserved for increased venous return.

dehiscence and recurrence of the defect. These defects are usually centralized and have more dead space than initially thought. Even though it is sometimes possible to bring the skin edges together thanks to the thick volume of tissue over the buttocks, not addressing the dead space underneath properly is the main reason for recurrence. Closing the defect with local flaps reduces dead space, provides tension-free closure, obliterates the natal cleft, and lateralizes scars—all factors that may be important in reducing said complications. In the past, randomized transposition flaps were used with certain geometrical designs, such as the Limberg flap.[7] These kinds of randomized flaps may contain perforators underneath, but they are confined to a certain design and rotation angle, which could force our hands into bigger or differently sized defects.

Perforator flaps, with their designated vascular supply, increased mobility, and increased rotation angle, allow us to design free-style flaps individualized for each defect. For sacral repair, the superior gluteal artery perforator (SGAP) flap is frequently employed. Similarly, like an SGAP flap, several descriptions of the flap favor dissection and elevation in a subfascial plane.[8] This is believed to play a role in recruiting additional vessels into the flap.[9] The parasacral perforator flap repairs large sacral pressure sores without altering the vascularity or innervation of the gluteus maximus muscle. In the treatment of sacral ulcers that cannot be covered by primary closure or a local fasciocutaneous flap, the parasacral perforator flap is a feasible alternative for reconstruction.[10] Numerous local flap alternatives are available, including fasciocutaneous flaps, musculocutaneous flaps, perforator flaps, and combinations of these, as well as their modifications.[11,12]

In our present study, skeletonization and intramuscular dissection of the perforator. were not carried out, and flap rotation was easily carried out in every single case. Although portable dopplers may show false-positive results, the presence of the parasacral perforators is highly reliable, and no significant arterial or venous flow insufficiency was encountered in any of the cases. A high density of large-caliber perforators can be found symmetrically over the imaginary vertical lines on each side of the sacral spine, and a 2-3 cm soft-tissue bridge was considered sufficient to include 1 or more perforators. That bridge also served as a protector of the perforator from inadvertent injury or acute torsion. Low rotation arcs (40-100°) used throughout the surgeries allowed us to completely preserve the soft tissue cuff without undue tension. There was always 1 perforator for each flap, but as mentioned in the manuscript, no individual perforator isolation or dissection was done. We design our flaps based on the acoustic signal from the doppler and preserve a small cuff of soft tissue around the perforator. The duration of the surgery is quite short because we move swiftly and elevate the flap from everywhere but the marked perforator area. Harvesting takes approximately 15-20 minutes.

The parasacral perforator flap introduces large amounts of vascularized tissue after wide excision of the disease or debridement of the wound, with low donor site morbidity. The parasacral perforator flap was used as a single flap to reconstruct sacral defects up to 9 × 11 cm in length. The vascular anatomy of the parasacral perforator also allowed us to completely preserve the contralateral side. One of the main advantages of these flaps is that they can be combined with other perforator flaps for a large defect or even with the same flap from the contralateral side, and additional flaps can be raised from the untouched regions in a later operation (case 20, Figure 7). Pressure sores are bound to relapse eventually, so having multiple options for possible future defects would be beneficial.[13,14] In our study, re-elevation and advancement of these parasacral perforator flaps were possible because they were mostly rotation flaps pivoting around the corner where perforator vessels emerge. This is an important advantage of rotational perforator flaps over muscle flaps.

The skin type of the lower back region is much tighter compared to the gluteal region; therefore, it was the main setback limiting the usage of the parasacral flap when it was designed superiorly. The flap's dimension was limited to the extra skin and soft tissue of the lower back region to ensure primary closure of the donor defect. The size of the flap is not limited by vascularity but by the possibility of primary closure. In our series, the maximum size of the flap donor area that could be primarily closed was 10 × 9 cm.

Limitations

The small number of combined cases is a limitation for our study. This combined approach was included just to put it out there as an option for significant defects and to demonstrate the versatility of this approach.

Conclusion

The abundance of perforators around the sacral and lower back areas propels us to a new area for reconstruction of these previously problematic defects. Perforator surgery may necessitate advanced surgical skills when isolating perforators or performing intramuscular dissection. With their high reliability and mobility without the need for extensive intramuscular dissection, parasacral perforator flaps can be useful for surgeons unfamiliar with perforator flap surgery in the reconstruction of said defects. In our experience, parasacral perforator flaps can be a quick, reliable, and reusable option for small to moderate defects as a singular flap or as a good complementary piece for the other workhorse flaps of the area while resurfacing bigger defects.

Ethics Committee Approval: Ethical approval was obtained from the institutional review board of İstanbul University-Cerrahpaşa (Approval Number: 2023/29, Date: October 10, 2023).

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – A.E.; Design – A.E.; Supervision – A.E., L.D.E.; Resources – A.E., C.E.Y.; Materials – A.E.; Data Collection and/or Processing – A.E., L.D.E., S.M.; Analysis and/or Interpretation – A.E.; Literature Search – A.E.; Writing Manuscript – A.E., S.M.; Critical Review – L.D.E., C.E.Y.

Declaration of Interests: The authors have no conflict of interest to declare.

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