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# Freestyle Perforator propellar Flaps for Gluteal and Perigluteal Pressure Ulcers Reconstruction

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## Abstract

**Background:** Pressure ulcers frequently occur in the gluteal region, particularly in paraplegic patients with a high risk of recurrence. For this reason, future reconstructive treatments should be considered when choosing flaps for reconstructive surgery. Both the upper and superior gluteal artery perforator flaps (IGAP and SGAP) are examples of neural perforator flaps; first and second perforators from profunda femoris artery perforator (PFAP) are popular perforator flaps in the treatment of gluteal pressure sores.

**Objective:** To assess the gluteal and para-gluteal regions by providing different sizes and designs of perforator propeller flaps to reconstruct gluteal pressure ulcers.

**Material and methods:** A prospective study was conducted on forty patients at Al-Azhar University Hospitals between Dec. 2018 and Feb. 2023. Patients presented with different gluteal pressure ulcers reconstructed by free-style perforator propeller flaps. Flap size, source artery of the perforator, perforator site, flap survival, rotation angle, operative time, and complications were recorded.

**Result:** The Mean hospital stay (days) was  $37.85 \pm 12.71$ , and the follow-up mean was  $8.68 \pm 1.95$ . The mean of propeller flap size was  $183.64 \pm 31.76$ , and the mean of Flap operation time was  $158.50 \pm 43.76$ .

**Conclusion:** Reconstruction of pressure ulcers can benefit from the free-style perforator flap, which has the advantage of having little donor-site morbidity and preserving spare tissue for future reconstruction.

**Keywords:** Pressure Ulcers; Morbidity; Perforator Propeller Flaps; Reconstruction; Aesthetic Outcomes

## 1. Introduction

Due to their inability to actively change positions, bedridden patients are more likely to develop pressure ulcers, which puts them at risk for several recurrences even following successful surgery. Poor nutrition and systemic and local infections frequently exacerbate the patients' general illnesses. Having a good surgical procedure without long-term recurrences is difficult because of all of these considerations.<sup>1</sup>

The pressure ulcers have been rebuilt using various techniques and flap covering. Examples include the posterior thigh flap, the V-Y fasciocutaneous flap, and the gluteus maximus island flap. However, given the high rates of problems and recurrence, future reconstructive treatments should be considered

when choosing flaps for reconstructive surgery.<sup>2</sup>

Freestyle flaps can be used anywhere in the body, with a competent perforator and sufficient local tissue availability. Common perforator flaps for the therapy of gluteal pressure sores include the (SGAP), (IGAP), and the two initial perforators from the profunda femoris artery.<sup>3</sup>

Compared to other procedures, the traditional style perforator-based flap approach has less donor-site morbidity and maintains more tissue. This is crucial, particularly for wheelchair users, since they experience a high recurrence rate.<sup>4</sup>

This study aims to assess both the gluteal and para-gluteal regions and provide perforator propeller flaps of varying sizes and designs for rebuilding gluteal pressure ulcers.

## 2. Patients and methods

The Al-Azhar University Faculty of Medicine's Ethical Committee and Institutional Review Board approved this study in the Department of Plastic and Reconstructive Surgery at Al-Azhar University Hospitals in Cairo from December 2018 to February 2023.

### 1.2. Inclusion criteria and exclusion criteria

Forty patients with gluteal and para-gluteal pressure ulcers of different causes (stages 3 and 4) were included in the study. Patients with renal, hepatic, hematologic, or immune disease or who received radio or chemotherapy were excluded.

### 2.2. Assessment and evaluation

A complete medical history and local examination were performed to analyze the defect, and general investigations according to the American Society of Anesthesiologists (ASA) classification were done using radiological investigations in the form of X-rays and 8 MHz Handheld Doppler. Freestyle propeller perforator flaps corrected 42 deficiencies in the gluteal and para-gluteal area's sacrum, ischial, and trochanteric regions.

Eleven females and 29 males ranged from five to 68 (mean: 37.45 years). Three patients (7.5%) presented with diabetes, two patients (5.0%) presented with Previous reconstructive operations in the gluteal region, seven patients (17.5%) presented with surgical history (spinal vertebrae fixation, cholecystectomy, renal stones, and cataract), two patients (5.0%) presented with Hypertension and four patients (10%) presented with smoking. The defects were sacral in 10 cases (25%), ischial ulcer in 24 cases (60%), and trochanteric ulcer in 6 cases (15%), with two patients suffering from 2 pressure ulcers in different sites (Case 10, 19). Twelve cases (30%) were in stage 3, and 28 (70%) were in stage 4. Twenty-eight patients (70.0%) suffered from RTA (spinal cord injury), four patients (10.0%) had FFH (spinal cord injury), four patients (10%) had meningocele, and 4 patients (10%) had a stroke. There were sacral ulcers in 10 cases (25%), ischial ulcers in 24 cases (60%), and trochanteric ulcers in 6 cases (15%).

Forty-two flaps were elevated since two patients require two flaps each to cover their deficiencies. On average, the flap size was 6 x 11 cm<sup>2</sup> to 14 x 25 cm<sup>2</sup> (width-to-length ratio of 11.5: 19.8). In 32 flaps (76%), there had been minimal perforator dissection, and in 10 flaps (24%), there had even been partial dissection of the mother artery. There were three perforators in ten flaps (23.8%), two in twenty flaps (47.6%), and one in twelve flaps (28.6%) at the base of the flap. To hide the flaw, all flaps were pushed up to 180 degrees.

### 2.3. Preoperative preparation

All patients were admitted to the plastic

surgery department at Al-Azhar University Hospitals. The patient was kept on an air mattress, and the ulcer was cleaned daily. According to the culture, appropriate preoperative antibiotic therapy was administered.

### 2.4. Flap design

Using a portable 8 MHz Doppler, perforators were identified prior to surgery in every instance. To minimize the angle of rotation, the optimal perforator was selected as the pivot point closer to the flaw. To ensure that the flap is comfortably inset and does not put any strain on the pedicle, 1-2 centimeters were added to the skin covering the defect, separating the perforator from the distal edge of this defect.

### 2.5. Operative Technique

Most of the patients were operated on in prone positions under local anesthesia, and ten patients needed general anesthesia.



Figure 1. Female patient with Lt. Ischeal and Rt trochanteric pressure ulcers.

A drastic bursectomy was accomplished. Using a bone chisel, the fragment in grade 4 was extracted from the fibrotic pocket by cutting it open to the bony region. A drastic bursectomy was accomplished. Using a bone chisel, the fragment in grade 4 was extracted from the fibrotic pocket by cutting it open to the bony region.



Figure 2. Radical bursectomy.

Measurements and records were made of the final defect's breadth and length. To investigate the perforators, a deep incision was performed on the opposite side of the indicated flap, close to the defect, to reach the deep fascia. Subsequently, the



flap was lifted during subfascial dissection and all of the identified perforators were preserved under a 3x magnification loop. Based on factors such location, size, ability to support the flap, number of venae comitantes, and a powerful pulse, the optimal perforator or perforators were selected.



Figure 3. Elevation of the IGAP flap with 2 dissected perforators.

The flap opened in a circular manner like an island until it reached the required range of motion.



Figure 4. Circumferential release of the flap

The flap moved in both clockwise and counterclockwise directions, being careful not to kink or become tense. A nylon suture and resorbable polyglactine were used to inset the flaps. The donor site was immediately shut down without incident.

Tablet 1. Show the patient's data

Case	Age (y)	sex	Defect		N. of perforator	Rotation	Complica-tion	TTT.	F/ up (m)
			SITE	SIZE					
1	39	F	Sacral	7x10	2 IGAP	120	None		8
2	29	M	Sacral	5x8	3 SGAP	100	None		6
3	39	M	Ischeal	5x9	1 IGAP	180	None		6
4	52	M	Sacral	8x13	2 IGAP	120	None		12
5	53	F	Ischeal	7x10	2 IGAP	160	None		10
6	43	M	Ischeal	7x12	2 IGAP	180	None		7
7	57	M	Sacral	8x10	1 IGAP	120	None		6
8	47	M	Sacral	6x9	1 IGAP	100	None		9
9	36	M	Ischeal	7x11	3 IGAP	150	None		8
10	32	F	Bilateral	8x15	2 IGAP	180	None		12
			Ischeal	7x13	2 IGAP	180			
11	5	M	Sacral	5x7	2 SGAP	90	None		11
12	44	F	Trochantric	6x10	2 IGAP	120	None		10
13	68	M	Ischeal	8x11	3 IGAP	160	Marginal	Heald by 2ry	6



Figure 5. Flap inset with direct closure of the donor site

All flaps were designed in a fashion (transverse or longitudinal axis) that permits direct closure of the donor site.

#### 2.6. Postoperative follow-up

Patients were positioned in a prone for two weeks to prevent any pressure on the flap. Appropriate antibiotic cover was given. Flap monitoring (color, capillary refilling, and temperature) was done once every 2 hours during the first 48 hours and then twice daily. Dressings are changed every two days, and the 12th- 15th POD does complete suture removal.

#### 2.7. Statistical Analysis

The Statistics Package for Social Science (IBM SPSS) version 20 was used to enter, edit, and amend the data. Numbers and percentages were used to portray the qualitative data, and mean, standard deviation, and ranges were used to present the quantitative data when their distribution was parametric. A margin of error of 5% was acceptable, and a confidence interval of 95% was established. As a result, the following p-value was regarded as significant:  $P < 0.05$  indicates substantial (S), and  $P > 0.05$  indicates non-significant (NS).

14	13	M	Ischeal	6x8	2 IGAP	180	necrosis	intention	8
15	45	M	Ischeal	7x10	1 IGAP	180	None		8
16	22	M	Ischeal	6x10	1 PFAP	90	None		6
17	38	M	Sacral	9x10	3 IGAP	150	Wound dehiscence	Heald by 2ry intention	10
18	25	M	Trochantric	6x7	1 IGAP	120	None		12
19	29	F	Lt Ischeal	6x10	2 IGAP	180	None		7
			Rt Trochantric	4x6	2 IGAP	90			
20	57	M	Ischeal	5x11	3 IGAP	150	None		12
21	5	M	Sacral	4x8	2 IGAP	120	Venous insufficiency	Stitch removal Derotation 2ry sutures	12
22	62	M	Ischeal	8x11	2 IGAP	180	None		12
23	47	M	Ischeal	8x10	2 IGAP	180	None		9
24	22	F	Ischeal	7x11	1 IGAP	160	None		8
25	49	M	Ischeal	9x13	3 IGAP	180	None		12
26	37	F	Sacral	9x10	2 IGAP	100	None		8
27	6	F	Ischeal	4x9	2 IGAP	180	None		10
28	33	M	Trochantric	7x8	1 IGAP	90	None		6
29	40	M	Trochantric	7x7	1 IGAP	90	None		6
30	25	F	Ischeal	6x9	3 IGAP	180	None		12
31	27	M	Ischeal	7x12	2 PFAP	160	None		12
32	55	F	Ischeal	8x13	1 IGAP	180	None		12
33	41	M	Sacral	7x10	3 SGAP	100	None		12
34	61	M	Ischeal	7x11	2 IGAP	180	Wound dehiscence	Heald by 2ry intention	10
35	37	M	Trochantric	5x8	1 IGAP	90	None		8
36	18	F	Ischeal	8x11	3 IGAP	180	None		6
37	29	M	Ischeal	7x10	2 IGAP	160	None		6
38	46	M	Ischeal	6x9	1 IGAP	180	None		11
39	33	M	Ischeal	7x9	2 IGAP	180	None		6
40	52	M	Ischeal	8x10	3 IGAP	150	None		6

### 3. Results

In order to reconstruct pressure ulcers in the gluteal and perigluteal areas caused by spinal injuries (from traffic accidents) in 28 patients (70%), falls from height in 4 patients (10%), meningocele in 4 patients (10%), and stroke in 4 patients (10%), free style propellar perforator flaps were utilized.

Forty patients, 29 were males and 11 were females with age ranging from 5 to 68 years with (mean 37.45 years). Three patients (7.5%) were controlled Diabetics, 2 (5.0%) were controlled Hypertension, 2 (5.0%) with reconstructive operations in gluteal region, 7 (17.5%) with Surgical history, and 4 (10%) were Smokers.

The pressure ulcers were sacral in 10 cases (25%), ischeal in 24 cases (60%) and trochanteric in 6 cases (15%). Twelve ulcers (30%) were stage 3 and 28 (70%) were stage 4.

Forty two flaps their size ranged from 6x11cm<sup>2</sup> -11x20 cm<sup>2</sup> were elevated for reconstruction of these defects. Three flaps were based on SGAP (7%), 37 flaps were based on IGAP (88%) and 2 flaps were based on PFAP (5%), with one dissected perforator in 12 flaps (28.6%), 2 in 20 flaps (47.6%) and 3 in 10 flaps (23.8%). All flaps were propelled up to 180 degrees.

The follow up period ranged from 6 to 12 months (mean: 8.95 months). All flaps healed completely except in 2 cases (5.0%) developed wound dehiscence in some sutures, 1 (2.5%) developed marginal flap necrosis, and another (2.5%) developed venous insufficiency. In the first 3 cases, wound was healed by secoundry intention after repeated dressing and in the case of venous insufficiency, sutures removal and derotation was done for 1 week then flap inset was done safely

Case Reports:



Figure 6. Five years old male patient with sacral ulcer was reconstructed by SGAP flap.



Figure 7. Thirty two years old female patient with bilateral ischial ulcers were reconstructed by 2 IGAP flaps.

#### 4. Discussion

A pressure ulcer is an isolated wound caused by pressure or pressure combined with shear to the skin and underlying tissues, generally over a bony prominence.<sup>5</sup>

Pressure ulcers in stages III or IV cannot be effectively treated conservatively. Treating pressure ulcers with surgery involves removing all devitalized tissue from the lesion and covering the incision with a strong tissue flap.<sup>6</sup>

Even after a successful restoration, the gluteal area is prone to pressure ulcer recurrence. Various flap types can be employed in flap surgery for pressure ulcers. Examples include the posterior thigh flap, the V-Y fasciocutaneous flap, and the gluteus maximus island flap. However, given the high rates of problems and recurrence, future reconstructive treatments should be considered when choosing flaps for reconstructive surgery.<sup>2</sup>

Gradual muscular atrophy brought on by muscle separation, partial devascularization, denervation, and weight-bearing pressure is the same in the muscle flap as it is in the skin flap.<sup>7</sup>

Following Taylor and Palmer, The advent of the angiosomes notion of skin vascularization and anatomic analysis of skin perforators. The skin perforators could be scanned using Doppler sonography alone, and a preliminary flap design for the audible perforators could subsequently be completed.<sup>8</sup>

The internal iliac artery is the principal trunk that supplies the gluteal region with skin perforators via the lateral sacral, internal pudendal, superior, and inferior gluteal branches. A portion from the fourth lumbar artery is also present.<sup>9</sup>

Higgins et al. discussed the restoration of ischial decubitus wounds using the inferior gluteal artery perforator flap (IGAP). The benefit of preserving the muscular tissues and reducing donor-site morbidity was highlighted by this method. The local muscle tissue is still viable for reconstructing the defect in the event of a recurrence.<sup>10</sup>

In 2011, Yang et al. described rebuilding the sacral, ischial, & trochanteric pressure using a free-style perforator-based flap. Compared to previous procedures, this one has less donor-site morbidity and maintains more tissues.<sup>11</sup>

This study showed that little perforator dissection is highly favorable in 32 flaps (76%), and even partial dissection of the mother artery is advantageous in 10 flaps (24%). Initially, it permitted the flaps to inset peacefully without the vessels kinking. Second, it provided excellent flexibility in advancing the flap and rotating it from 0 to 180 degrees clockwise in 12 flaps (28.6%) or counterclockwise in 30 flaps (71.4%) without sacrificing the vascularity of the flap. This is contrasted with Seyhanwho, who, to prevent flap compromise, chose to rotate the flaps in smaller increments with a maximum range of 145 degrees.<sup>12</sup>

There is disagreement over the quantity of perforators in the flap's base. One perforator in 12 flaps (28.6%), two perforators in 20 flaps (47.6%), and three perforators in 10 flaps (23.8%) were the number of dissected perforators in this study.

Twelve flaps were elevated on a single perforator with no complications. While 30 flaps were elevated on 2 or 3 perforators, partial necrosis was developed in one Patient (2.5%), and venous insufficiency was created in one Patient (2.5%).

Koshima<sup>13</sup> raised perforator flaps on a single perforator and achieved satisfactory outcomes. At the same time, Seyhan<sup>12</sup> suggests adding a backup perforator if the primary perforator is insufficient.

Yildirim noted transient venous insufficiency in a few of his cases during the first postoperative phase, and he asserted that this was evident in flaps with a single perforator and big flaps. Additionally, he noted one complete flap necrosis due to one perforator that was deeply sliced inside the muscle.<sup>14</sup>

Our results and those of other research indicate that the number of perforators does not determine the success of a flap; still, specific surgical precautions to prevent problems need to be taken during surgery.

Bravo and Schwarze suggested a local perforator flap transfer classification system. These consist of a peninsular pattern with one or more perforators and a skin bridge integrated into the flap base, multiple perforator-based, allowing rotation and advancement with a maximum of 145 degrees, and single perforator-based, which permits flap propelling up to 180 degrees. Additionally, he stated that because the third form is double vascularized, it is not a true perforator flap<sup>15</sup> In this investigation, twenty-six flaps (62%) were turned from 150 to 180 degrees



with just two problems. In contrast, eighteen flaps (38%) were rotated from 90 to 120 degrees with the same amount of complications.

#### 4. Conclusion

Freestyle propeller perforator flaps were an appealing option for reconstructing all defects in the gluteal and para-gluteal areas. They provide the advantage of minimal donor-site morbidity and keep extra tissues for further reconstruction. The effectiveness of a flap is not dependent on the number of perforators; however, specific surgical precautions to prevent problems must be taken during surgery.

#### Disclosure

The authors have no financial interest to declare in relation to the content of this article.

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All authors have a substantial contribution to the article

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