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Two-layer reconstruction in advanced pressure ulcers: Clinical outcomes of muscle flap and rotational fasciocutaneous flap combination

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Abstract

This study aims to evaluate the clinical outcomes of combining a muscle flap with a rotational fasciocutaneous flap in the surgical treatment of stage III–IV pressure ulcers, focusing on postoperative complications and recurrence rates. Seventeen patients who underwent surgery with rotation flap over a muscle flap combination for stage III–IV ischial or adjacent region pressure ulcers between January 2024 and January 2026 were retrospectively analyzed. Demographic characteristics, defect localization and size, postoperative complications, need for reoperation, and recurrence rates were investigated. Of the patients included in the study, 16 were male (94.1%), and 1 was female (5.9%). The average age was 45.9 years. Two-layer flap reconstruction was used in all patients; In this technique, muscle flaps were used to obliterate deeper defects, while rotational fasciocutaneous flaps were used to close the upper surface, creating a mechanically resistant covering. In the early postoperative period, complications developed in 3 patients. One patient underwent surgical drainage for haematoma, and two patients required resuturing due to wound dehiscence. In the follow-up period, no flap perfusion problems were observed, recurrence occurred in one patient, and no mortality was recorded. The two-layered reconstruction technique using a combined muscle flap and rotational fasciocutaneous flap is a reliable and effective method for the surgical treatment of advanced pressure ulcers. This approach offers advantages for obliterating deep defects and providing superficial mechanical resistance. However, larger patient series and long-term follow-up data are needed to demonstrate long-term efficacy and recurrence rates more clearly.

Keywords: Ischial ulcer, muscle flap, pressure ulcer, random flap, rotation flap

Introduction

Pressure ulcers are still a common and clinically significant problem in patients who are immobilized for extended periods, have neurological disorders, or are managed under intensive care units [1]. Despite advances in current treatment approaches, the prevalence of pressure ulcers has been reported to range between 5% and 20% in hospitals, reaching up to 30% in long-term care facilities and nursing homes [2]. Pressure ulcers are associated with increased morbidity, more extended hospital

stays, increased healthcare costs, and higher mortality rates [3].

The aetiology of pressure ulcers is multifactorial, with the fundamental pathophysiological mechanism being tissue ischemia resulting from prolonged pressure and friction. Moisture, decreased tissue perfusion, malnutrition, and other systemic diseases play a significant role in the development and progression of the disease [2]. Stage III–IV pressure ulcers are characterized by significant soft-tissue loss, deep cavitory defects, and often exposure of bone or joint structures

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[4]. Therefore, the management of advanced pressure ulcers requires a multidisciplinary approach including wound care, infection control, nutritional support, and surgical reconstruction [2]. For this reason, the management of advanced pressure ulcers requires a multidisciplinary approach including wound care, infection control, nutritional support, and surgical reconstruction [2].

Surgical reconstruction aims to close the defect with sufficiently vascularized, compression- and shear-resistant tissues of adequate volume [2]. For this purpose, fasciocutaneous rotation flaps, V–Y advancement flaps, perforator flaps, muscle flaps, and various combinations of these techniques have been described. In recent years, there has been increased interest in reconstructive approaches that have two-stage muscle-skin combinations with high practicality [5]. Successful clinical results have been reported with random-pattern flaps that provide skin coverage over underlying muscle tissue [6].

Muscle flaps are often preferred in pressure ulcer reconstruction because of their robust vascular supply makes them effective in obliterating dead space and controlling deeper infections [7] It has been reported that repairs based only on muscle tissue may be limited in terms of superficial mechanical strength in the long term, therefore, interest in combined flap approaches using muscle and skin tissue together is increasing [8]. Knowledge on the long-term clinical outcomes, complication profile, and recurrence rates of this combined reconstructive approach is limited in the literature. Examining long-term outcomes in pressure ulcer patients involves methodological difficulties, which leads to significant heterogeneity in reported recurrence rates [8]. Current studies indicate that recurrence rates after pressure ulcer reconstruction vary widely, ranging from 3% to 100%, and that most reported recurrences occur following surgical wound closure [9].

This study aims to evaluate the clinical effectiveness of combining a muscle flap with a rotational fasciocutaneous flap in the surgical treatment of Stage III–IV pressure ulcers, to determine the rates of postoperative complications and recurrence, and to compare the results with those of other reconstructive approaches reported in the literature.

Material and Methods

Study Design

This study includes 17 patients who underwent surgery for pressure ulcers using a combination of muscle and skin flap at the Plastic, Reconstructive and Aesthetic Surgery Clinic between January 2024 and January 2026. Ethical approval for the study was obtained from the Non-Interventional Research Ethics Committee of Samsun University (Date: 05.11.2025; Protocol No: GOKAEK 2025/2121). The study was conducted in accordance with the principles of the Helsinki Declaration.

Patients with stage III–IV pressure ulcers who were deemed suitable for surgical reconstruction and had complete and accessible medical records were included in the study. Patients with stage I–II pressure ulcers, those unsuitable for surgery, those requiring only dressing changes, or those without proper follow-up were excluded. In addition, patients with active systemic infection, concomitant malignancy, or advanced coagulopathy were excluded.

Demographic data (age and gender), comorbidities, smoking history, prior surgical interventions, defect localization and size, postoperative complications, need for reoperation, and mortality rate were considered in this study.

The combination of a muscle flap and a rotational fasciocutaneous flap for the treatment of pressure ulcers has been successfully used in our clinic for 2 years. In this technique, all patients undergo serial debridement in the preoperative period. Surgical debridement and negative pressure wound therapy are used until the wound bed becomes ready for reconstruction. All surgical procedures are performed under general or spinal anaesthesia. Deep cavity defects are filled with a muscle flap to achieve obliteration. Muscle flap selection was determined according to the localization and depth of the defect, as well as the patient's previous surgical history. For ischial and adjacent region defects, appropriate segments of the gluteus maximus muscle were most commonly used. Superficial tissue coverage is provided with a rotational fasciocutaneous flap planned according to the defect size. The rotation directions of the muscle and skin flaps are planned differently to reduce tension along the wound bed and stitches. The same technique (two-layered repair using a muscle flap and a rotational fasciocutaneous flap) was used in all patients included in the study. Closed drainage systems were placed in all patients. Postoperative evaluation showed that regular follow-up and supportive treatments were applied. Patients' medical records showed that follow-up examinations were performed at 1 week, 1, 3, 6 months, and 1 year postoperatively. The wound and surgical technique stages for patients in the study group are shown in Figure 1.

Postoperative flap monitoring was performed through regular clinical assessment, including evaluation of skin color, temperature, capillary refill, and signs of venous congestion. In the early postoperative period, wound healing was assessed based on flap viability, wound condition, and routine flap monitoring until suture removal. The viability of the underlying muscle flap was indirectly evaluated by the absence of deep tissue necrosis, infection, or dead-space-related complications during follow-up. In the late postoperative period, pressure ulcer recurrence rates and the need for further surgical intervention were assessed according to clinical examination findings and follow-up records.

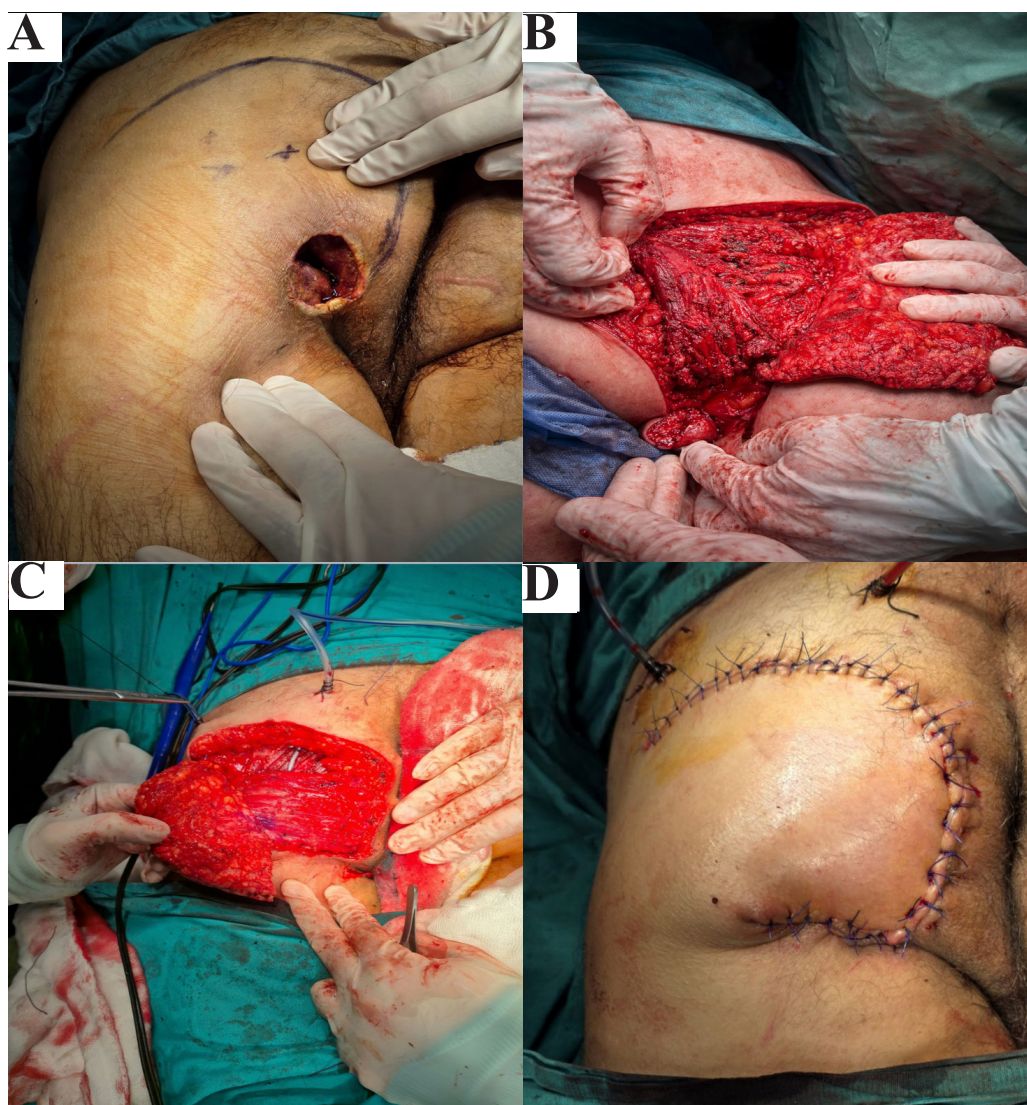


Figure 1. (A) Preoperative view of a stage III–IV ischial pressure ulcer after marking of the planned incision lines; (B) Intraoperative appearance following transposition of the muscle flap used to obliterate the deep cavity defect; (C) Coverage of the muscle flap with a rotational fasciocutaneous flap to provide superficial tissue closure and mechanical resistance; (D) Final postoperative appearance after completion of wound closure

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean, minimum, and maximum values; categorical variables were expressed as number and percentage (%). Since the study was descriptive, data analysis was primarily based on descriptive statistics.

Results

Medical data of a total of 17 patients were obtained in the study. Sixteen of the patients were male (94.1%). The mean age was 45.9 years, with a range of 15 to 81 years. Of the 17 patients included in the study, 11 (64.7%) had no additional diseases, while 6 (35.3%) had at least one comorbidity. Diabetes mellitus (DM) was the most common comorbidity, observed in 3 patients

(17.6%). One patient had multiple comorbidities, including hypertension, DM, chronic obstructive pulmonary disease (COPD), and coronary artery disease. Other comorbidities included COPD, a history of renal transplantation, meningocele, hydrocephalus, and meningomyelocele. Six patients had a history of smoking. It was found that 14 patients had undergone repeated surgical interventions due to pressure ulcers, and three patients were operated on for the first time (Table 1).

When considered by defect location, pressure ulcers were most commonly located in the ischial region (13 patients). Defect sizes ranged from 2×2 cm to 10×15 cm. It was noted that large and deep cavity defects were more common, especially in patients who had previously undergone surgical operations. After a 1-year follow-up, recurrence was observed in only 1 patient (Table 2).

Table 1. Demographic characteristics of the patients

Patient number	Age	Sex	Comorbidities	History of smoking	Previous surgical history
1	59	Male	DM	Yes	Yes
2	45	Male	No	No	No
3	66	Male	CAD, HT	Yes	Yes
4	44	Male	No	Yes	Yes
5	40	Female	No	No	Yes
6	81	Male	HT, DM, COPD, CAD	No	Yes
7	52	Male	DM	Yes	No
8	54	Male	No	No	Yes
9	29	Male	Renal transplantation, meningocele	No	Yes
10	42	Male	Chronic pyelonephritis	Yes	Yes
11	36	Male	Emphysema	No	Yes
12	36	Male	Myeloproliferative disease	No	Yes
13	15	Male	Meningocele	No	Yes
14	31	Male	No	No	No
15	50	Male	COPD	Yes	Yes
16	39	Male	No	No	Yes
17	52	Male	DM, CVI	No	Yes

*DM: diabetes mellitus, CAD: coronary artery disease, HT: hypertension, COPD: chronic obstructive pulmonary disease, CVI: chronic venous insufficiency

Table 2. Pre- and postoperative patient data

Patient number	Defect location	Defect size (cm)	Complications / flap loss	Recurrence	Follow-up duration (months)
1	Sacral region	8x5	No	No	12
2	Right ischial region	5x7	No	No	12
3	Sacral region	10x15	No	No	14
4	Left ischial region	10x8	Wound dehiscence	No	15
5	Right ischial region	7x5	No	No	16
6	Rigt / Left ischial region	4x3/5x5	Wound dehiscence	Yes	22
7	Right ischial region	3x3	No	No	12
8	Right ischial region	4x4	No	No	21
9	Right ischial region	5x7	No	No	24
10	Left ischial region	9x8	Hematoma	No	21
11	Right ischial region	4x3	No	No	21
12	Right ischial region	3x4	No	No	19
13	Sacral region	6x8	No	No	16
14	Sacral region	9x8	No	No	17
15	Left ischial region	4x4	No	No	15
16	Right ischial region	3x4	No	No	12
17	Left ischial region	2x2	No	No	24

It was noted that a two-layer reconstruction technique combining a muscle flap and a rotational fasciocutaneous flap was used in all cases. No major circulatory problems related to flap viability were observed in the early postoperative period. Records showed that one patient developed a haematoma and required reoperation, and

two patients underwent re-suturing due to suture line dehiscence. In the two patients who developed wound dehiscence, this complication occurred between postoperative days 10 and 14. In both cases, flap circulation was assessed as normal, and no deep tissue infection or necrosis was detected. The wound dehiscence

was surgically repaired by refreshing the wound edges followed by primary suturing, and it was determined that no additional flap was required. Other wound-related issues were managed conservatively.

During the follow-up period, a recurrent pressure ulcer had developed in one patient. No recurrence was observed in 16 patients. It was significant that the patient who developed recurrence had previously undergone multiple operations and had a high-risk profile. No arterial insufficiency, venous congestion, or muscle flap necrosis was observed in any patient during the early or late postoperative periods.

The study found that the need for reoperation was limited among the included patients, and no mortality was observed.

Discussion

In this study, the clinical outcomes of a two-layer reconstruction technique combining a muscle flap with a rotational fasciocutaneous flap were evaluated. The findings show that the combined flap technique is an effective method for obliterating deep defects, controlling infection, and ensuring the mechanical strength of the superficial layer. The literature reports that combined fasciocutaneous treatments for pressure ulcers have lower recurrence and complication rates than isolated flaps. The robust vascularisation provided by the muscle flap and the superficial resistance of the fasciocutaneous flap against pressure and shear forces are the main advantages of this technique. In this two-layer reconstruction technique, it is thought that the tension in the suture lines is reduced by the rotation of the flaps in different directions, thereby preserving flap circulation [8,10,11]. This finding reduces the risk of flap ischemia and decreases the likelihood of recurrence. Furthermore, the preference for a random-pattern rotational fasciocutaneous flap represents another important advantage of this technique, as it allows for a shorter operative time in a predominantly comorbid plegic patient population.

In this study, unlike the combined flap techniques reported in the literature, the rotation directions of the muscle and skin flaps were planned differently. This approach aimed to reduce tension along the suture lines. Consequently, lower recurrence and complication rates were targeted in this patient group. To the best of our knowledge, no previous studies have described the technique used in this study. Our findings indicate that surgical procedures performed with this technique are associated with a low incidence of recurrence and complications. These results suggest that this method may be safely applied in patients with decubitus ulcers. However, due to the limited sample size, further studies with larger patient populations are required. Our study may contribute to the introduction of this technique into the literature.

In patients with recurrent pressure ulcers following multiple surgical procedures, reconstructive options may be limited by alterations in local vascular anatomy and reduced reliability of

perforator vessels. In this context, perforator flaps have been reported to be suboptimal in some instances due to technical challenges, a potentially increased risk of ischemia, and longer operative times [12]. Muscle flaps provide enhanced vascularity, which may aid in controlling infections and obliterate dead space. In contrast, the superficial mechanical resilience of fasciocutaneous flaps may contribute to improved long-term wound stability, particularly in patients at high risk of recurrence [13].

In this study, three patients developed postoperative wound-site complications during the early postoperative period. Surgical drainage was required in one patient due to hematoma formation, while two patients underwent reoperation because of suture line dehiscence. Ischial pressure ulcers, due to their anatomical location, are particularly exposed to continuous pressure and shear forces, faecal contamination, and maceration. These factors are major contributors to delayed wound healing and an increased risk of complications [14]. In addition, difficulty in repositioning and continuous sitting pressure in the ischial region create additional mechanical stress that may compromise postoperative wound integrity [2]. The literature reports that complications such as hematoma, wound-edge dehiscence, and infection are common during surgical reconstruction of advanced pressure ulcers, negatively affecting flap outcomes [15]. Moreover, deep tissue infections, such as osteomyelitis, have been shown to increase the risk of postoperative complications, while a multidisciplinary approach may help reduce these rates [16]. These findings indicate that surgical complications remain a significant clinical challenge in the reconstruction of ischial pressure ulcers.

The surgical management of pressure ulcers, particularly in patients with stage III–IV lesions, remains a significant reconstructive challenge due to high recurrence rates and associated systemic comorbidities [2]. In the literature, recurrence rates following flap surgery for advanced-stage pressure ulcers have been reported to range between 20% and 40% [13]. In our study, recurrence was observed in only 1 out of 17 patients (6%). Considering the high-risk profile of our patient cohort and the fact that 65% of the patients had ischial ulcers, these findings can be regarded as clinically satisfactory.

Purely muscle-based reconstructions have been reported to be insufficient for long-term durability in the superficial tissues and do not eliminate the risk of recurrence [17]. For this reason, in recent years, two-layered reconstruction techniques combining fasciocutaneous flaps over muscle flaps have gained prominence [12]. Although perforator flaps have become increasingly popular in pressure ulcer reconstruction, they may not always be ideal options for advanced-stage lesions and high-risk patient populations [18]. The literature indicates that perforator flaps technically require longer operating times, the vascular pedicle is more susceptible to shearing and compression, and the risk of ischemia may increase, especially in paraplegic patients or those with severe comorbidities [19]. In contrast, random-

pattern rotational fasciocutaneous flaps are supplied by a broader vascular network and have a lower risk of complete blood flow interruption when subjected to compression-friction forces [20]. Therefore, in high-risk, immobile patient populations, rotational fasciocutaneous flaps are preferred over perforator flaps as a safer alternative, reducing surgical time and perioperative complications.

This study has some limitations. The limited number of patients and the single-centre nature of the study restrict the generalizability of the results. Since the study was designed retrospectively, evaluations were made based on existing clinical records. The non-homogeneous follow-up period for all patients made it difficult to evaluate long-term recurrence rates in particular. However, subjective parameters such as functional outcomes, patient satisfaction, and quality of life were not evaluated. Further studies with larger patient series and long-term follow-up data will more clearly demonstrate the effectiveness of this surgical approach.

Conclusion

In the surgical treatment of advanced pressure ulcers, the two-layer reconstruction technique combining a muscle flap and a rotational fasciocutaneous flap is a safe and effective option. While the muscle flap provides obliteration of deep defects and vascular support, the rotational fasciocutaneous flap offers a superficial covering resistant to mechanical stresses. Planning the flaps in different rotation directions can help reduce tension at the suture line, supporting flap viability and wound stability. When applied with appropriate patient selection and a multidisciplinary approach, this technique has been shown to provide satisfactory clinical results with low complication and recurrence rates; however, studies with larger patient series and long-term follow-up are needed to demonstrate its long-term effectiveness more clearly.

Ethical Approval

Ethical approval for the study was obtained from the Non-Interventional Research Ethics Committee of Samsun University on 05.11.2025, with protocol no: GOKAEK 2025/2121.

Patient Consent

Informed consent was waived due to the retrospective design.

Conflict of Interest

The authors confirm the absence of any conflicts associated with this work.

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