

Delayed Perforator Flaps for Reconstruction of Extensive Defects of the Posterior Trunk

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ABSTRACT

OBJECTIVES: The delay phenomenon involves neovascularization of tissue after ischemic preconditioning. When employed, the delay phenomenon promotes flap survival and increases length-to-width ratio in conventional flaps. Although well-planned perforator flaps cover defects without tension, the success rate is unpredictable in extensive defects that are closed because of the unknown vascularity of perforasomes. We aimed to increase perforator flap size by utilizing the delay phenomenon for broad defects of posterior trunks.

MATERIALS AND METHODS: Between 2019 and 2020, 10 patients (6 female, 4 male) underwent posterior trunk reconstruction with delayed perforator flaps. We retrospectively analyzed etiology, defect size, flap size and type, postoperative complications, and long-term results. The etiology of defects was meningomyelocele, soft tissue sarcoma, and pressure ulcers in 3, 3, and 4 patients, respectively. Defects were covered with delayed lumbar, intercostal, and thoracodorsal perforator flaps. Flaps were planned unilateral or bilaterally. Perforators were located preoperatively with a handheld Doppler. In the first session, delaying incisions and pedicle dissection were performed. The delayed incision was primarily sutured. Perforator flaps were elevated 1 week later, and defects were closed.

RESULTS: Mean defect size was 375 cm², and mean flap size was 420 cm² (202-625 cm²). The donor site was closed primarily for 7 patients. Two patients required split-thickness

skin grafts. One patient had donor site closed with secondary healing. No flap losses among patients were shown. Hematoma was seen in 2 patients in the immediate postoperative period. After 2 weeks, seroma and donor site dehiscence were shown in 2 and 1 patient, respectively.

CONCLUSIONS: The delay phenomenon can be utilized in perforator flaps as in random pattern local flaps. Perforasome areas can be extended with delayed incision. In addition, broad defects of the posterior trunk can be safely covered with delayed perforator flaps.

KEY WORDS: Delay, Extensive defects, Perforator flaps, Staged closure

INTRODUCTION

Reconstruction of extensive posterior trunk defects presents a substantial challenge in plastic surgery because of the need for tension-free closures, reliable vascularity, and functional preservation. Among the various reconstruction techniques, perforator flaps have emerged as a superior option, offering minimal donor site morbidity and excellent adaptability to complex defect geometries. These flaps utilize a specific vascular perforator to supply skin and subcutaneous tissue, preserving the underlying muscle integrity.^{1,2} However, the success of perforator flaps in extensive defects, particularly in the posterior trunk, can be unpredictable because of the uncertain vascularity of perforasomes in the region.³ This unpredictability necessitates advanced strategies to improve flap viability and outcomes in such reconstructions.

The delay phenomenon, a well-established surgical technique, enhances flap survival through ischemic preconditioning, which promotes neovascularization, improves venous outflow, and extends the territory of perforasomes.^{4,5} With the delay phenomenon, the dimensions and reliability of perforator flaps can be substantially increased, enabling their effective use in covering large posterior trunk defects. The aim of our study was to evaluate

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the outcomes of delayed perforator flaps in posterior trunk reconstruction and to demonstrate their potential to safely and effectively address broad defects while minimizing complications.

MATERIALS AND METHODS

Between 2019 and 2020, 10 patients (6 females and 4 males) underwent posterior trunk reconstruction using delayed perforator flaps at Baskent University's Department of Plastic, Reconstructive, and Aesthetic Surgery. Patient data, including etiology of defects, defect size, flap size, flap type, postoperative complications, and long-term outcomes, were collected and analyzed retrospectively. The etiologies of defects were meningocele (3 patients), soft tissue sarcoma (3 patients), and pressure ulcers (4 patients). Delayed lumbar, intercostal, and thoracodorsal perforator flaps were used to cover the defects based on their anatomical location.

Surgical technique

The procedure was performed in 2 stages, ensuring meticulous planning and execution to optimize flap survival and achieve robust defect coverage. In the preoperative planning phase, each patient was evaluated to determine defect characteristics, including size, location, and depth, as well as overall health status. A handheld Doppler device was used to preoperatively map the perforator vessels. The location, caliber, and flow were assessed to select the most reliable perforator for the planned flap. Flaps were designed to include the selected perforator at the center, and, depending on defect size and location, unilateral or bilateral flaps were planned.

In the first stage, or delay procedure, the flap was marked with dimensions tailored to the defect size, ensuring adequate vascular supply from the perforator. A full-thickness incision was made around the flap's periphery, ensuring that the perforator and surrounding vascular structures remained intact. The perforator pedicle was carefully dissected through the subcutaneous tissue to isolate it while preserving its vascular connections. Adjacent vascular connections were interrupted to induce ischemic preconditioning and promote neovascularization. The delaying incision was sutured primarily, and the flap was left in situ for 1 week to allow for angiogenesis and perfusion enhancement.

In the second stage, or flap elevation and defect reconstruction procedures, the flap was elevated based on the delayed perforator. Dissection proceeded along the marked borders of the flap with extreme caution to protect the vascular pedicle. The delay period ensured the flap was better vascularized, reducing the risk of ischemia. The flap was transposed, rotated, or advanced to cover the defect. The

donor site was addressed as follows: primary closure was achieved in 7 patients for smaller donor sites, split-thickness skin grafts were required in 2 patients because larger donor sites, and secondary healing was used in 1 patient for a large donor site where grafting was not feasible. Negative pressure drains were inserted at both the donor and recipient sites to minimize hematoma and seroma formation.

Postoperative care included close monitoring for complications such as vascular compromise, hematoma, or seroma. In 2 cases, immediate postoperative hematomas required evacuation. Within 2 weeks, seroma and donor site dehiscence were observed in 2 and 1 patient, respectively, which were managed conservatively. Long-term follow-up showed no flap loss, with good aesthetic and functional outcomes in all cases.

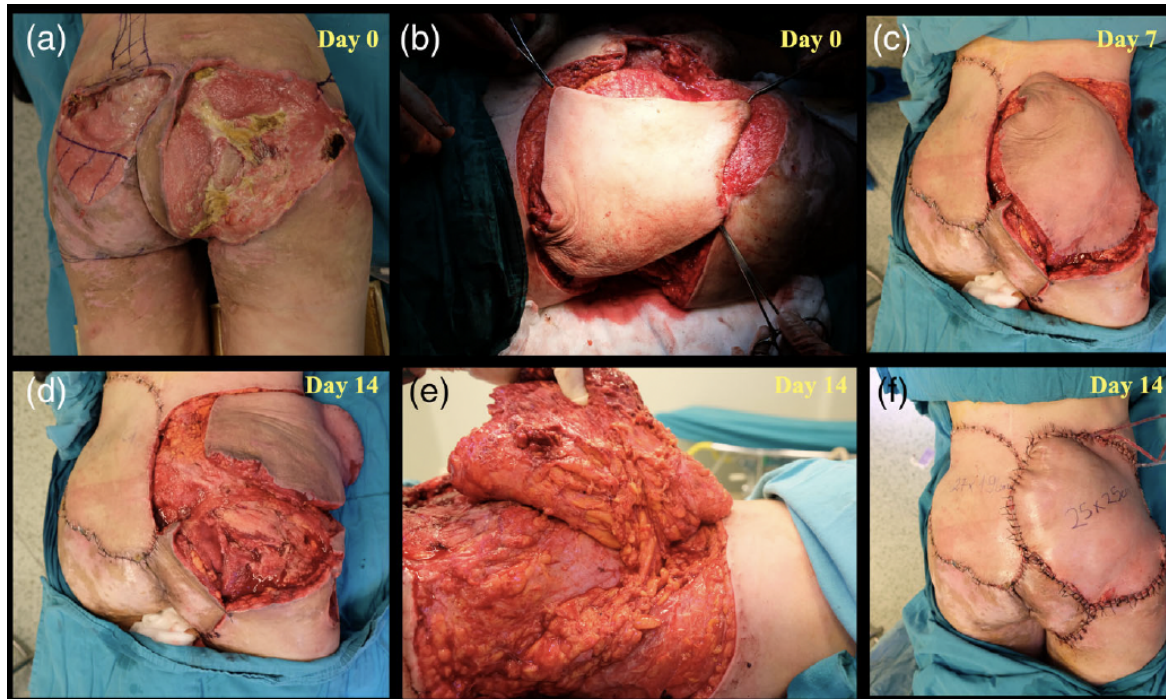
RESULTS

The mean defect size was 375 cm², and the mean flap size was 420 cm², ranging from 202 to 625 cm². Lumbar perforator flaps were used for lower posterior trunk defects, intercostal perforator flaps for midline posterior defects, and thoracodorsal perforator flaps for upper trunk defects (Figure 1). Seven donor sites were closed primarily, and 2 required split-thickness skin grafts. For 1 patient, secondary healing was allowed because of the large donor site size.

DISCUSSION

Perforator flaps have revolutionized reconstructive surgery by enabling precise, tension-free coverage of extensive defects with reduced donor site morbidity. These flaps rely on the vascular supply derived from specific perforator vessels, preserving the surrounding muscle and tissue integrity. In particular for posterior trunk defects, perforator flaps are advantageous because of their versatility in adapting to complex defect geometries and their ability to minimize functional impairment. However, challenges arise when dealing with extensive defects, as the vascularity within perforasomes can be unpredictable, necessitating innovative techniques like the delay phenomenon to ensure flap viability.¹

The delay phenomenon plays a pivotal role in enhancing the dimensions and vascular robustness of perforator flaps. By its ability to induce a gradual neovascularization process, the delay technique allows for the successful elevation of larger flaps with reduced risk of ischemia. In this study, the mean flap size of 420 cm² highlights the effectiveness of delay procedures in increasing flap dimensions while achieving high survival rates. Notably, no flap necrosis was observed in our patients, underscoring the reliability of the technique in preventing ischemic complications.² Furthermore, the ability to extend perforasome territories

FIGURE 1. Extensive Pressure Ulcer Defect

(a) Pressure ulcer defect. **(b)** Left-sided lumbar artery perforator flap elevation. **(c)** Left-sided lumbar artery perforator flap adapted to left defect side, with right-sided lumbar artery perforator flap delaying incision. **(d)** Right-sided lumbar artery flap elevation. **(e)** Lumbar artery perforators. **(f)** Right-sided lumbar artery perforator flap adaptation.

provided an invaluable advantage in managing extensive defects in the posterior trunk.

Although delayed perforator flaps have demonstrated remarkable efficacy, alternative options remain viable depending on defect size, patient comorbidities, and surgical expertise. Local random-pattern flaps, latissimus dorsi musculocutaneous flaps, and free flaps such as antero-lateral thigh flaps are frequently used for posterior trunk reconstruction.³ However, these alternatives often involve increased donor site morbidity or prolonged surgical times. Compared with these methods, delayed perforator flaps offer a balance between functional preservation, aesthetic outcomes, and surgical efficiency, particularly for challenging cases with broad defects.

The primary objective of using the delay phenomenon is to optimize the vascular supply within a planned flap. Preconditioning of the tissue can be achieved through ischemic stimuli; thus, the technique encourages angiogenesis, improves venous outflow, and enhances flap perfusion. This technique results in a more reliable vascular network, allowing for the safe elevation of larger flaps without compromising viability.⁴ For posterior trunk defects, this approach ensures robust coverage while maintaining donor site integrity, making it a cornerstone strategy in complex reconstructions.

Despite its benefits, the delay phenomenon is not without drawbacks. The staged nature of the procedure increases the overall treatment timeline, requiring 2 separate surgical sessions, which may inconvenience patients. Furthermore, the technique demands meticulous preoperative planning, including accurate perforator mapping, which can be time-consuming and operator-dependent.^{1,5} Postoperative complications such as hematoma, seroma, and donor site dehiscence, as observed in our study, highlight the need for vigilant perioperative care. These factors may limit the applicability of this approach in resource-constrained settings or for patients requiring urgent reconstruction.

This study provided valuable insight into the efficacy of delayed perforator flaps but is not without limitations. The retrospective nature of the analysis inherently introduces potential biases, and the relatively small sample size may limit the generalizability of the findings. In addition, the absence of long-term functional and aesthetic outcomes restricted our ability to comprehensively evaluate patient satisfaction and quality of life. Future research should aim to include a larger cohort, consider prospective methodologies, and incorporate objective assessments of long-term outcomes to further validate the utility of this technique.

CONCLUSIONS

Delayed perforator flaps represent a reliable and effective approach for reconstructing extensive posterior trunk defects. The delay phenomenon enhances flap vascularity, allowing for the successful elevation of larger flaps with minimal donor site morbidity and high survival rates. Despite the requirement for staged procedures and meticulous preoperative planning, the advantages of this technique, such as improved flap viability, reduced ischemic complications, and favorable aesthetic outcomes, make it a valuable option in complex reconstructive surgery.

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