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Reconstructive

Dual Reconstruction of Lumbar and Gluteal Defects with Freestyle Propeller Flap and Muscle Flap

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Background: The reconstruction of complex tissue defects in the lumbar and gluteal areas is a surgical challenge. The use of freestyle perforator-based flaps has gained popularity in the reconstruction of these defects due to several advantages: versatility, minimal donor-site morbidity, and tension-free closure. The present study reports the outcome of using a dual coverage of lumbar and gluteal defects with a gluteus maximus rotation flap as a deep layer and a freestyle propeller perforator-based flap as a superficial layer.

Methods: A retrospective analysis of 18 patients who had a dual coverage of complex wounds of the lumbar and the gluteal areas was conducted. Different propeller flaps were used as superior gluteal artery perforator flap (SGAP), inferior gluteal artery perforator flap (IGAP), and posterior thigh perforator flap (PTP).

Results: The study included 15 men and 3 women. The mean age was 26.3 years. The causes of the defects were: pressure ulcers in 14 patients and post-traumatic in 4 patients. A total of 28 freestyle flaps was used: 11 patients had 1 flap, 4 had 2 flaps, and 3 had 3 flaps. The mean postoperative follow-up was 12.2 months. The complications registered in the medical records were venous congestion in 2 patients, partial flap necrosis in 2 patients, and wound dehiscence in 1 patient.

Conclusions: A freestyle propeller perforator-based flap combined with a gluteus maximus muscle flap is a solution that provides well-padding over bony prominence with a low complication rate. However, a long-term follow-up is needed to verify these results. *(Plast Reconstr Surg Glob Open 2021;9:e3376; doi: 10.1097/GOX.0000000000003376; Published online 26 January 2021.)*

INTRODUCTION

Historical Introduction

The concept of reconstruction of complex soft tissue defects using propeller designed flaps was first introduced in the early 1990s by Hyakusoku et al.[1] The flap was based on a subcutaneous pedicle that was rotated 90 degrees to cover the soft tissue defect and the procedure was initially used in the reconstruction of post-burn contractures in the axillary and cubital regions with successful outcomes. In 1993, Koshima et al[2] promoted the concept of perforator-based flaps for repair of sacral complex soft tissue defects; however, the study did note the random distribution of the perforators from the internal pudendal artery and the lateral sacral artery. Two decades later, Higgins et al[3] reported the use of the inferior gluteal artery perforator flap (IGAP) in the reconstruction of ischial decubitus wounds. This technique emphasized the advantage of sparing the muscle tissues and minimizing the donor-site morbidity. In the event of complications after this particular type of flap, the local muscle tissue remains as an acceptable alternative for reconstruction of the remaining soft tissue defect, allowing for additional attempts at salvage.

In 2006, Hallock[4] introduced the propeller perforator-based adductor muscle flap in the reconstruction of ischial and trochanteric pressure sores. This technique again provides the advantage of minimal donor-site morbidity, while also serving as an extra versatile alternative when compared with other techniques to reconstruct these challenging defects, which are known for their high rate of complications. In 2011, Yang et al[5] reported the use of freestyle perforator-based flap in the reconstruction of sacral, ischial, and trochanteric pressure sores with promising results.

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Soft Tissue Defects in the Trunk

The reconstruction of complex tissue defects in the trunk, such as pressure sores, is a challenging problem due to the high rate of recurrence, the poor initial general condition of the patients, and the frequent complications that arise after surgical reconstruction.[6,7] The plan for reconstruction should also take into consideration the possibility of recurrence and therefore the design should be adapted to guarantee skin excess in these cases.

The former workhorse flap for reconstruction of sacral defects was the gluteus maximus myocutaneous flap.[8] This type of flap was associated with several disadvantages, such as limited flap mobility, sacrifice of the underlying muscle, increased blood loss, donor-site morbidity, especially in an ambulatory patient, and muscle atrophy. Consequently, it was replaced by fasciocutaneous gluteal rotational flap with good results. Therefore, the gluteal perforator flaps have gained popularity in the reconstruction of sacral defects due to several advantages: large flaps, highly versatile, have minimal donor-site morbidity, provide a tension-free closure, and are capable of being reused.[9]

In 2013, Chen et al[10] showed that both gluteal perforator flaps and gluteal fasciocutaneous flaps are comparable for the reconstruction of these defects. However, some disadvantages are associated with the gluteal perforator flaps, such as a varied perforator distribution, unpredictable nature of perforator venae comitantes, and the requirement of increased intramuscular dissection.

In an effort to minimize the recurrence of this type of soft tissue defects, some authors (such as Borgognone et al[11]) suggested a modification to previous techniques. They suggested using 2 independent flaps to reconstruct the defect in 2 layers and went on to name this procedure the "criss-cross" musculocutaneous flap. The deeper layer is reconstructed by a rotated split-muscle gluteus maximus flap and is then covered by another transposed fasciocutaneous flap to form the superficial layer. The technique is safe and valuable for reconstruction of primary and recurrent ischial pressure sores. A recent article by Ku et al[12] reported the dual padding of ischial pressure sore by a split-muscle gluteus maximus flap and the IGAP flap on top. This dual padding can provide bulkiness to occupy the dead space and double the layer thickness, and helping prevent pressure ulcer recurrence.

In this report, we present our experience in the reconstruction of variant gluteal and lumbar defects using a combination of a rotation gluteus maximus flap and a freestyle propeller perforator-based fasciocutaneous flap on top. We expand the application of the dual flap coverage method to reconstruct medium to large lumbar and gluteal defects, based on the previous study of Ku et al[12] for ischial pressure sore reconstruction.

SUBJECTS AND METHODS

It is a retrospective study that included all adult patients operated on for the reconstruction of lumbar and gluteal complex soft tissue defects due to various reasons, in the time period between December 2017 and January 2019. The study was accepted by the regional ethics board at Faculty of Medicine, Suez Canal University. It was carried out following the guidelines for retrospective register studies. No experimental protocol was used and no subjects under 18 years old were included. The photographs represented in the study do not reveal the patients' identity. Therefore, no consent was required by the regional ethical board from the patients to be enrolled in this study.

All patients received a dual reconstruction with a gluteus maximus rotation flap and a freestyle propeller perforator-based fasciocutaneous flap. Different parameters were recorded: demographic data, cause of injury, site of the defect, size of the defect, site of the perforator, and complications.

Surgical Technique

A preoperative location of the perforator was performed using a hand-held 8-MHz Doppler near the defect.[4,13] Based on previous studies, a gluteal perforator flap such as the superior gluteal artery perforator flap (SGAP) or the IGAP was used to cover a sacral defect, whereas an ischial defect was covered by the posterior thigh perforator flap (PTP) or the IGAP.[3,5,14–16]

Complete debridement is performed in traumatic wounds, including excision of the bursa and bone until the level of bleeding bone is achieved in a pressure ulcer. Based on the site of the defect, nearby fibers of gluteus maximus muscle are identified away from the site of the

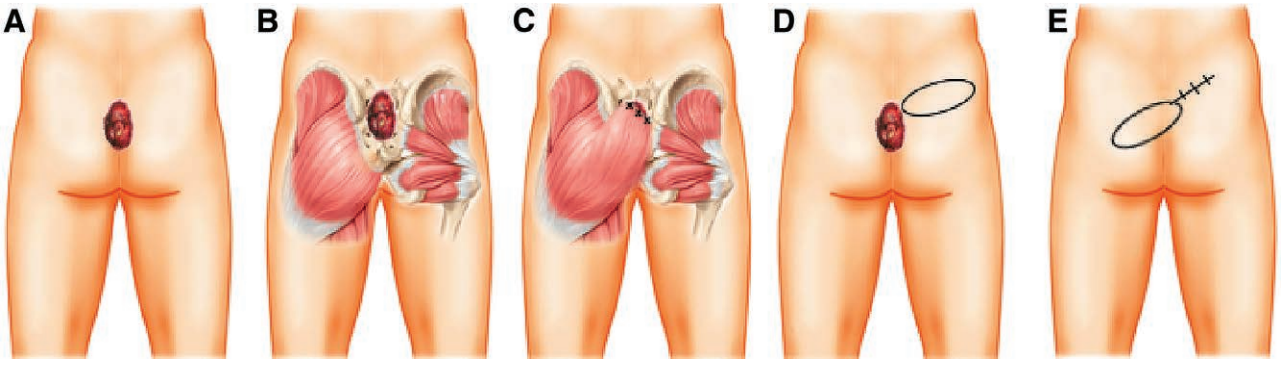

Fig. 1. An illustration of the dual coverage of the sacral defect. A and B, The sacral defect. C, A gluteus maximus rotation flap. D, Design of the SGAP. E, The second layer closure is done by the SGAP and the donor-site is closed primarily.

perforator. The muscle is elevated and rotated to cover the defect after partial release of its origin or insertion (Fig. 1). The rotated muscle is then sutured to the residual muscle at the other side of the wound in cases of the ischial defect and the contralateral muscle in cases of sacral defect.

A fusiform-shaped perforator-based fasciocutaneous flap is then elevated from distal to proximal in the subfascial plan until the identification of the perforator is achieved. Complete skeletonization of the perforator is frequently performed to facilitate flap rotation. The flap is kept in place for few minutes before rotation and a topical vasodilator is applied around the pedicle to provide proper perfusion and avoid vasospasm. The flap is then rotated up to 180 degrees based on the pivot point of the pedicle. Rotation should be in the direction that provides less tension on the venae comitantes, or in the direction that requires a smaller degree of rotation. Two sutures are placed on either side of the axis of the pedicle to secure the flap position and to ensure that there is no tension on the pedicle. A suction drain is also inserted away from the pedicle, and a secure 2-layer closure of the flap is achieved along with primary closure of the donor site. During the postoperative period, patients lie strictly on a pressure relief air mattress bed for 10 days after the operation, and then a position-changes program is started gradually.

Statistical Analysis

Data are presented using descriptive statistics. Statistical significance was set at $P < 0.05$. Variables registered from the patients' clinical charts are age, sex, localization of the defects, the underlying cause of the defect, the technique used for reconstruction, and the registered complications.

RESULTS

Eighteen patients were operated on according to the medical records in the study period. Fifteen (83.3%) were men and 3 (16.7%) were women. The mean age of the studied group was 26.3 years (range, 22–48). A total of 28 freestyle flaps were used to reconstruct the tissue defects: 11 patients (61.1%) had 1 flap, 4 (22.2%) had 2 flaps, and 3 (16.7%) had 3 flaps. The causes of the defects were: pressure ulcers in 14 (77.8%) patients and post-traumatic in 4 (22.2%) patients (Table 1).

Sixteen (57.1%) flaps were SGAP flap, 8 (28.6%) were IGAP flap, and 4 (14.3%) were PTP flap. The mean flap diameter was 12.4 × 7.6 cm and the mean postoperative follow-up was 12.2 months (range, 7–19). The complications registered in the medical records were venous congestion in 2 flaps (7.1%), partial flap necrosis in another 2 flaps (7.1%), and partial wound dehiscence in 1 flap (3.6%). Venous congestion was treated with removal of distal sutures and application of vacuum-assisted closure therapy. Minimal debridement and secondary closure of the wound were performed in a patient with partial flap

Table 1. Description of the Study Group

Cause of the defect	
Pressure ulcer	14 (77.8%)
Gun shot	4 (22.2%)
Flap used	
Superior gluteal artery perforator flap (SGAP)	16 (57.1%)
Inferior gluteal artery perforator flap (IGAP)	8 (28.6%)
Posterior thigh perforator flap (PTF)	4 (14.3%)
Complications	
Venous congestion	2 (7.1%)
Partial flap necrosis	2 (7.1%)
Wound dehiscence	1 (3.6%)

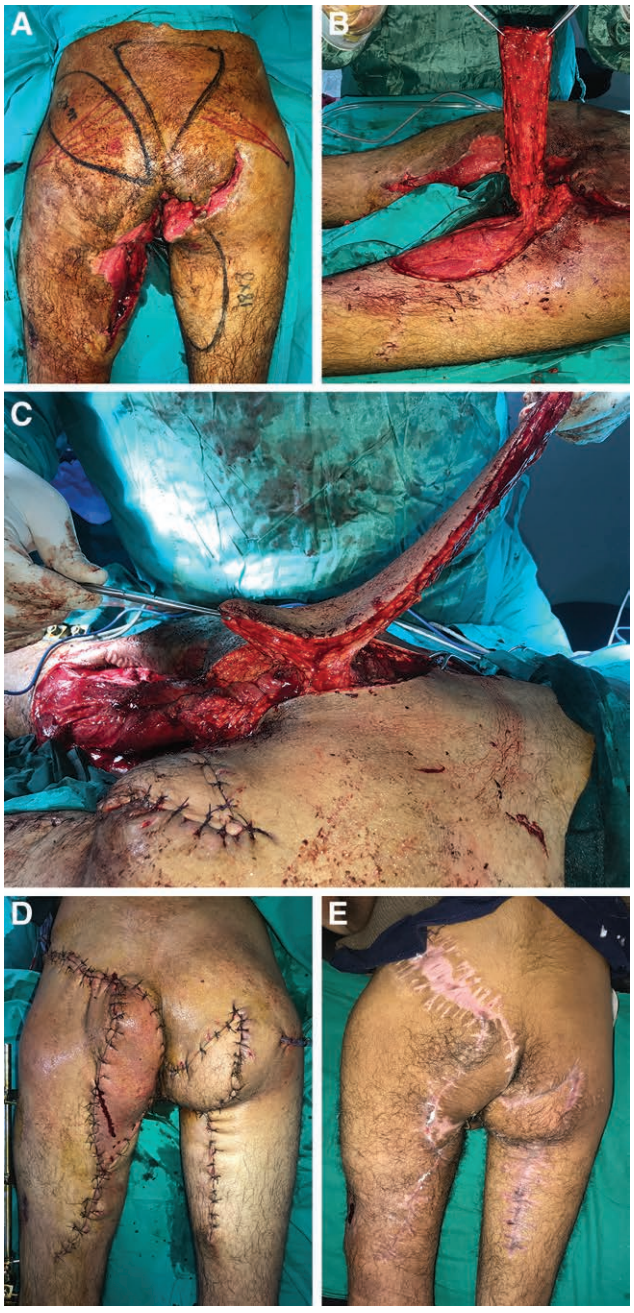

Fig. 2. A gunshot injury with an inlet at the right gluteal region and an exit at the left thigh. A, The PTP flap is designed to cover the right gluteal defect and the IGAP flap for the thigh defect. B, Harvesting the PTP flap. C, Harvesting the IGAP flap. D, Insetting of both flaps on top of rotational gluteus maximus flaps. E, Late postoperative view.

necrosis. All flaps were salvaged with no need of further flap surgery. Furthermore, there was no reported case of recurrence during the follow-up period.

Case Presentations

Case 1 (Fig. 2)

A 24-year-old man presented with a gunshot injury at the gluteal and upper thigh regions with an inlet at the right gluteal region and an exit at the left thigh. He had an open fracture of his left femur and a sciatic nerve injury at the site of exit point of the bullet. Initial debridement, external fixation of fracture femur, and protective colostomy were performed. Two days later, he had further debridement, cable sural nerve graft for the sciatic nerve, and flap coverage of the defect. The right gluteal defect was reconstructed with a rotation gluteus maximus muscle flap as a first layer and a PTP flap as a second layer on top. The left gluteal defect was also reconstructed with a rotation gluteus maximus flap and the IGAP flap on top. The patient had an uneventful recovery with 16 months follow-up.

Case 2 (Fig. 3)

A 28-year-old paraplegic man presented with bilateral ischial and sacral grade IV pressure sores. Debridement of the wounds, excision of bursae, and bone debridement were performed. Gluteus maximus rotation flaps were used for wound coverage followed by the left SGAP flap for reconstruction of the sacral defect and bilateral PTP flaps for reconstruction of ischial defects. The patient had an uneventful recovery during the follow-up period.

Case 3 (Fig. 4)

A 31-year-old paraplegic man presented with grade IV large sacral pressure sore. Bilateral gluteus maximus rotational flaps were performed to provide a first layer of coverage following wound debridement and excision of the bursae. The right PTP flap and the left SGAP flap were elevated and rotated to cover the defect. At the third postoperative day, the SGAP flap developed venous congestion at its distal half approximately. Removal of distal sutures of the flap was performed, and vacuum-assisted closure was applied for 12 days. The flap was salvaged and complete wound healing was achieved.

DISCUSSION

The reconstruction of complex soft tissue defects in the trunk is associated with a high rate of complications and recurrences, especially in pressure ulcer patients.[6,15,17] Factors behind those complications can be related to the deficient general condition of the patients or due to poor vascularization of the wound area. To eliminate those factors that can lead to an unwanted outcome, several measures can be performed. The first measure is to improve

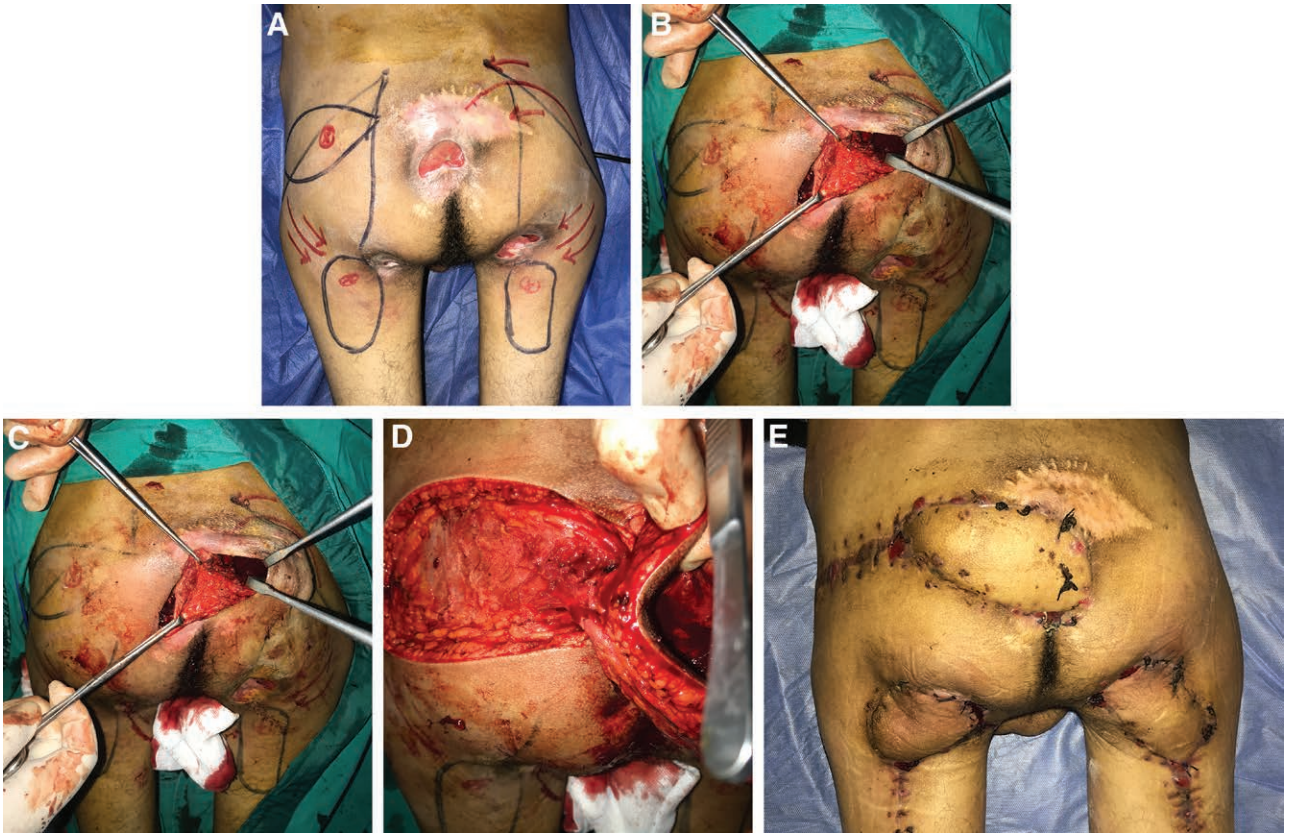

Fig. 3. Sacral and bilateral ischial pressure sores. A, The left SGAP flap is designed for reconstruction of the sacral sore and the PTP flap for the ischial sore. B and C, A gluteus maximus flap is elevated and rotated to the sacral defect to be sutured to the contralateral gluteus maximum muscle. D, The SGAP flap is elevated. E, Late postoperative view.

Fig. 4. A, An extensive grade IV sacral pressure sore. B, Reconstruction of the defect with PTP and SGAP flaps. C, Venous congestion in the distal half of the SGAP flap. D, Late postoperative view.

the patient's general condition by optimizing the nutrition and the other associated medical conditions like diabetes or other cardiovascular disorders.[18]

However, the problem concerning the impaired vascularity of the wound bed is difficult to handle. It is proposed that using muscle or myocutaneous flaps in reconstruction of these deep defects is associated with improved blood supply to the wound and consequently better healing.[19–21] In this case series, a solution based on a combination of 2 separate flaps to reconstruct the defect is described. The muscle flap is used to cover the wound bed followed by coverage with a freestyle propeller perforator-based fasciocutaneous flap as the outer covering to minimize the rate of recurrence of these defects. Borgognone et al[11] proposed a similar technique but used instead a gluteus maximus muscle splitting technique to cover the base of the defect, which is then followed by another flap to cover the muscle flap. However, muscle atrophy impairs the quality of the gluteus maximus muscle and makes the splitting technique difficult to be applied in the paraplegic/bedridden patients. Therefore, the technique proposed in this report is focused primarily on a large rotation of the gluteus muscle flap instead of rotation and splitting to reconstruct large defects in 2 layers. It allows more blood flow to the affected area for better control of infection and better quality of healing. Furthermore, the propeller perforator-based fasciocutaneous flap provides thick coverage of the defect. Consequently, after a certain period of time, the patient can sit on the reconstructed wound, and the scar is able to tolerate this kind of stress/pressure.

In the presented case series, only a few patients had complications such as venous congestion, wound dehiscence, and partial flap necrosis. The wounds were healed properly with no recurrence in the follow-up period.

However, a long-term follow-up of the patients is planned to verify the usefulness of this technique in the reconstruction of these soft tissue defects.

CONCLUSIONS

A freestyle perforator-based propeller flap combined with a gluteus maximus muscle rotation flap is an appropriate solution capable of providing increased padding over bony prominences, with a low complication rate. However, a long-term follow-up is needed to verify these results.

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