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Simple Pedicled Flaps for Complex Defects of the Head, Neck, and Lower Extremity

Ming H. Lee[1], Lauren M. Perry[2], Erik Reinertsen[3, 4], J. Brian Boyd[5], Jay W. Granzow[5]

[1]*Boston University School of Medicine, Department of Dermatology, Boston, MA.*

[2]*UC Davis Health, Department of Surgery, Sacramento, CA.*

[3]*Emory University School of Medicine, Atlanta, GA.*

[4]*Department of Biomedical Engineering, Georgia Institute of Technology, Atlanta, GA.*

[5]*UCLA Division of Plastic Surgery, Harbor-UCLA Medical Center and UCLA David Geffen School of Medicine, Los Angeles, CA.*

Abstract

Background: Free tissue transfers are among the most technically demanding methods of repair available to reconstructive surgeons. For the classical defects involving heel, head and neck, and distal lower extremity, free flaps are often considered to be first-line options primarily due to the unique anatomy and scarcity of adjacent tissue in these areas. Nevertheless, local flaps offer distinct advantages over free flaps. They provide simpler, quicker, and less resource-intensive solutions that require less rigorous post-operative monitoring. Furthermore, they also do not preclude the use of microsurgical flaps as a salvage option. In this article, we review the use of simple pedicled flaps as first line options for complex defects of the heel, head and neck, and distal lower extremity.

Methods: A comprehensive review of the literature was performed utilizing both modern surgical texts as well as peer-reviewed journal articles to assess and summarize the key features of modern operative techniques utilized for defects in these anatomic locations.

Results: While many sources acknowledge that free-tissue transfers are often employed as first choice for these defects, there is an abundance of emerging literature supporting the use of simple pedicled flap repairs over free tissue transfers.

Conclusions: The preponderance in favorable outcomes reported in the literature in conjunction with the practical benefits afforded to patients argues in favor of simple pedicled flap repairs as a viable first-line option for many difficult anatomic defects previously thought to be solely the domain of microvascular surgery.

Keywords: *Bipedicled Flap; Supraclavicular Artery Island Flap; SCAIF; Head and Neck Reconstruction; Medial Plantar Flap; Heel Reconstruction.*

Introduction

Free tissue transfers are among the most technically demanding methods of reconstruction and therefore reside at the top of the reconstructive ladder [1, 2]. Despite their complexity, advances in microsurgical training and technique have greatly expanded the use of free flaps in modern reconstructive surgery. In many situations, free tissue transfers have become the first-line method of repair in reconstruction of the head and neck, distal extremity, and breast. Although techniques requiring advanced microsurgery are more broadly available than before, local regional flaps still offer distinct benefits for patients. These include less operating room time and complexity, less extensive post-operative monitoring, and preservation of free flap donor sites. Improvements in surgical technique, execution, and anatomic understanding have played a critical role in this emerging trend. For all flaps, bleeding typically is minimal. For these reasons, we have adopted the following pedicled flaps as first-line options on our microsurgery service, relegating our microsurgery expertise to a second-line role in these select cases. In this article, we review the use of local flaps as a first-line option for reconstruction of the distal lower extremity, heel, and head and neck.

***Address for Correspondence:** Dr. Jay W. Granzow, M.D., M.P.H., F.A.C.S, Division of Plastic and Reconstructive Surgery, Department of Surgery, Harbor-UCLA Medical Center, 1000 W. Carson Street, Box 25, Torrance, CA 90509, USA. Tel: (310) 222-2760; Fax: (310) 782-1562; Email: DrJay@PlasticSurgery.LA*

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Bipedicled Flaps for Lower-Extremity Reconstruction

Open wounds of the middle and distal third of the lower-extremity with exposed bone, tendon or hardware present particularly difficult technical challenges. The lack of sufficient adjacent soft tissue limits options for pedicled flaps and often makes free flaps a first-line option [3]. However, local bipedicled flaps are an excellent first-line option in selected cases.

The use of a bipedicled flap for lower extremity defects was first described by Crawford in 1957 and initially presented as an alternate approach to the cross-leg and tubed pedicle flaps [4]. Our current technique has been described in detail previously [5]. The flaps are raised using adjacent skin and underlying fascia on one or both sides of a defect. The flap width is usually 5 cm or more.

The technique lends itself best to long, narrow defects with relatively healthy adjacent skin and soft tissue. Flap elevation tends to be fast and easy, and skin grafts are used to cover the adjacent donor site defects [5-7]. Bipedicled flaps are useful for treating lower extremity defects, but may have limited mobility [8]. Additionally, these flaps require large amounts of intact skin and underlying subcutaneous tissue to permit flap mobilization, and may not be a viable option in the case of severe and diffuse traumatic injuries [5]. Nevertheless, bipedicled flaps can still be attempted in these situations, with more advanced modalities as alternatives if the initial bipedicled flap fails.

Despite the advantages of bipedicled flaps over free flaps, this procedure is not commonly described in the literature. As a result, this relatively simple technique is often ignored in lieu of more complex surgical methods. The procedure is versatile, having demonstrated efficacy in the repair of defects overlying the Achilles tendon and burn contractures in the knee and ankle [9, 10]. These studies reported thirty-six cases, with seven minor complications and two major complications. Of these patients, only one required further operative management in the form of an additional flap [5, 6, 11, 12]. A simple operative technique, good long-term results and the relatively low rate of short-term complications for this procedure make the bipedicled flap is an excellent first-line option for selected lower extremity defects [Figures 1 and 2].

Figure 1a

Figure 1b

Figure 1c

Figure 1d

Figure 1e

Figure 1f

Figure 1: A 51-year-old male status post motor vehicle accident with open tibia-fibula fracture status post open reduction and internal fixation with intramedullary nail and antibiotic methylmethacrylate spacer placement. Open wound present over distal third of lower leg with bone and spacer exposed with partial degloving of adjacent soft tissue.Two 5-cm wide bipedicled flaps were elevated and advanced with skin grafts placed on donor sites. Coverage was achieved with uneventful postoperative course.

Figure 2a

Figure 2b

Figure 2: A 53-year-old male with left sided open femur and tibia fractures after being struck by a motor vehicle. The fractures were treated with open reduction and internal fixation.An open wound of the proximal tibia (approximately 8 cm by 5cm) was covered with a single 10cm by 7 cm bipedicled flap. The patient's postoperative course was uncomplicated and his wound healed uneventfully.

Medial Plantar Flap for Heel Reconstruction

Reconstruction of the heel is particularly challenging. The heel possesses a thick epidermis with minimal underlying subcutaneous tissue, and bears 50-80% of the body's weight [13-16]. Sensation on the heel and plantar foot are critical, although the exact role and necessity of sensation in this area is controversial [13, 14, 17-19]. Numerous techniques have been described for the repair of heel defects, including skin grafts, muscle flaps, septocutaneous flaps, axial flaps, and free flaps [20-29]. Various iterations of cross-leg flaps have also been described in the literature [30-33]. Although several strategies have been proposed to address this reconstructive challenge, the long-term viability of many of these interventions has been limited [34]. Skin grafts have notoriously failed in the repair of these defects, likely dueto repeated shear stress and abrasion [13, 19].

Techniques utilizing free tissue transfer have yielded successful results and are generally considered first line [13, 35-38]. While free flaps are often employed to repair heel defects, there are several important limitations to consider. First, functional results have been poor due to: pain; inability to wear shoes; the requirement for assistive devices, and gait difficulties [39]. Furthermore, there have been several reports of recurrent ulceration of free flaps when transferred to weight bearing areas of the feet [19, 40-42]. Although several factors play a role in the etiology of foot ulcers, lack of protective sensation is believed to be significant [13, 42, 43].

The medial plantar flap is an innervated fasciocutaneous pedicled flap based on the medial plantar artery, and was initially introduced by Shanahan and Gingrass in 1979 [13, 32, 44]. The flap is harvested with a branch of the medial plantar nerve that supplies sensation to the region, thereby preserving protective sensation to the reconstructed area [13]. Once elevated, the flap is transposed posteriorly to cover the heel [Figure 3]. Since the procedure was first introduced, several advances have significantly enhanced its utility and broadened its applications [45-49].

Figure 3a

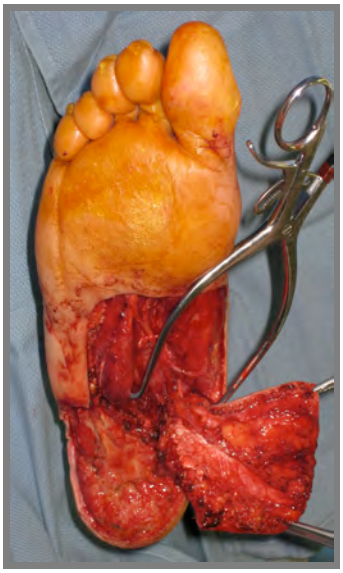

Figure 3b

Figure 3c

Figure 3: A 47-year-old male status post wide local resection for heel melanoma with exposed tendon and calcaneus. Initial defect and flap markings for an innervated medial plantar flap (3A), flap elevation (3B) and healed flap with skin grafted donor site (3C).

The innervated medial plantar flap may bea more optimal approach for repairing defects of the heel, as it causes little morbidity to the adjacent donor site. This flap also preserves sensation, which may play a critical role in short-term flap survival and ultimate longevity. We have shown the flap sensation to be equivalent to instep donor site and superior to the sensation in the opposite, unaffected heel [13]. Due to its preserved innervation and sparing of distant donor sites, we find themedial plantar flapto be superior to free flaps and other methods for repairs of the heel.

Supraclavicular Artery Island Flap (SCAIF) for Head and Neck Reconstruction

Free tissue transfers are generally considered the first-line approach for repairing complex defects of the head and neck [50]. Like all free flaps, these flaps require advanced microsurgical training, intensive postoperative care, recipient vessels that can accommodate the flap, and a patient that is a candidate for major surgery [51]. Local tissue transfers often fail to provide adequate surface area, and regional muscle flap scan be bulky and unwieldy [51]. For example, the pectoralis flap, a commonly employed pedicled flap in head and neck defects, has limited application due to its short reach and excessive thickness, and generally has poorer outcomes when compared to free flaps [52].

The use of fasciocutaneous flaps based on the supraclavicular artery has experienced renewed interest in recent years. The SCAIF flap is raised as a fasciocutaneous flap based on the supraclavicular artery, a branch of the transverse cervical artery, which has a consistent anatomic course. Flaps are typically 5-8cm wide and 25cm or more long, although larger viable flaps may be taken with excellent flap viability [53]. We have found the flaps to have comparable outcomes, shorter operative time, lower ICU stays, and no need for postoperative monitoring when compared with comparable free flaps [Figure 4] [53].

Figure 4a

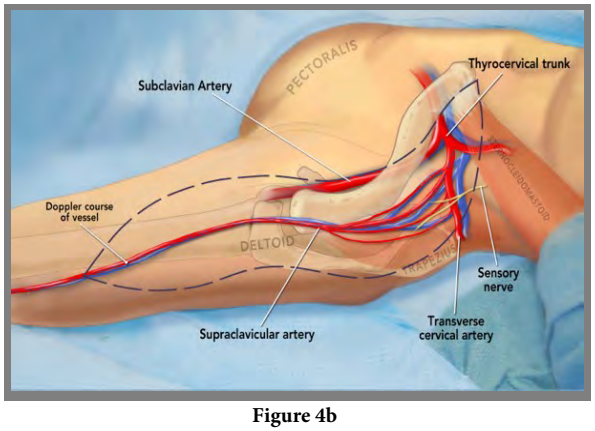

Figure 4b

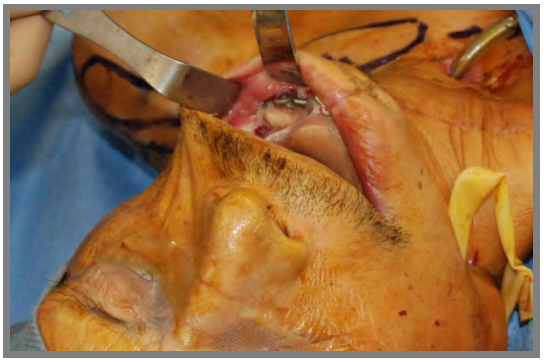

Figure 4c

Figure 4d

Figure 4e

Figure 4f

Fig 4g.

Figure 4: This figure depicts a patient who had previously undergone fibula free flap reconstruction for intraoral and mandibular defects and pedicled Pectoralis major flap for external skin coverage by another team. The preoperative marking (4A) and schematic (4B) are depicted here. Note the exposed plate at anterior aspect of intraoral wound (4C), the flap after elevation (4D), flap tunneling (4E), and flap inset (4F).Figure 4G represents postoperative views of this patient. Note the differences the donor and recipient sites between the right-sided Pectoralis major flap and left-sided SCAIF (4G) [51].

Although such flaps have been described rarely in literature for several decades, their versatility as well as our anatomic understanding of these flaps have evolved considerably [54-64]. Some authors have even reported transitioning away from free fasciocutaneous flaps to using the pedicled supraclavicular artery island flap (SCAIF) as a first-line option [53, 65]. Authors supporting this notion describe the successful implementation of SCAIFs in a variety of reconstructive contexts including the tongue, floor of the mouth, pharynx, face, and retrosternal esophagus [53], with additional literature suggesting even broader applications [54, 65-74]. Currently, several variations of this flap have been described in the literature and have been successfully employed in a variety of contexts, including repair of contractures [51, 63, 75-80]. Some authors assert that it may become the "gold standard" for soft tissue defects of the head and neck [81]. SCAIFs boast impressive versatility, yet also result in comparable outcomes and rates of complication when compared to free flaps [51, 82, 83].

SCAIF flaps may not provide sufficient volume for reconstruction of a total glossectomy, although it is likely to be sufficient for a hemiglossectomy [51]. Additionally, SCAIF flaps are contraindicated in cases of a radical or functional neck dissection necessitating ligation of the vascular pedicle, or in cases of vascular insufficiency demonstrated on angiogram [51, 73].

Conclusion

Pedicled flaps possess several advantages to free flaps, including a simpler harvest, shorter procedure and recovery times, and no requirement for microsurgical expertise, equipment and postoperative monitoring and resources. Limitations include limited reach and a requirement for intact adjacent tissue and vessels. We strongly encourage a re-evaluation of pedicled flaps as a first-line option for the repair of heel, head and neck, and distal lower extremity defects, even when microsurgical options are available.

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