

FREE FLAP: IMPORTANT TOOL FOR LOWER EXTREMITY RECONSTRUCTIONAravind L. Rao¹, Deepa V. Kanagal²**HOW TO CITE THIS ARTICLE:**

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ABSTRACT: INTRODUCTION: Reconstruction of lower 3rd of extremity poses great challenge to reconstructive surgeon. Free flap coverage brings a striking difference in lower limb salvage. Lower extremity defects can be managed by direct closure, skin grafting, local flaps, cross leg flap and free flap. The versatility of free flaps in covering a defect of any size irrespective of their locality keeps them in the top rung of the reconstructive ladder. **MATERIALS AND METHODS:** We present a retrospective study of 12 patients who underwent free flap reconstruction for lower extremity defects between august 2012 to June 2014. Different flaps were chosen based on the size and location of the defect. Radial forearm flap was done in 6 patients, anterolateral thigh flap in 4, latissimus dorsi flap in 1 and free fibula flap in 1 patient with a success rate of 91.6%. **CONCLUSION:** Free flap is the most cost effective and stable solution for lower extremity reconstruction. It is the best solution to manage large defects. They play a major role in limb salvage. In spite of the steep learning curve, practicing micro surgical principles can save a limb and influence the life of the person in a positive way.

KEYWORDS: Free flap, Lower extremity reconstruction, Perforator flaps.

INTRODUCTION: Lower extremity reconstruction in the lower third of leg, ankle and foot poses a challenge many at times for the reconstructive surgeon. Among the methods for reconstructing defects of the lower extremities, there are direct closure, skin grafting, and local flaps including the muscle flap, cross-leg flap and free flap.^[1]The anatomic variations of the area and the lack of suitable local flaps, especially when dealing with larger defects cause difficulties in satisfactory reconstruction.

The cross leg flap limits the mobility of the patient for a long time causing inconvenience to the patient. Also, it requires a second stage surgery for division of the flap. Therefore, free flap is a useful option and an effective method for lower extremity reconstruction. It is advantageous that the flap itself has good vascularity, can be used for defects of any size and site and satisfactory cosmetic outcome can be achieved with proper flap selection.

MATERIALS AND METHODS: This retrospective review involves study of 12 patients undergoing free flap reconstruction for various lower extremity defects from august 2012 to june 2014. Patient demographic data, medical histories, co morbidities like diabetes, hypertension, peripheral vascular diseases, surgical indications, defect characteristics and locations, hospitalization, complications and follow-up were evaluated and are presented as uncontrolled case series. All patients underwent arterial Doppler of lower limbs to evaluate the status of vessels. The recipient vessels chosen for anastomosis were away from the zone of injury.

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RESULTS:

DEMOGRAPHIC DETAILS: 12 patients had free flaps for reconstruction of lower extremity defects. Among them, 8 were males and 4 were females. 6 patients had diabetes mellitus and 2 of them had hypertension. Two of the subjects had both diabetes and hypertension.

CAUSES OF DEFECTS: In our Study, causative factors included road traffic accidents in 6 patients, diabetic soft tissue infection in 3 subjects, skin malignancy in 2 patients, and below knee amputation stump wound dehiscence in one patient.

SITES OF DEFECTS: The sites of the defect included the dorsal aspect of the foot in 5, heel in 4 patients, and medial aspect of ankle in 2 of them and below knee amputation stump in 1 patient.

TYPES OF FREE FLAP: The type of free flap was designed based on the size of the soft tissue defect, location and characteristics and associated bone defects. Radial forearm flap was done in 6 patients, antero lateral thigh flap in 4, latissimus dorsi flap in 1 of them and free fibula flap in 1 patient. (Figures 1, 2, 3 and 4).

SUCCESS RATE: Out of 12 free flaps, 11 survived and reconstructive goals could be achieved. (Success rate 91.6%) There was flap loss in one patient due to venous obstruction on the third day. The raw area was skin grafted after formation of granulation tissue after vacuum therapy.

VASCULAR ANASTOMOSIS: Posterior tibial artery and accompanying vein were used for anastomosis of donor vessels of the free flap in 8 patients and anterior tibial artery and accompanying vein was used in remaining 4 patients. Single vein anastomosis was done in all the patients in our study. Superficial venous system was not used for anastomosis in any of the free flaps and all the anastomosis were end-to-end type only. The summary of the procedure and outcome is shown in table 1.

DISCUSSION: The primary goal of lower extremity reconstruction is to recover its function and maintain it, for which skeletal reconstruction with stable soft-tissue coverage is essential.^[2] Local flap options for reconstruction of lower extremity defects are less in distal 3rd of the leg. Adjacent area may be involved in the zone of injury, skin and subcutaneous tissue may be avulsed by injury, and muscles may be contused with injury to their vascular pedicle. Local flaps and distally based flaps may have high risk of flap necrosis. Whenever there is complete degloving of dorsal aspect of foot, the dimensions of local flap may not suffice to cover the defect.

Musculocutaneous flaps lead to loss of function of the particular muscle.^[3] Free flaps can be tailored to suit massive or irregular skin defects, whereas the design of a pedicled flap tends to be limited by the local anatomy and availability of skin and wound orientation.^[4]

Local flaps can leave a significant cosmetic defect relating to the donor site, which may be difficult to camouflage.^[4] The distally based sural nerve flap is frequently used for the reconstruction of the distal third of the leg, ankle, and heel because of its simplicity, versatility, low cost, and minimal donor site morbidity.^[5] Though the success rate of the sural flap is high if the peroneal artery is patent, when the soft-tissue defect is located at the dorsum of the metatarsophalangeal joint, distal

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marginal necrosis of the flap usually occurs, which is the exact part of the flap that one needs the most.^[5]

Cross-leg flap is another alternative for reconstruction of lower third defects of the leg. Major problems associated with cross-leg flaps are immobility of the patient for a long span of 3 weeks, long-term admission in the hospital, and discomfort to the patient due to fixation of both legs in uncomfortable position by external fixators or adhesive bandages. Free flaps would be the ideal treatment for patients with severe lower extremity injuries.

However, relative contraindications of free flap include electrical burns, single vessel limb, delayed referral, and in patients after bone tumor resection that had radiotherapy.^[6] Free flap cannot be used in patients with major lower extremity injury with axial vessel damage and a history of previous trauma and thrombosis of blood vessels. In pediatric age group, it is fraught with technical difficulties. In these situations, the cross-leg fasciocutaneous flap can be a good alternative to reconstruct the defects.^[6]

The field of reconstructive surgery has taken a significant leap forward with the introduction of perforator flaps.^[7] This has been made possible with the development of knowledge in vascular anatomy and cutaneous circulation.^[8] It is ideal for reconstruction of small-to-medium size defects of distal leg and ankle region with good cosmetic, excellent color and thickness match.^[7] However, there are no studies to define the safe limit of the perforator flap in lower extremity.^[3]

One of the disadvantages of local perforator flap is that they are raised within the zone of injury, which may leave part of the flap with a potentially impaired perfusion.^[9] They have a limited role in large defects. Closing the open fractures with free muscle flaps prevent infection and has positive effect on bone healing due to increased vascularity. The most important factor, which affects the result in a positive way, is closing the open fractures with free muscle flaps before the formation of bacterial colonization.^[10]

In cases of larger- sized defects, it would be appropriate to use a free muscle flap regardless of the defect site; the latissimus dorsi muscle, the rectus abdominis muscle, and the serratus anterior muscle being the ones primarily used.^[2] We have used latissimus dorsi free flap in one of our patients who had a raw area over whole of dorsum foot and exposed metatarsals. We could cover a large area with this muscle and skin grafting was done over that. Patient had developed wound infection and graft loss, subsequently requiring skin grafting again.

All the 4 patients on whom free anterolateral thigh flap was done underwent flap-debulking procedure. Radial forearm free flap done for 6 patients needed no more flap debulking procedure. All donor area healed without any problem. 10 patients on whom free flaps were used for reconstruction are ambulant and have resumed their normal work. One patient with below knee amputation for which free radial forearm flap was done is leading a sedentary life. Another patient where free latissimus dorsi flap was done had to change his profession due to loss of 3 toes in the accident.

CONCLUSION: Free tissue transfer has a definite role in lower limb reconstruction, especially in patients with large defects. Free flap is the best solution to deal with large defects over the sole and dorsal aspect of the foot, till today. Whatever may be the size of the defect irrespective of its site; free flaps can cover the defect successfully and salvage the limb. Functional outcome of the salvaged limb is far better than the best available limb prosthesis.

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Even though free tissue transfer has a steep learning curve, it is really worth learning and practicing micro-surgical principles to save a person's limb and influence his life in a positive way.

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Fig. 1: Radial forearm free flap done to cover post oncological resection of squamous cell carcinoma over heel of foot with 6 months follow up.



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Figure 1

Fig. 2: Free latissimus dorsi muscle flap done to resurface whole of dorsal aspect of foot with skin graft over it.



Figure 2

Fig. 3: Exposed bone and joint over ankle covered by radial forearm flap and skin graft with 3 months follow up.



Figure 3

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Fig. 4: Anterolateral thigh free flap done to cover lateral border of foot and a part of sole.



Figure 4

Serial No.	Age/Sex	Causes for defect	Site	Free Flap	Recipient vessels	Complications	Result
1.	42/male	RTA	Dorsum foot	LD muscle flap	PTA and Vein	Wound infection	Success
2.	52/female	Diabetic foot	Heel	ALT	PTA and Vein		Success
3.	32/male	RTA	Dorsum foot	RF	ATA and Vein		Success
4.	22/male	RTA	Medial aspect of ankle	RF	PTA and Vein	Loss of flap on 3rd day	Skin graft after vacuum dressing
5.	48/female	Post onco resection	Heel	ALT	PTA and Vein		Success
6.	68/male		B/k Stump	RF	PTA and Vein		Success
7.	38/female	RTA	Dorsum foot	Fibula free flap	ATA and Vein		Success
8.	48/male	Diabetic foot	Heel	ALT	PTA and Vein	Wound infection	Success
9.	41/female	RTA	Medial aspect of ankle	RF	PTA and Vein		Success
10.	36/male	Post onco resection	Heel	ALT	PTA and Vein		Success
11.	29/male	RTA	Dorsum foot	RF	ATA and Vein	Small ulcer-treated by graft	Success
12.	38/male	Diabetic foot	Dorsum foot	RF	ATA and Vein		Success

Table 1 Patient Summary

RTA—Road traffic accident, LD—Latissimus Dorsi, RF—Radial forearm, ALT—Anterolateral Thigh, ATA—Anterior tibial artery, PTA—Posterior tibial artery.

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