

Lower Extremity Reconstruction: 5 Years of Clinical Experience

Alt ekstremitenin Rekonstruksiyonu; 5 Yıllık Klinik Deneyimimiz

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Abstract

Aim: Management of lower extremity soft tissue defects, which are encountered due to many reasons is quite difficult. The use of the reconstructive ladder and elevator directs to the appropriate reconstruction method for these defects.

Materials and methods: We retrospectively evaluated 162 patients with lower extremity defects treated in our clinic between 2014 and 2019. The patients were evaluated according to age, gender, accompanying morbidity factors, defect location, etiology, reconstruction method, complication and secondary reconstruction methods.

Results: Of the patients 48 were female and 114 were male. The age range was between 5 and 91. The most common etiology of the defects was trauma. The most common defect site was in foot and leg. The most commonly preferred reconstruction method was skin grafts, followed by free flaps. The failure rate of all reconstructions was 11%.

Conclusion: Reconstruction of lower extremity defects with free or perforator flaps is a reliable and effective method.

Keywords: Lower extremity reconstruction; free flap; perforator flap

Öz

Amaç: Birçok nedene bağlı olarak karşılaşılan alt ekstremitte yumuşak doku defektlerinin tedavisi oldukça zordur. Rekonstrüksiyon merdiveni ve asansörünün kullanımı defektin yerine uygun rekonstrüksiyon yöntemine yönlendirir.

Gereç ve yöntemler: Kliniğimizde 2014-2019 yılları arasında tedavi edilen 162 alt ekstremitte defektli hasta retrospektif olarak değerlendirildi. Hastalar yaş, cinsiyet, eşlik eden morbidite faktörleri, defekt yerleşim yeri, etiyoloji, rekonstrüksiyon yöntemi, komplikasyon ve ikincil rekonstrüksiyon yöntemlerine göre karşılaştırıldı.

Bulgular: Hastaların 48'i kadın, 114'ü erkekti. Yaş aralığı 5 ile 91 arasındaydı. Defektlerin en sık etiyolojisi travmaydı. En sık görülen defekt bölgesi ayak ve bacakta idi. En sık tercih edilen rekonstrüksiyon yöntemi cilt greftleri idi, bunu serbest flepler izliyordu. Tüm onarımların başarısızlık oranı %11 olarak izlendi.

Sonuç: Alt ekstremitte defektlerinin serbest veya perforator flep ile rekonstrüksiyonu güvenilir ve etkili bir yöntemdir.

Anahtar sözcükler: Alt ekstremitte rekonstrüksiyonu; serbest flep; perforatör flep

Introduction

Lower extremity defects' etiology includes many factors such as trauma, malignancy, osteomyelitis, soft tissue infection, vasculopathy, diabetes and burn. It requires a multidisciplinary approach due to accompanying osseous pathologies, metabolic problems or infectious factors. The ultimate goals in defect repair are ambulation, restoration of motor-sensory functions, optimal aesthetic appearance, and prevention of infection that may develop due to open wounds. While choosing the reconstruction method, general condition of the patient, comorbidities, location of the defect, presence of accompanying bone defect or infection should be considered. If a flap is planned, the suitability of the donor site should be considered as well (1,2).

One of the main causes of complicated wound formation is trauma. There are studies showing that the complication rate is higher in trauma-induced reconstructions (3,4) The location of the defect creates also some obstacles in terms of repair. In particular, presence of thin skin on the distal legs and feet, and presence of thin subcutaneous tissue reduce repair options. In addition, causes such as terminal artery vascularization, venous return which is positional relatively difficult, and body weight bearing complicate the repair.

Recent studies have shown that there is no significant difference between fasciocutaneous flaps and muscular flaps in terms of preventing infection and filling dead space (4-6). With continued improvement in microsurgical techniques and equipments, free fasciocutaneous or musculocutaneous tissue transfers have become more feasible (6). There are studies showing that, a free flap with perfusion problem decreases in patients undergoing revision surgery within 48 hours (5). In postoperative period, care should be taken in terms of coagulopathic conditions that may lead to hematoma or bleeding in order to reduce complications, especially in the lower extremities (6).

In the last two decades, with a better understanding of vascular physiology and technical developments, perforator flaps have become a popular reconstruction method for lower extremity defects (4). It causes minimal donor site morbidity, due to the preservation of deep fascia and underlying structures. The main advantages of this method are: It can be performed in a single stage; does not require intraoperative position change; supports bone healing and can be easily reexplored for secondary procedures (7). Despite all these improvements, repair of lower extremity defects still poses a challenge for reconstruction surgeons.

The aim of this study is to transfer our clinical experience in the light of all this information and developments in lower extremity reconstruction cases in the last five years.

Material and Methods

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards. Institutional review board approval (University of Health Sciences, Sisli Hamidiye Etfal Training and Research Hospital Ethical Committee for Clinical Research, no.2674) was obtained prior to conducting this prospective study. Patients who were hospitalized for lower extremity defects and reconstructed in the plastic and reconstructive surgery clinic between January 2014 and December 2019 were included in this study. The patients were evaluated according to age, gender, comorbidities, defect location, etiology, reconstruction method, complication and secondary reconstruction methods. Fasciotomy defects, amputation cases, and primary sutured lesion excision cases were excluded from this study.

Serial debridement and if necessary, negative pressure wound closure (NPWT) treatment were applied to dirty wounds before the closure operation. In order to evaluate distant spread in malignancy cases, scans were made with whole body imaging methods, and reconstruction was performed in patients without distant metastasis. In the presence of lymph node metastasis, regional lymph node dissection was performed.

The reconstruction method to be preferred in lower extremity reconstruction was determined according to the location and characteristics of the defect area (Figure 1).

While skin grafting is generally preferred in cases with only skin defects, many elements of the reconstructive ladder, from local flaps to free flaps, are used in composite defects with vital structures or plate-screw exposure. In the reconstruction with free flap, the patient's accompanying chronic diseases and comorbidities such as diabetes and hypertension, as well as arterial and venous insufficiency in the donor and recipient areas were taken into account. Preoperative vascular status was evaluated with either contrast-enhanced computed angiography or lower extremity Doppler ultrasound. In cases where free flap reconstruction was not preferred; local flaps, muscle flaps, perforator flaps or skin grafts were preferred. In perforator flap choice, the presence of a suitable perforator was evaluated in addition to flap geometry. Before the operation, the perforators were determined with a handheld doppler

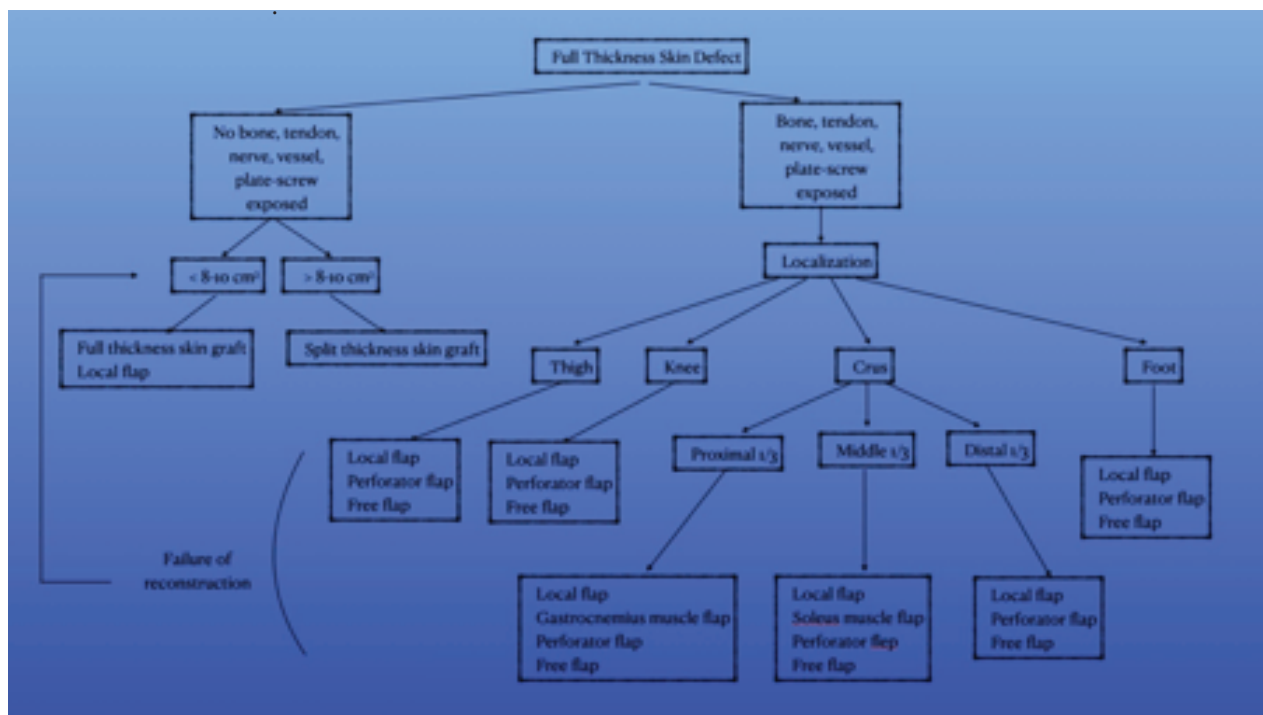


Figure 1. The preferred reconstruction algorithm for lower extremity reconstruction.

Results

A total of 162 patients, 48 women (29.6%) and 114 men (70%), were included in this study. The mean age of the patients was 48.1 (range: 5-91). Defect etiologies included trauma (56%), diabetes mellitus (14%), infection (9%), vascular insufficiency (8%), tumor (7%), burn (3%), hidradenitis suppurativa (0.6%). Defect localization was observed equally on the right and left side (47.5% and 47.5%), 5% of the defects were bilateral. 41% of the defects were located in the foot, 41% in the crus, 13% in the thigh and 4% in the knee (Table 1). Skin grafts accounted for the majority (52%) of the reconstruction (Table 2).

Table 1. Demographic characteristics of patients

	Sample Size	Percentage
Age		
<19	16	9,8
20-45	53	32,7
>45	93	57,4
Gender		
Female	48	29,6
Male	114	70,3
Etiologies		
Post-traumatic	92	56,7
Diabetes	23	14,1
Infectious	15	9,2
Vascular Insufficiency	13	8,0
Oncologic resection	12	7,4
Burn injury	6	3,7
Hidradenitis suppurativa	1	0,6
Location of Defects		
Thigh	22	13,5
Knee	7	4,3
Leg	68	41,9
Foot	68	41,9

Table 2. Reconstruction methods

Location of Defects	Skin Grafts	Free Flaps	Perforator Flaps	Regional Flaps	Distant Flaps
Thigh	11	1		12	
Knee	3	1		2	1
Leg	35	13	3	13	4
proximal third	8			3	
middle third	25	4		8	2
distal third	2	9	3	2	2
Foot	42	6		23	1

Among the reconstruction methods, the most preferred free flaps (11%) are anterolateral thigh flap (4%), latissimus dorsi muscle skin flap (3%), vastus lateralis muscle flap (3%), transverse rectus abdominis muscle flap (0.6%) and radial forearm flap (0.6%). Amongst the perforator flaps (3%), pedicled anterolateral thigh flap, medial plantar flap and peroneal artery perforator flap were used. In addition, sural flap and cross leg flap were among the regional flaps (2.4%). Figures 2-5 show some follow-up patients.

The failure rate of all reconstructions was 11%. Failure causes were recurrence of the underlying vascular disease, thrombosis, hematoma or infection. Failure of free and perforator flaps developed due to thrombosis in seven cases, infection in two cases and hematoma in three cases (Table 3). Salvage flaps were free transverse rectus abdominis muscular (TRAM) flap or free anterolateral thigh (ALT) flap in two cases. No

complications were observed in salvage free flap reconstructions of 4 patients. In other failed cases, the defects were closed by local flaps and grafts.

Table 3. Complications

No.	Location of Defects	First operation	Complication	Salvage Operation
1	Distal third leg	MSAP	Thrombosis	Free ALT
2	Distal third leg	Free LD	Thrombosis	Local flap + Graft
3	Distal third leg	Free ALT	Thrombosis	Local flap + Graft
4	Middle third leg	Free LD	Thrombosis	Free TRAM
5	Thigh	Free ALT	Thrombosis	Local flap + Graft
6	Foot	Free TRAM	Thrombosis	Local flap + Graft
7	Distal third leg	Perforator	Hematoma	Free ALT
8	Distal third leg	Free VL	Hematoma	Local flap + Graft
9	Middle third leg	Free LD	Hematoma	Free TRAM
10	Foot	Free VL	Partial necrosis, Infection	Local flap + Graft

MSAP, medial sural artery perforator flap; LD, latissimus dorsi musculocutaneous flap; ALT, anterolateral thigh flap; TRAM, transverse rectus myocutaneous flap; VL, vastus lateralis muscle flap



Figure 2. Trauma-induced left foot tissue defect (a) was reconstructed with a free vastus lateralis flap (b). Tissue compatibility is seen after thinning operation (c).



Figure 3. Trauma-induced right ankle tissue defect (a) was reconstructed with a free anterolateral thigh flap (b). Post-operative sixth month image (c) is shown.

Discussion

Defects of the lower extremities are encountered due to many reasons such as trauma, tumors, diabetes, and vascular diseases. In this research, trauma was the most common etiological cause. Macedo et al. mentioned that traffic jam in big cities and increased motorcycle use led to an increase in the etiology of trauma (3). The fact that traffic accidents and industrial accidents are the most common causes of trauma; implies an important message in terms of the preventability of these situations. Most of the defects require a multidisciplinary approach according to the formation mechanism. Very large defects can occur after a tumor resection with safe surgical margins or high energy traumas such as motor vehicle accidents, gunshot wounds. Preoperative and postoperative wound care and, protection from infection are important. Eisenschenk et al. stated that taking a preoperative culture from the wound may be beneficial for antibiotic therapy administering (1). However, since the effective debridement before reconstruction will

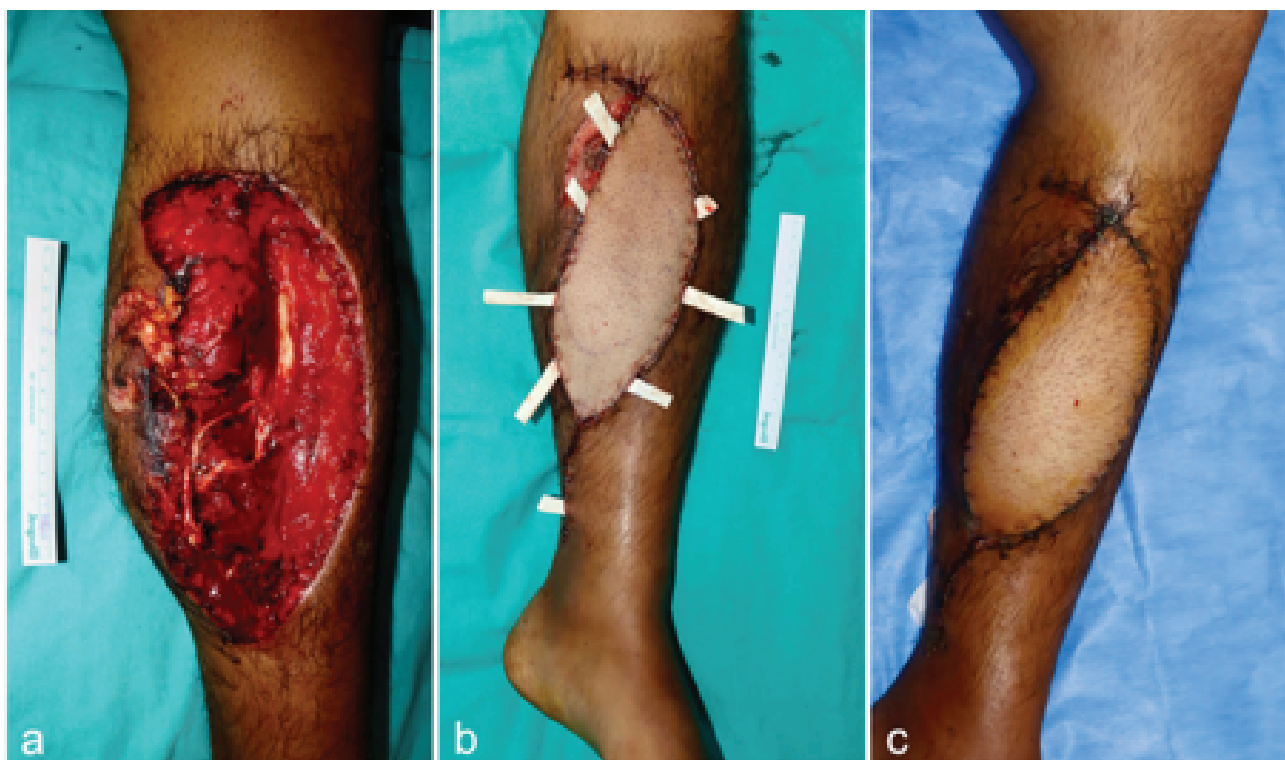


Figure 4. Left crus defect (a) due to gunshot injury was reconstructed with a free anterolateral thigh flap (b). Post-operative second week image (c) is shown.



Figure 5. Preoperative (a) and second year image of the patient with left diabetic foot after reconstruction with partial thickness skin graft (b)

seriously reduce the microorganism load, the choice of antibiotic therapy should not be aggressive. Clinical parameters of the patient should also be considered in antibiotic choice. In the same study, it was concluded that when vascular disease is predicted preoperatively, vascular imaging with contrast material would be great beneficial (8). And in the presence of stenotic condition vasculoplasty would be great beneficial as well. However, cost of imaging methods and their applicability in each center are also a subject of discussion.

The localization of the defect is one of the most important parameters that determine the treatment option. In the light of our classical knowledge, for lower third of crus and ankle defects reconstruction with free flaps is performed. Because of insufficiency of existing local tissue and width of defect (8,9). With more understanding of perforator flap physiology, perforator flaps become reliable and successful method for lower third of crus and ankle defects (10). Although superiority of treatment methods or flaps was not compared in this study, the study is beneficial. Because this study is giving an idea about patients, complication management and epidemiological profile.

The reconstruction method was chosen according to condition of defect and donor area. Although various surgical techniques are developed, the most frequently used treatment method was skin grafts. Skin grafts were used especially after evaluating the patient's existing comorbidities, operation time, patient compliance and suitability of the defect or in cases where free tissue transfer methods failed. According to many studies, free tissue transfers' and perforator flaps' success rate are affected by patient's unpredictable vasculopathic conditions and accompanying trauma (10-12). Similarly, in our study, these unpredictable vasculopathic conditions and effects of accompanying trauma reduced the success rate of our free and perforator flaps.

Since partial necrosis and minimal hematoma may result in permanent wound infection, chronic wounds or delayed physical therapy; local debridement of possible cases and graft adaptation should be considered (6,10-12). For our failed flaps, the defect was closed by skin grafts, after preparing the appropriate ground.

Conclusions

In lower extremity reconstruction, the repair method should be chosen by adhering to the general principles and evaluating the patient's current comorbidities, operation time, patient compliance and suitability of the defect. In appropriate cases, free tissue transfers in the upper step of the reconstruction

adder can be applied as the first reconstructive option with the contribution of developing microsurgical methods.

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