Lower Leg Flaps Comparison Between Free Versus Local Flaps

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Abstract

Background: In lower leg defects with bone, hardware, or articular joint exposure, a free tissue transfer is often the only valuable option. However, in well-selected clinical cases,
local flaps are still indicated because they provide an alternative for the more demanding
and risky microsurgical procedure.

Methods: Twenty-six muscle flaps (performed in 26 patients) were reviewed retrospectively and compared with a series of 24 free flaps (23 patients) for lower leg reconstruction of almost similar indications. All patients with defects less than 25 cm2, peripheral vascular disease, deep defects, and osteomyelitis were excluded in order to obtain the same surgical indications .Also excluded were cases which needed split skin graft.

Results: The overall surgical results were comparable, but more medical complications, a longer operative time, and a longer hospital stay were seen in the free muscle group.

Conclusions: Free flap coverage is not mandatory to cover bone in the lower leg. The non-free flap can provide a good alternative for free flap coverage. This flap seems to have fewer medical complications, requires a shorter operative time and hospital stay, and can provide better aesthetic results than a free muscle flap depending upon selection of cases.

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INTRODUCTION

Whenever bone, osteo-synthesis material, or tendons are exposed in the lower leg, the reconstructive procedure will be a challenge for the reconstructive surgeon. Because of the lack of available local soft tissue, the middle and distal thirds of the lower leg are the most problematic areas.

Free flaps are the first choice procedure to manage soft-tissue defect of the lower limb for
many authors, but loco-regional flaps are an alternative since they were described in the
1980s. We analyzed the changes in our practice as it has become prevalent. Microsurgical tissue transfers were predominant in the 1980s and decreased in the 1990s, whereas the
local flap had an opposite evolution. In our experience, local flaps are related to a non significant lower rate of complication (18%) than free flaps (27%). Moreover, complications of local and regional flaps are less severe.

Our practice has changed to make local flaps as our first choice to cover soft-tissue
defects of the lower limb. However, we still use free flaps as a first choice for wide or
composite defects, when local flaps are not feasible.

Still management of soft-tissue defects of the lower limb remains difficult and the distal
third of the leg is considered the most difficult area to reconstruct.

The tibia is in a subcutaneous position and therefore often exposed in case of leg injury.

Moreover, the lack of both local skin laxity and muscular tissue in this area make the
reconstruction difficult.

Muscle flap coverage remains the first choice for many surgeons because of the high vascularity and the high tolerance and resistance to infection of these flaps.[3,4,5,6,7] However, fascial and fasciocutaneous flaps have regained popularity as excellent alternatives for coverage of lower leg defects.[3,8,9] the recently described medial adipose-fascial flap [10,11,12,13] has several advantages: it spares all the major vessels of the lower limb and there are multiple harvesting possibilities. Increasingly surgeons are experimenting options of different local flaps like peroneus brevis muscle flap, reverse soleus flap, flexor digitorum longus flapsetc.Many studies are also being done to find out the anatomical relationships of vessels feeding different local flaps.

There have been many wounds when the options of the local flap would also arise
alongside free flap and the surgeons have to make a decision what is the best for the
patient at that time ?.Our study aimed to find out similar indications of the lower leg
reconstruction and compare results of free flap versus local flap.

We compared our series of non-free flaps with a series of free muscular flaps that had
almost similar clinical circumstances and causative factors . In this way, we could
compare the clinical results of lower leg defects covered with a highly vascularized,
local flap and a free muscular flap.

PATIENTS AND METHODS

The study was carried out in retrospective manner in which consecutive patients with
lower leg defect having coverage by flaps operated by different surgeons in between
January 2000 and January 2005 were included .All the patients needing only skin grafts
were excluded as well where the options of the local flap was not feasible because of
damage to perforators due to severe trauma ,fractures or extensive retraction of the
vessels due to chronicity of the wound. Also excluded few cases where the application of
the external fixator or internal rods makes the option of the local flap very risky.
In this way, we obtained two homogeneous groups for which only the surgeon's
preference determined the use of a local or free flap.
Patients' medical records were
reviewed retrospectively to determine the cause and localization of the defect, size of the
defect ,the tissue that had to be covered, and the type of flap (free or local flap) that had
been used. All patients with defects less than 25 cm2, peripheral vascular disease, deep
bony defects, and osteomyelitis were excluded in order to obtain the same surgical
indications.

In both groups, the following features were studied: (1) surgical complications, such as partial or complete flap necrosis, local wound problems, and donor-site problems; (2) medical complications; (3) duration of hospital stay; and (4) final aesthetic outcome. All flaps were harvested using the standard techniques described in literature (Heymans et al).[13]Before incision, if indicated the pedicle and perforating vessels of the local flaps are mapped by Doppler study. Whenever the flap based on the saphenous artery has to be harvested, an incision is made from the medial condyle to the anterior tibial crest and the skin is elevated superficially. The base of the flap should be as large as 5 cm at the level of the medial side of the knee. The fatty tissue is incised anteriorly along the tibial border, distally, and posteriorly until the deep fascia is encountered. Dissection is continued in a plane under the deep fascia, starting distally. If the decision is made to harvest a flap based on the posterior tibial perforators, then the incision is made 1 cm medial to the tibial crest. The dissection is continued subcutaneously along the entire medial side of the lower leg, followed by incision of the deep fascia along the tibial crest. During this dissection, the intermuscular septa are divided, but the perforators, representing the pivot point, are preserved. Depending on the selected perforator (pivot point), the flap will be supplied in an antegrade way (based on a proximal perforator) or in a retrograde way (based on a distal perforator). The adiposofascial flap is covered during the same operative procedure with a thin split-thickness skin graft, and a suction drain is placed at the donor site for 3 days.

Similarly the gastrocnemius and soleus muscle were planned by planning the vertical
midline incision on the calf and while saving the sural nerve in the line of dissection ,the
muscle flap were harvested base on the sural arteries.

Free flaps used for lower leg reconstruction in this series included lattismus dorsi ,rectus
abdominus , gracilis, radial forearm and anterolateral free flap. The free flap was harvested according to the standard defined techniques in the literature. Comparisons between groups used the chi-square test and statistical significance was set at the level of 0.05.

RESULTS

Out of the total of 26 patients having undergone local flaps 17 were male and nine
female ranging in age from 15 to 75 years (mean age, 50 years) Table 1. The mean
follow-up time was 6 months (range, 4 to 10 months). Indications for flap coverage were
open fracture (n =24), exposure of osteosynthesis material (n = 12), osteotendinous
exposure (n = 8), soft-tissue necrosis (n = 6), with bone exposure (Table 2). The size of
the wounds, their distribution over the distal leg and distribution of the different surgical
procedures according to the size of the defect are shown in tables 3 & 4.

Figure 1

AGE RANGE	FREE	LOCAL(NONFREE
15-50	17	12
51-69	6	6
70- <	1	8

Table 1- Age distribution

NO OF CASES	FREE FLAP	NON FREE FLAP
BONE ONLY	14	10
BONE + METAL	9	8
OTHERS	1	8

Table 2 Distribution according to the structures exposed

SIZE OF THE WOUND DEFECT IN CM SQUARE	FREE FLAP	NON FREE FLAP
4-10 CM SQUARE	14	10
10 & >	10	16

Table 3- Size of wound defect

Out of the total of 24 patients who had free flaps where eighteen patients were men and six were women, ranging in age from 26 to 72 years (mean age, 47 years). The mean
follow-up time was 6 months (range, 4 to 8 months). The distribution of the hospital stay
and operative time is compared in tables 5 & 6 respectively.

It can be seen the use of newly described flaps like medial adiposofascial flap,sural artery
based flap and saphenous flap etc. Surgical results are presented in Table 7. There were
two complete flap losses in the free groups and 2 partial flap necrosis each in local and free flap group. In one of the medial adipose-fascial flap series, the flap was lost in the early postoperative period because of venous congestion related to inadequate tunneling of the flap. In the free flap series, venous congestion was the cause of flap loss and even reexploration could not save the flap. One of the free flap failed needed reexploration and
cover by another free flap ,anterolateral thigh in one case and gracilis muscle free flap in
other cases in both the cases the failed flaps were latisimusdorsi flap.

The overall graft take was 95 percent in the muscular flaps both in the local and free flap
harvest. There were three flaps complicated with bleeding with two hematoma had to be
evacuated in the free flap group.

Medical complications occurred in both series, although their incidence seemed to be
slightly higher in the free flap group (18 percent): there were two cases with DVT, one
acute myocardial ischemia, and one sepsis, compared with one local flap necrosis in the
local flap group. (Table 7).

Figure 2

FREE FLAP	NON FREE FLAP
LATISSIMUSDORSI(9)	FASCIOCUTANOUS(7)
RECTUS ABDOMINUS (7)	BIPEDICLE FLAP (5)
ANTEROLATERAL THIGH (2)	GASTROCNEMIUS(8)
RADIAL FOREARM (2)	ADIPOSOFASCIAL (2)
GRACILIS MUSCLE FLAP (4)	MEDIAL SOLEUS (4)

Table 4 Distribution of the flaps free versus non free

DURATION OF STAY	FREE FLAP	NON FREE FLAP
2 WEEKS	6	16
> 2 WEEKS	18	10

Table 5 – Duration of stay

OPERATIVE TIME	FREE FLAP	NON FREE FLAP
MEAN	270MIN	75MIN
RANGE	105MIN – 480 MIN	45MIN – 270 MIN

Table 6 Distribution of flaps on the basis of operative time

Complication	Free Flap	Non-Free
Infection	4	2
Haematoma	3	0
Venous Cong.	4	1
Graft loss	2	1
Flap necrosis	2	1
DVT	2	0
Sepsis	1	0

Table 7 Distribution of complications in between two groups

DISCUSSION

Trauma is the most common aetiology in this young and active population. This probably explains the location of the wounds at the lower third of the leg and the rate of bone exposure (43%) which is more likely to occur in this area.

The surface of the wounds to cover (mean size: 50 cm2) was equivalent through the years and this factor could not represent a bias for the selection of the procedure.

Regarding the procedure used, 35% of the cases were treated with either a skin graft or dressing for secondary healing as a single procedure. As a confirmation of the lack of laxity in this area, local flaps were used in only 7.1% of the cases. The remaining cases required the mobilisation of a local or free flap to achieve the reconstruction.

Among the local flaps, the fasciocutanous flap, the bipedicled flap and the distally based muscular soleus flap and gastrocnemius flap were the most commonly used. Among the free flaps, preference was given to the latissimus dorsi myocutaneous flap, thus confirming its facility and reliability.

Many factors have always influenced the indications for a procedure (technical skills, wound size and localization as well as the exposed tissues), but the choice has changed with time. Free flaps were the first option from the 1980s to the early 1990s. At this time, the development of many local flaps made them predominant for the last decade. Moreover, the definition of complication differs from one study to another, since vascular thrombosis is not always considered as a complication,[12,13] and skin grafting of the donor site is considered as such.[21] Nevertheless, the complication rate for free flaps ranges from 10% 11,13 to 38% 10 and from 21% [2, 13, 20] to 46% [22] for local flaps. In our experience, local flaps are related to a lower rate of complication (18%) than free flaps (27%). Moreover, complications of local and regional flaps are less severe. With time our practice has changed to make local flaps our first choice to cover soft tissue defects of the lower limb, because these flaps are less demanding, easier to use and related to less severe and less numerous complications.

Should this procedure fail, it does not preclude the use of a free flap as a secondary procedure which remains a rare instance. However, we still use free flaps as a first choice for wide or composite defects.

Throughout the literature, numerous studies confirm the advantage of immediate soft tissue coverage of exposed bone.[4,5,13,14,15] The goal of this study, performed on two homogeneous patient populations, was to answer two questions that remain controversial in the literature. First, is there still place for local flaps in coverage of lower leg defects? Second, the exposed bone covered with local flap have better outcome than free flap or not?

Although free flaps have become the first choice for reconstructive procedures in the lower leg since the popularization of microsurgery, local flaps can still be indicated in selected cases.[3, 16] Proper patient and flap selection is key for these conditions. In our study, we excluded all patients with defects larger than100 cm2,

peripheral vascular disease, deep defects, and osteomyelitis, because in our department these clinical presentations remain indications for free flap surgery. The use of local muscle flaps, such as the gastrocnemius and the soleus, has proven to be valuable in the management of soft tissue defects over the tibia.[1,16] However, because of local contusion of the soft tissues after trauma, local muscle flaps are not always perfectly healthy and will not have the trophic qualities of a free flap. Moreover, there will be local devascularization subsequent to the removal of the flap, and the tissue defect will often be covered with the least vascularized distal part of the muscle flap. Local fascial and fasciocutaneous flaps can provide an excellent alternative, [3, 8, 9] but they have limited reach and can be unreliable, especially if the area around the wound has been traumatized or is chronically scarred. Moreover, they often leave ugly donor-site scars because of the need for skin grafting.[2,9,17] Among these fasciocutaneous flaps, the distally based sural flap has some exceptional features. Although first described by Masquelet et al.[18] as a "neuroskin" island flap; it can be harvested without sacrificing the sural nerve end, thereby reducing the donor site. It has the largest arc of rotation among flaps that have been described for the lower leg, and it can be elevated in cases of peripheral vascular disease or damage to major vessels caused by trauma, as long as the peroneal artery is preserved.[19] The sural flap is harvested most of the time as a fasciocutaneous flap, leaving an ugly donor-site scar, [20] but it can be harvested as a pure fascial flap, thereby reducing donor-site morbidity.

The recently described medial adipose-fascial flap [10,11,12,13] is another exceptional local flap with several advantages. As in the distally based sural flap, no major vessel has to be sacrificed, the flap is reliable even in traumatized areas, and no skin is harvested (although it is possible), leaving minimal donor-site scarring. However, the medial adipose-fascial flap has some additional advantages to the sural flap: it can easily be harvested with the patient in the supine position; because of its dual vascularization, [13] the flap can be tailored for proximal and distal defects; and well-vascularized tissue can be harvested to cover a defect of up to 40 cm2, without noticeable venous congestion. In the literature, it has been well documented that after vigorous débridement of lower leg defects, coverage is needed with well-vascularized tissue, preferably muscle.[2,21,22] Indeed, since the works of Mathes and coworkers initiated the concept of bone coverage by muscle flaps in the 1980s,[6,7] a dogma persists on using muscle flaps as coverage whenever bone is exposed. It is a common misconception that muscle provides better vascularity and greater tolerance to infection than adipofascial or fasciocutaneous flaps. Muscle flaps are not the solution for "curing" established infection. Recent clinical work also confirms that nonmuscular tissue can be successfully transferred to cover bone defects after aggressive débridement, which remains the key factor.[23,24,25,26] Moreover, muscle harvesting can induce a certain morbidity of the donor site and may induce some aesthetic disadvantages on the recipient site.

Nowadays, successful flap transfer rates approach 98.8 percent in literature, [27] and harvesting of the free flap provides a bulky flap with donor-site morbidity, [28] comparable to local muscle/fascial flap harvesting.

In our series, the microsurgical procedure prolonged the operative time. A longer hospital stay was noticed in the free flap group, which increased perioperative costs.[2, 29] we documented a higher medical complication rate after the free flap surgery (45.8% percent than in the local fascial group (11.5%), but we believe this study is too small to determine the reasons for the increased morbidity. Although operation was significantly longer in the free flap group, it has not generally been implicated in increasing the morbidity rate, [30] unless the surgical time exceeds 10 hours, which never occurred in this series. It might be that the longer hospital stay, implying prolonged stress, exposure to the hospital environment, and diminished physical activity, plays an important role in the increased morbidity rate. However, this was not the goal of this study and more extensive work on larger series regarding this subject should be performed.

CONCLUSIONS

In selected cases of bone, hardware, or articular exposure without obvious osteomyelitis,
the final functional outcome after free or fascial coverage is identical. Although free flap
surgery has become a versatile procedure, it remains a more demanding and risky
procedure than local flap surgery. Moreover, the local fascial flap of the leg can
provide a better alternative for free flap coverage with fewer medical complications, a
shorter operative time and hospital stay, and better aesthetic results.

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