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RESEARCH PAPER

A study on clinical application of adipofascial flaps for reconstruction in leg defects

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Background and aims: The reconstruction of lower limb defects is challenging, and several options have been applied for soft tissue covers over the years. We evaluate the indications, limitations, advantages and disadvantages of adipofascial flaps in soft tissue reconstruction of leg defects. The paper aims to study the indications, limitations, advantages and disadvantages of adipofascial flaps in reconstructing leg defects. **Methods:** Patients with various soft tissue defects of the leg below the knee were studied retrospectively in 25 patients for 1 year 8 months. Planning for the proposed flap was done depending on the availability of local tissue around the defect. Perforators were located by handheld Doppler for perforated based adipofascial flap. Where a definite perforator was not found, and for small size defects, random pattern adipofascial flaps were planned. The surgery was completed in one surgical time with immediate skin grafting. In all cases, split skin grafting over the flap was used, and the donor sites closed primarily. Flap complications, functional and aesthetic outcomes and their satisfaction with the surgery were assessed. **Results:** There was partial loss of flap in 5 patients. Marginal skin necrosis occurred in 4 patients. Only 2 cases of partial donor skin necrosis required further split skin grafting. The flaps have shown good contour and good donor site scar even in patients with complications. The majority of the cases showed fair to good results on follow up. **Conclusions:** Adipofascial flaps are helpful in the armamentarium of reconstructive surgery, particularly in small to medium-sized lower leg defects and provides aesthetically better recipient-site scar with minimal donor-site morbidity and favourable functional outcome.

Keywords: Adipofascial flap, lower leg defect, soft-tissue defect, reconstruction.

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INTRODUCTION

The reconstructive ladder option for leg defects ranges from simple primary closure to complicated microvascular free tissue transfer. With free tissue transfer, contour defect at the recipient and donor site remains significant. Also, there are limitations in acquiring technical expertise and proper instrumentation, leading to less use of this option. Therefore, local flaps remain a workhorse for coverage of soft-tissue defects of the lower leg.

Adipofascial tissue has evolved from fasciocutaneous flaps.

They are composed of subcutaneous fat and deep fascia with a reliable blood supply. The surgical plane in the leg is deep to the deep fascia.¹ This flap incorporates two plexuses less than fasciocutaneous flaps, i.e., dermal and subdermal plexuses.^{2,3}

The defects around the ankle and foot present a huge problem to plastic surgeons because of lack of local tissue, donor site morbidity and bulkiness following reconstructive surgery.^{4,5} Adipofascial flaps are locally available, offer superior donor site scar, single staged and have a wide arc

of rotation up to 180 degrees.^{6,7,8,9} The disadvantages include partial /total flap loss, donor site necrosis, marginal skin loss.^{10,11,12,13,14}

Therefore, this study was conducted to study the indications, limitations, advantages and disadvantages of adipofascial flaps in reconstructing leg defects.

MATERIAL AND METHODS

This is a retrospective study carried out from January 2018 to August 2019. Patients of all ages and both sex with clinically small-medium-sized post-traumatic/post-surgical defect of the leg requiring flap cover were included in the study. Patients with associated soft tissue contusion around the primary defect, osteomyelitis, large defect with cavity were excluded from the study. Twenty-five patients with leg defects were evaluated and reconstructed with an adipofascial flap cover. Due permission was taken from the institutional research and ethical committee.

The assessment was done based on history, clinical findings, radiological investigations and handheld Doppler study to include a perforator whenever possible. Based on the anatomical location of the defect, adipofascial flap covers were considered after discussing the plan with the patient/attendants. Written/informed consents were taken about the procedure and photographs were taken preoperatively, intraoperatively, postoperatively and on follow-up.

Patients were operated on under regional/general anaesthesia. Planning for the proposed flap was done depending on the availability of local tissue around the defect. Whenever feasible, a perforator-based adipofascial flap was done, but a definite perforator was not located; a random pattern flap was considered. The flaps were either proximally/distally based or vertically based with a transversely oriented flap in a few cases. After planning in reverse, skin flaps were raised as planned just deep to dermis sparing only minimal adipose tissue with the skin flaps and protecting the subdermal plexus. Once adequate skin was undermined, dissection of the adipofascial flap was started from the distal-most part of the flap. A horizontal incision was made through the remaining portion of fat and deep fascia. Then two vertical incisions were made up to the margin of the proposed base. The adipofascial flap was then dissected through the subfascial plane and gently hinged over or transposed to cover the defect. In some of the transposed flaps, the skin was incised at the anterior border of the proposed flap, deepened upto subcutaneous adipose tissue, and dissected until the proposed flap was undermined. For small-sized defects and where a definite perforator was not located, random pattern adipofascial flaps were planned. Those flaps that were turned over were planned considering the defect, the base of the flap, the part of the flap that rolls to allow hinging, the part that rolls over the base and the effective flap that covers the defect. The flap was covered with a

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split-thickness skin graft, and the donor area was closed primarily.

Postoperatively, the operated leg was immobilised for one week, and a light dressing was used over the pedicle area. The primary dressing was done on the 5th postoperative day. If any, the complications relating to surgery were studied and analysed in all cases. Patients were followed up at 2nd week, 4th week, 12th week and every 6 months till 1.5 years and observations were documented to assess the functional and aesthetic outcome in terms of adequate healing of the wound, any functional limitations imposed by harvesting flap, sensory abnormalities and contour deformities of the donor site.

RESULTS

Out of 25 patients included in the study, the youngest patient was 4 years, and the oldest was 60 years of age. The mean age was 34.12 years, and the median was 35 years (**Table 1**).

Table 1 Number of patients in different age groups

Age group (years)	Number of patients (%)
≤15	5 (20%)
16-30	6 (24%)
31-45	7 (28%)
46-60	6 (24%)
>60	1 (4%)

The majority of the patients were male with a male-female ratio of 4:1 (**Table 2**).

Table 2 Gender distribution of patients in different age groups

Age group	Male	Female	Total
≤15 years	1	4	5
>15 years	19	1	20
Total	20	5	25

Traumatic cases constituted major aetiology with 24 defects (96%) and a single non-traumatic case of post-burn unstable scar (4%). The left leg was involved in 16 patients (64%). The location of the soft-tissue defect in the lower limb is shown in **Table 3**.

Table 3 Site of involvement

Location of defect	Number of patients (%)
Lower one-third of leg	9 (36%)
Mid-third of leg	7 (28%)
Upper third of leg	1 (4%)
Ankle	3 (12%)
Dorsum of foot	2 (8%)
Tendoachilles region	3 (12%)

Random pattern adipofascial flaps (**Figure 1a, 1b, 1c, 1d & Figure 2a, 2b, 2c, 2d**) were used in 14 cases (56%) while perforator based adipofascial flaps (**Figure 3a, 3b & 3c**) were used in 11 cases (44%). For perforator-based flaps, there were 9 posterior tibial artery perforators and 2 peroneal artery perforator based adipofascial flaps. The adipofascial flap has 2 surfaces, fascial and adipose, either of which can be inserted over the defect. In our study, the adipose side was used for insetting in 15 cases (60%) and in the remaining 10 cases (40%), the fascial side was used. The arc of rotation ranged from 45 degrees to 180 degrees, i.e., for 12 patients (48%), the turnover flap was done in a 180-degree arc of rotation, followed by 90-degree rotation in 11 cases (44%) and a 45-degree rotation in 2 cases (8%).



Figure 1a Random adipofascial flap for left lower leg defect



Figure 1d 6 months follow-up



Figure 2a Right mid-third leg defect



Figure 2b Random adipofascial flap raised



Figure 1b Adipofascial flap transposed to defect

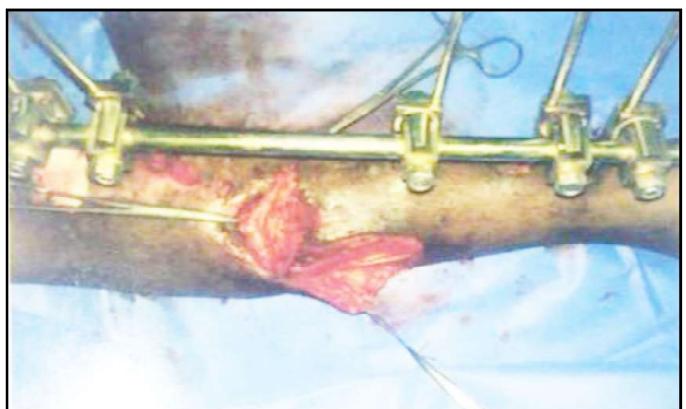


Figure 2c Flap transposed to defect



Figure 1c Immediate postoperative SSG over flap

**Figure 2d** Immediate post-operative**Figure 3c** 6 months follow-up**Figure 2e** Follow-up at 4 weeks**Figure 3a** Right tendoachilles defect**Figure 3b** Flap turned over a defect

The size of defects ranged from 3x2 cm to 7x5 cm and flaps ranged from 5x3 cm to 12x7 cm. The largest flap (12x7 cm) was a posterior tibial artery perforator-based flap. In 19 cases (76%), flaps were distally based and 4 cases (16%) were proximally based. In 2 cases (8%), the base was vertically based with a transversely designed flap design.

Partial flap necrosis was found in 5 patients (20%) and total flap necrosis in 1 patient (4%). Only 1 case (4%) had partial graft loss, which healed with dressings. Marginal skin necrosis occurred in 4 patients (16%), 2 cases (8%) had partial donor skin necrosis, which required split skin grafting. One case had a hematoma in the donor site, and one hematoma was found above the insetted adipofascial flap. There were no cases of flap oedema/venous congestion. There was no hypertrophic scar on follow up. Patients' satisfaction on follow up revealed 8 patients (32%) had excellent result, 11 patients (44%) with good result and 5 patients (20%) with fair result and 1 patient with poor result (4%).

DISCUSSION

The present study was a retrospective analysis of 25 patients with defects of lower limb requiring soft tissue reconstruction. Out of 25 patients included in the study, 20 were male and 5 were female. The youngest patient was 4 years and the oldest patient was 60 years of age. Similar other studies have also observed wide age range among the patients.^{15,16}

Traumatic causes constituted our study's major cause of leg defects (96%). Similar other studies also found trauma as the major etiological factor.^{2,17} In another study, it was noted that all the defects were due to road traffic accidents.¹⁸

Patients with osteomyelitis were excluded from the present study. However, in a previous study, stable coverage was achieved in one patient with chronic osteomyelitis treated with a distally based adipofascial flap.¹⁶

The present study involved the left leg in 16 patients (64%). Along with lower, middle and upper-third leg defects, the other sites of defects in the present study were the ankle, tendoachilles and foot dorsum. Tendoachilles defect was covered with adipofascial flap in three patients in our study. Stable coverage was achieved in all the patients though hematoma at donor site caused complications in one case for which evacuation of hematoma and split-skin grafting was done at a later stage. Donski & Fogdestam¹⁹ have mentioned raising a distally based fasciocutaneous flap based on the distal perforator of the peroneal artery to cover the Achilles tendon.

Random pattern flaps were used in 56% of the cases while perforator-based flaps were used in the remaining 44% of cases. 9 posterior tibial artery perforators and 2 peroneal artery perforators based on adipofascial flaps. Another study has found high success rate and minimal donor-site morbidity in 10 consecutive patients.²⁰

The adipofascial flaps have the advantage of the availability of either the fatty tissue side or the fascial side, which can be insetted over the defect.¹⁶ In our study, both adipose side (60%) and fascial side was (40%) used for insetting. Lin et al.²¹ have also used both the adipose and fascial sides in their study and noted partial graft loss due to fat necrosis in three cases. Bhattacharya et al.² preferred the skin graft on the fascial surface of the flap most likely due to fat necrosis on the adipose side. Our study found equally good results with both the adipose and fascial sides.

The grafting was completed in one surgical time in all the cases in our study. Other authors reported grafting with split or full-thickness graft 5-7 days after the initial surgery.^{15,22} Delaying skin grafting for 3 to 5 days allows an early granulating bed to develop and eliminates the problem of immediate, postoperative oozing beneath the skin graft.²²

The flaps were distally based in 19 cases (76%), proximally based in 4 cases (16%) and vertically based with a transversely designed flap in 2 cases (4%). The proximally based flap cannot easily include adequate donor tissue for reconstruction in the lower part of the leg, because the soft tissue around the ankle is relatively tight and scanty.²¹ Worseg et al.¹³ have concluded that the vertical arrangement of the vessels supplying it ensures that any part of the lower leg can, at least in theory, be reached with the flap when raised with a paratibial or parafibular pedicle, except the heel and the Achilles tendon. In the present study, a vertically based flap was used in 2 cases. So, there is flexibility in planning this flap, in that, any location around the defect can be used as a base provided there is adequate adipose tissue.²⁰

There were 5 smokers in the study ranging from 18 to 45 years of age and no flap or donor skin necrosis complication was found in any of them similar to another study.² There was one diabetic patient in the study who had marginal donor-site skin necrosis, which did not require further surgery. Other studies also reported partial tip necrosis, partial graft loss and partial flap necrosis among diabetic patients.^{21,23}

Out of the 25 cases, there was partial flap necrosis in 5 patients (20%) and a total flap necrosis in 1 patient (4%). One case (4%) with partial graft loss with no flap loss healed with dressings, while 4 patients (16%) with marginal skin necrosis did not require further surgery. Two cases of partial donor skin necrosis required further split-skin grafting. Bhattacharya et al.² found marginal skin necrosis on each side of the donor site incision in three cases. The adipofascial flaps have certain inherent peculiarities including flap thinness, bleeding or hematoma, difficulties in monitoring and problems associated with skin graft take. Meland & Weimar²² have demonstrated that avoidance of all external pressure is essential to maintain flap viability.

There were 2 cases in the study with complications of hematoma, one in the donor site and the other case with hematoma over the insetted adipofascial flap, beneath the skin graft. These two cases were also associated with complications of flap and donor site skin necrosis. Complications of hematoma is also mentioned in other studies^{15,17} and proper haemostasis before closure of donor sites and flap insetting is advocated. There were no cases of venous congestion of the flaps in the study. Similar findings were also found by some other studies.^{15,17}

No debulking procedures were required in any of the cases on follow-up. In this study, the flap has shown good contour and good donor-site scar and even in those patients who had complications and required further surgery, satisfactory results were obtained.

CONCLUSION

Adipofascial flaps are versatile flaps due to their flexibility of flap design and the feasibility of using the flap as either a random pattern or perforator-based flap. Both fascial and adipose sides can be used for insetting depending on ease of closure and insetting requirements. It has a wide range of arc of rotation. It has reduced donor site morbidity and as thin flaps are used, the recipient sites are aesthetically better. However, the Adipofascial flaps need to be handled with care as they are delicate flaps, and if adequate adipose tissue is not left behind on the donor skin it may result in donor skin necrosis.

The adipofascial flaps are a helpful option in the armamentarium of the reconstructive surgeon, especially in small-to-medium sized lower leg defects, including the foot and tendoachilles.

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