

Anterolateral Thigh Perforator Flap for Reconstruction of Lower Extremity Soft Tissue Defects

YEHIA ZAKARIA, M.D.^{1,2}

The Departments of Plastic Surgery, Zagazig University, Egypt¹ and Al-Babtain Center for Burns & Plastic Surgery, Ministry of Health, Kuwait²

ABSTRACT

This study was conducted in Al-Babtain center for burns & plastic surgery, Ministry of Health, Kuwait, during the period from February 2010 to March 2014. The aim of this study was to evaluate the use of the free Anterolateral thigh perforator flap in reconstruction of soft tissue defects in different anatomical parts of the lower limb. It included 30 patients (24 males and 6 females). Their ages ranged from 7 to 59 years (average 28 years). They all had soft tissue defect of the lower limb; the defect was on the knee in 3 patients, on the tendo-Achillis in 6 patients, on the distal leg in 15 patients and on the foot & ankle in 6 patients. The main cause of the defects was trauma in 18 patients. The flap sizes ranged between 15-35cm in length and 10-15cm in width. The skin paddle was found supplied by musculocutaneous perforators in 26 patients. The flaps survived completely in 29 patients. Immediate flap thinning was done in all patients before pedicle separation leaving only 1/2 cm around the perforator. Further flap debulking was done three months later by liposuction and skin excision in 13 patients. All patients had good functional and aesthetic outcome during the follow-up period that ranged from 7 to 42 months (average 24 months).

INTRODUCTION

Microsurgical flaps are the mainstay of reconstruction of large lower limb defects with exposed vital structures like bones, blood vessels or tendons. Microsurgical reconstruction has improved very much in the last decade with achievement of success rate of nearly 100%. Therefore there is much concern about improving the functional and aesthetic outcome as well as reduction of the donor site morbidity [1]. Free muscle flaps have been used for long time in lower limb reconstruction. More recently the free perforator flaps were introduced especially the free Anterolateral Thigh Flap (ALT) which was first presented by Song et al., in 1984 [2]. The flap gained popularity and was used widely in head and neck reconstruction, abdominal wall reconstruction and limb reconstruction. The flap was reported to be reliable, versatile with large skin paddle, has a long vascular pedicle of good size and accepted donor site morbidity [3].

The aim of this study was to report a case series of 30 patients with large lower limb soft tissue defects reconstructed by free ALT flaps. Functional and aesthetic outcomes were evaluated in these patients during the follow-up period.

PATIENTS AND METHODS

This study was conducted in Al-Babtain centre for burns & Plastic Surgery, Ministry of Health, Kuwait during the period from February 2010 to March 2014 and included 30 patients; 24 males (80%) and 6 females (20%). Their ages ranged from 7 to 59 years (average 28.2 years). All of them suffered extensive soft tissue defects of the lower limb. The location of the defect was the knee in 3 patients (10%), tendo-Achillis in 6 patients (20%), distal leg in 15 patients (50%) and the foot & ankle in 6 patients (20%). The cause of the defect was trauma in 18 patients (60%), burn excision in 3 patients (10%), scar contracture release in 6 patients (20%) and unstable scar excision in 3 patients (10%).

Anatomical bases of the flap:

Blood supply of the ALT flap comes from the descending branch of the lateral circumflex femoral artery, which arises as one of three terminal branches of the profunda femoris artery together with the ascending and transverse branches. It runs through the septum between the rectus femoris and the vastus lateralis muscles in the anterior thigh region [3]. The diameter of the artery at its proximal part is about 2mm, it is accompanied by 2 venae comitantes, and one of them is usually dominant as shown by higher venous outflow [1]. It supplies the skin and subcutaneous tissue of the flap through perforators; either musculocutaneous (in 88% of cases) or septocutaneous (in 12% of cases) [4]. The pedicle length ranges from 8 to 20cm which is considered an advantage of this flap. The flap may

be sensate if branches of the lateral femoral cutaneous nerve are included with the flap [5].

There is an incidence of anatomical variations of the vascular supply of the ALT flap in about 2% of patients [1]. These variations may be in the form of:

- 1- Absent or too small perforators [4]; which may require shift to perforators of the transverse branch of the lateral circumflex femoral artery or change to another flap like the Tensor Fascia Lata flap (TFL), Medial Thigh flap (MTF) or contralateral ALT flap.
- 2- Deviated vein from the course of the artery [1,4]; which may need careful micro dissection under the microscope.

Surgical technique:

Preoperative localization of the perforators was done; reliable perforators were expected to be within a 3-cm circle in the center of a line drawn from the ASIS (anterior superior iliac spine) to the lateral edge of the patella. Doppler examination was used to confirm localization of the perforators. The skin island was outlined on the lateral thigh skin centered over the localized perforator. The medial skin incision was always started with to expose the lateral intermuscular septum and to look for septocutaneous or musculocutaneous perforators. A dominant perforator was chosen and was traced up to the lateral circumflex femoral artery to have a good length and caliber as needed. Dissection of the flap is carried out in a subfascial plane. Intramuscular dissection of the perforators was carried out under 5.5x loupes magnification and bipolar electrocauterization.

Thinning of the flap was done limited to its periphery and leaving a central zone of at least 2cm around the perforator.

The donor site was closed directly if the flap width was 6-8cm, otherwise it was skin grafted.

Further debulking of the flaps, when needed, was done 3 months later by liposuction and excision of excess skin.

RESULTS

The operative time ranged from 4 to 6 hours (mean 4.8 hours). Hospitalization time ranged from 7 to 10 days (mean 7.4 days). Flap size ranged between: 15-35cm (mean 28.7cm) in length and 10-15cm (mean 13.3) in width. The flap was supplied by a septocutaneous perforator in 4 patients (13%) while the remaining 26 (87%) flaps were

supplied by musculocutaneous perforators, Table (1). In cases where the flaps were supplied by musculocutaneous perforators, they were raised as true perforator flaps via intramuscular dissection of the perforators in 10 cases (38%), or a muscle cuff was raised with the flap in the remaining 16 cases (62%).

The overall success rate was 97%. Three flaps (10%) developed venous congestion on the second postoperative day and vascular exploration was done; 2 flaps survived completely while the other flap was lost partially and required another free flap to cover the exposed bone.

One case (3%) developed hematoma underneath the flap on the postoperative day 3 and was evacuated without flap compromise. Three patients (10%) developed infection at the flap recipient site; two of them were diabetics and the remaining one was a tobacco smoker.

The flap donor site was closed by direct closure in 3 patients (10%), while in the remaining 27 patients (90%) it was skin grafted. Partial loss of the skin grafts occurred in 2 patients (7%) and was treated conservatively.

Immediate thinning of the flap was done conservatively before pedicle separation, leaving only 1/2 cm around the perforator. In 13 (43%) patients, further flap debulking was done 3 months postoperatively by liposuction and excess skin excision.

Two patients (7%) were unhappy about the skin grafted donor site, the skin grafts were excised and the donor site was resurfaced by expanded thigh skin. Table (2) illustrates the post-operative complications.

The follow-up period ranged from 7 to 42 months (average 24 months). None of our patients developed ulceration over pressure areas during the follow-up period. All patients were satisfied about the functional and aesthetic outcome during the follow-up period.

Case 1: A 28 years old female patient with deep contact burn on the anterior surface of the left knee, after burn excision the joint was exposed with 22 x 15cm soft tissue defect. Free ALT, hooked to the anterior tibial vessels, was used to reconstruct the defect. She had good functional outcome with full range of movement of the knee joint at 2 years of follow-up (Fig. 1).

Case 2: A 47 years old male patient with 20 years old unstable scar over the right tendo-Achillis. Scar excision ended up by a 25 x 14cm skin defect

with exposed tendo-Achillis. Coverage was achieved by free ALT flap hooked to the posterior tibial vessels. Patient had stable wound coverage at 8 months of follow-up (Fig. 2).

Case 3: A 7 years old male patient with contracted scar on the dorsum of the right foot and ankle with extension deformity of the 2nd and 5th toes. Excision of the scar tissue was done, correction of the toes deformity, K-wire fixation of the toes and coverage of the 15 x 5cm defect by free ALT flap hooked to the anterior tibial vessels. Stable wound coverage was achieved with good functional outcome was achieved at 7 months of follow-up (Fig. 3).

Table (1): Type of the perforators.

Perforator type	No. of patients (%)
Septocutaneous	4 (13%)
Musculocutaneous	26 (87%)

Table (2): Postoperative complications.

Complication	No. of patients (%)
Total flap loss	0
Partial flap loss	1 (3%)
Partial skin graft loss over the donor site	2 (7%)
Haematoma	1 (3%)
Infection	2 (6%)
Ulceration of the flap	0

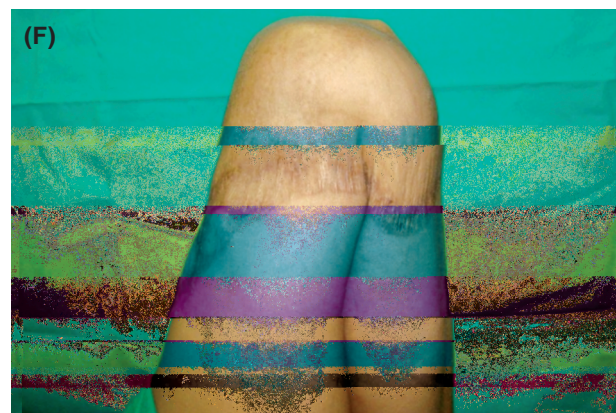
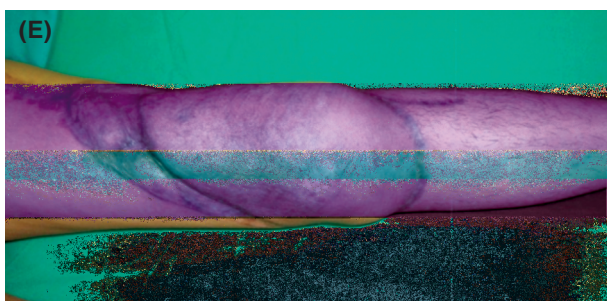
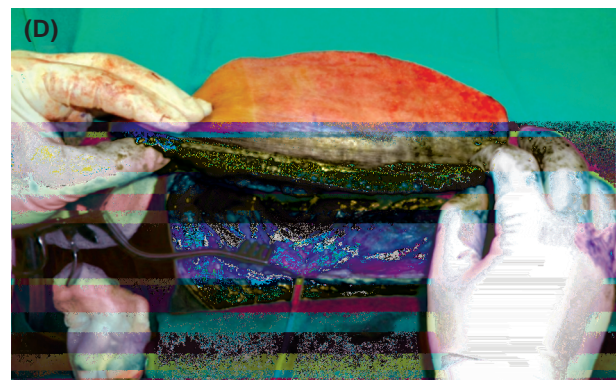
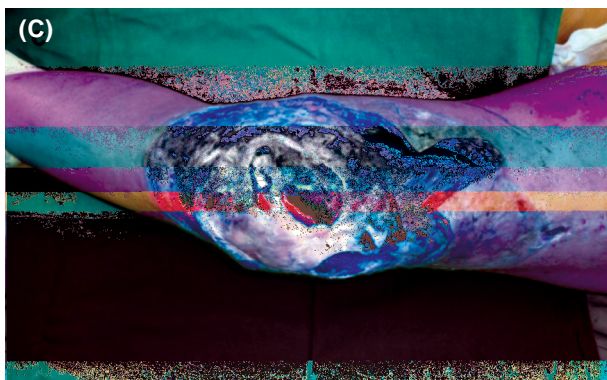


Fig. (1): (A) Preoperative view showing deep contact burn on the anterior surface of the left knee. (B) Following one session of debridement and skin grafting of a part of the wound. (C) Following radical debridement. (D) The ALT flap was raised from the contralateral thigh and partially thinned out. (E) 8 months postoperative. (F) 2 years postoperative with full knee flexion.

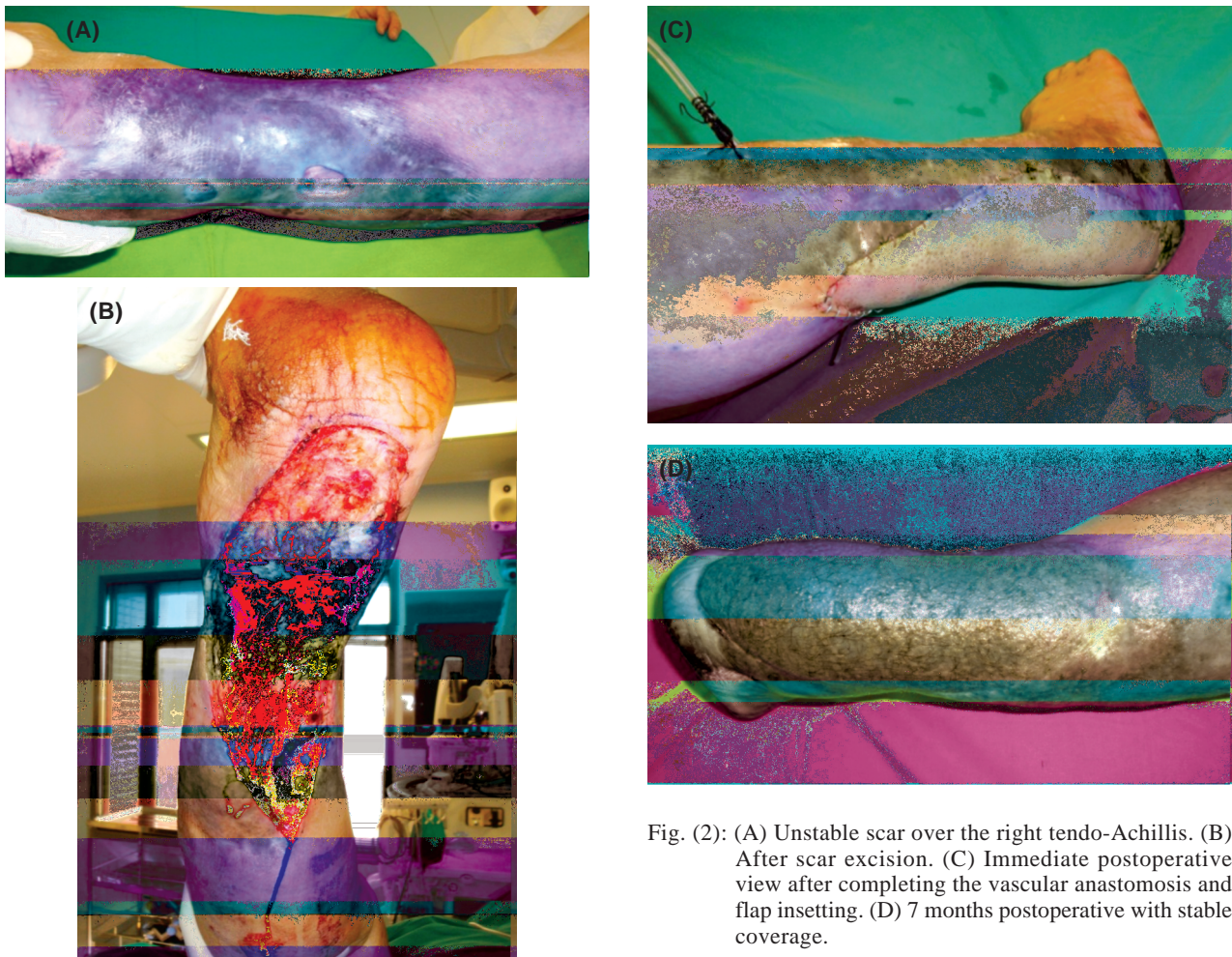


Fig. (2): (A) Unstable scar over the right tendo-Achillis. (B) After scar excision. (C) Immediate postoperative view after completing the vascular anastomosis and flap inseting. (D) 7 months postoperative with stable coverage.

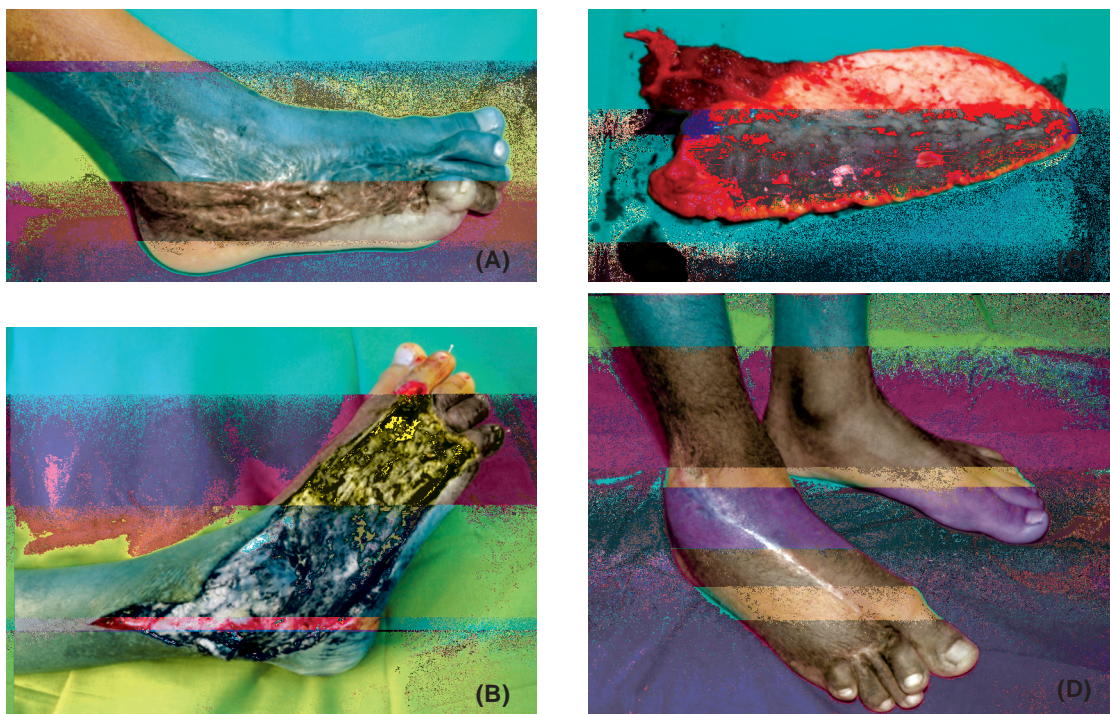


Fig. (3): (A) Contracted scar on the dorsum of the right foot and ankle. (B) After scar release and K-wire fixation of the 2nd and 5th toes. (C) Elevation of the free ALT flap with a piece of the vastus lateralis muscle. (D) Stable coverage with good functional and aesthetic outcome 11 months postoperative.

DISCUSSION

The ideal flap to be used for reconstruction of soft tissue defects of the lower limb should be versatile, well vascularized with long sizeable vascular pedicle, provide good color and texture match and with least donor site morbidity [6].

For large, distal lower limb defects where there is relatively poor vascularity and limited local tissues available to be used for reconstruction, free flaps remain the mainstay for reconstruction [7]. There is a variety of free flaps available for reconstruction of lower limb defects whether muscle or skin flaps. The idea that muscle flaps are superior to skin flaps in lower limb reconstruction especially because they are more prone to cope with infection, some authors find it lacks clinical evidence [8,9]. If adequate debridement, irrigation, hemostasis and obliteration of the dead spaces are achieved, then skin flap coverage is enough [9]. In this study, the majority of cases were having post traumatic soft tissue defects (60%); all were covered by free ALT flaps in the first week post trauma after patient stabilization, bone fixation and wound preparation by serial of debridements and wound irrigation. We had 3 cases of recipient site infection (10%), two of them were diabetics and the remaining one was a tobacco smoker. Our results are comparable with others in the literature; Yazar et al. [10] reported an incidence of post operative infection of 12.7% in their group of patients with distal third tibial and ankle open fractures treated with free fasciocutaneous flaps. Demirtas et al. [11] reported that the incidence of post operative infection in free flap surgery is more associated with history of tobacco smoking and co-morbid factors as diabetes, hypertension and hyperlipidemia. The ALT flap is easy and quick to harvest and it doesn't have a long learning curve [4,6]. In our series the mean operative time was (4.8 hours), we used two-teams working simultaneously; one harvested the flap and the other one prepared the recipient vessels, this might helped in reduction of the operative time. El-Gammal et al. [11], and Lee et al. [12], had comparable results. The ALT flap is a versatile flap and can cover big defects, its length can be up to 40cm and its width can be as big as half of the thigh circumference [1,13]. In this study the flap size ranged between 15-35cm (mean 28.7cm) length and 10-15cm (mean 13.3) width.

In our patients the ALT skin paddle was supplied by musculocutaneous perforators in 87% of cases. Kuo et al. [5] in their review of 140 free ALT flaps used to reconstruct different body parts; they reported that the blood supply of the skin islands was through septocutaneous perforators arising

from the descending or transverse branch of the lateral circumflex femoral artery or directly from the lateral circumflex femoral artery in 19 cases only (13.6%). In the remaining 121 cases (86.4%), it was through musculocutaneous perforators. In our study we did intramuscular dissection of the perforators only in 10 cases (38%) out of 26 cases where blood supply of the flap was through musculocutaneous perforators. In the remaining 16 cases (62%) a small vastus lateralis muscle cuff was raised with the flap, this made dissection of the flap easier and less time consuming. The ALT flap can be harvested as myocutaneous flap whenever bulk is needed to obliterate dead spaces by including part of the vastus lateralis muscle which also helps in improving the local circulation as reported by many authors [13,14]. In our series, we did not evaluate the functional morbidity after harvesting part of vastus lateralis muscle with the ALT flap. However, none of those patients complained of any functional limitations on the donor limb. Kimata et al. [15] and Agostini et al. [16] reported some fatigue at the hip and knee joints while climbing or descending stairs but no affection on the normal daily activities or the range of motion of both joints in those patients. However, Collins et al. [17] reported that the degree of vastus lateralis disruption did not affect the musculoskeletal function. The ALT flap can also serve as a thin flap whenever pliability is needed as in cases of coverage of the ankle, foot or the knee. The flap can be harvested as a thin flap by suprafascial dissection technique or thinning can be done after harvesting of a fasciocutaneous flap either primarily at the time of surgery or secondarily after neovascularization of the flap occurs from its surrounding tissues at the recipient site [11,18]. In this series, we raised the flaps as fasciocutaneous flaps then we did thinning out of them before separation of the pedicle, leaving an area about 1/2 cm around the perforator to protect it. Chen and Tang [3] reported that the ALT flap can be thinned out to the thickness of 3mm to 5mm without compromising the vascularity of the flap. They also advised to leave a circle of fascia around the perforator. Nasajpour and Steele [4] and El-Gammal et al. [11] preferred conservative direct thinning at the time of surgery with special attention to the perforators and then more aggressive thinning to be done later after complete healing of the flap in the recipient site. Being conservative in primary thinning of the flaps, we did not have any flap compromise related to the thinning procedure. Agostini et al. [18] found out that the incidence of the vascular related complications followed flap thinning in the form of partial flap loss, partial distal necrosis, marginal

necrosis or total flap loss was 13.4%, and they reported that the safest plane for ALT flap dissection was the subfascial plane. The suprafascial dissection of the flap makes it thinner, more pliable, avoids muscle herniation and preserves the sensory nerves running in the suprafascial plane. But, it makes identification of the perforators more tedious and disrupts the suprafascial plexus [6].

In our series the donor site was closed directly in 3 patients (10%), in the remaining 27 patients (90%) split thickness skin graft was used to close the donor site. In these 3 patients the width of the flap did not exceed 10cm. Many authors agree that the maximum width of the ALT flap that allows for direct closure is from 8cm to 10cm [19,20,21]. Most of the patients accepted the donor site scar, two patients were unhappy about the appearance of the skin graft on the thighs, they were young females and we could help them by tissue expansion of the adjacent normal skin and excision of the skin graft and using the expanded skin to resurface the donor site. Direct closure of the donor site results in a long scar but more aesthetically accepted than skin graft [22].

Conclusion:

From the results of this study we recommend ALT flap as a good option for reconstruction of large lower limb defects; it has a large well vascularized skin paddle, long large sized pedicle, easily dissected, can serve as a thin flap, has good color and texture match and accepted donor site morbidity. It also allows for two teams working simultaneously reducing the operative time.

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