



De-epithelialized Perforator Based Turnover Flap for Reconstruction of Lower Limb Defects

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Abstract

Lower limbs defects provide us with unique challenge in terms of soft tissue coverage. The definitive decision for flap coverage ultimately requires sound knowledge about the vascular anatomy of lower limb vessels, their branches and perforator vessels. The authors report a case series of a total 20 patients who underwent de-epithelialized perforator based turnover flap over a period of 3 years. Out of these, 16 were males and 4 were females. Out of the 20 patients, 4 patients developed complications in terms of flap loss, partial flap retraction and partial graft loss. The authors thus conclude that with the reconstructive advantages, the de-epithelialized perforator based turnover flap which is a modification of random pattern turnover flap is a simple, reliable and can be considered even a first line option in management of defects of lower limb.

Keywords: De-epithelialized; Perforator flap; Turnover flap; Lower leg defects

Introduction

Lower leg defects are frequently encountered in plastic surgery for reconstruction. Etiology of these defects may vary and factors such as the mode of injury, the site of injury, mechanism of trauma, the state of surrounding skin, state of opposite limbs and any other injuries, if present become important to decide about the type of reconstruction. The definitive decision for flap coverage ultimately requires sound knowledge about the vascular anatomy of lower limb vessels, their branches and perforator vessels.

Lower limbs defects provide us with unique challenge in terms of soft tissue coverage. Various reconstructive options are available for these defects which include random pattern flaps, fasciocutaneous flaps, perforator flaps and free flaps. We have explored here the utility of de-epithelialized perforator based turnover flap, based on the perforator vessels, in coverage of leg defects. With its advantages over traditional flap, the turnover flap has begun to establish itself as a highly effective, quick, and simple solution. They are especially useful in patients presenting with long vertical leg defects.

First use of turnover random pattern flap was described by Dr. Thatté RL in 1981. These flaps, as described, were originally random pattern flaps with limited length to breadth ratio. Taking into knowledge the perforator anatomy of lower limb and the concept of this turnover flap, designing a de-epithelialized perforator based turnover flap provides us with a flap having good vascularity and better chance at survival than traditional random pattern turnover flap. This flap provides an additional advantage with no limitations of its length to breadth ratio and low risk of necrosis of these flaps as compared to their random pattern turnover flap counterparts.

Materials and Methods

Out of all the patients with traumatic lower limb defects coming to or referred to our Plastic Surgery Department between July 2016 to July 2019, a total of 20 patients underwent de-epithelialized perforator based turnover flap after thorough evaluation of their suitability as a candidate for this procedure. Patients were evaluated clinically based on the defect size, location, number, depth, and presence of discharge or sequestrum, status of surrounding skin and presence distal pulsations. Perforators were evaluated close to the defect with hand held Doppler, for its presence and intensity of signals, and accordingly judged for their suitability and utility in flap transfer. A formal duplex scan was carried out preoperatively to assess the distal circulation in the leg. Preoperative preparations with routine laboratory investigations and radiograms done as per protocols. Evaluation was done

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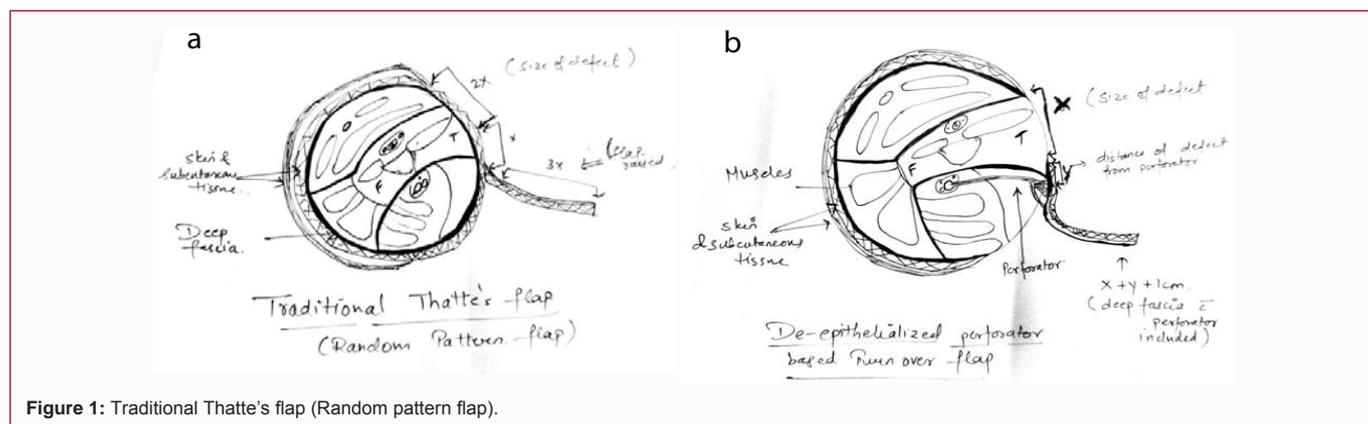


Figure 1: Traditional Thatté's flap (Random pattern flap).

with specific investigations as per presence of co-morbidities.

Under general or spinal anesthesia, perforators were marked using a handheld Doppler sound. After marking of these perforators, tourniquet inflated, thorough debridement of the recipient bed was done and true defect was delineated. Flap to be raised was marked so as the width of the flap to cover the defect equals the total width of defect + distance of the perforators from the defect + 1 cm. This area of presumed flap was then de-epithelialized. This pedicled perforator based flap was raised in its sub-fascial plane up to the perforators, turned over and sutured to the defect with non absorbable material. Anywhere between 2 to 4 perforators were included depending on the length of the flap. More the length of the flap more the number of perforators included in the flap. The donor defect and the turned over flap was then split skin grafted. Postoperatively, the operated limb was immobilized, dressing's changes done on alternate days and the donor site dressing of split thickness skin graft removed after 14th day. Patients were discharged after the split thickness skin graft donor

site healed.

Design

De-epithelialized perforator based turnover flap design compared to traditional turnover flap design as show in Figure 1.

Results

A total 20 patients who underwent de-epithelialized perforator based turnover flap were analyzed over a period of 3 years. Out of these, 16 were males and 4 were females. The mean age was 34.9 years with age group between 19 to 64 years. A total of 8 patients had upper third defect, 5 patients had middle third defects and 7 patients had lower third defect. The defect ranged from 3 cm × 3 cm to 10 cm × 5 cm in its greatest dimensions. Out of the 20 patients, 4 patients developed complications. Out of these 4 patients, 1 patient had partial flap retraction in immediate postoperative period which required re-suturing, 2 patients had partial graft loss with 1 requiring re-grafting

Table 1: The protocol of patients.

No.	Gender	Age (yrs)	Location of defect	Size of defect (cm)	Complications	Intervention required
1	Male	19	Upper third	6 × 3	Nil	Nil
2	Male	22	Upper third	6 × 4	Nil	Nil
3	Male	42	Lower third	10 × 5	Flap loss	Cross leg flap
4	Male	33	Middle third	7 × 4	Nil	Nil
5	Male	25	Upper third	5 × 4	Nil	Nil
6	Female	19	Upper third	5 × 3	Nil	Nil
7	Male	57	Lower third	6 × 2	Flap retraction	Resuturing
8	Male	64	Lower third	4 × 3	Nil	Nil
9	Male	29	Middle third	8 × 4	Nil	Nil
10	Male	36	Lower third	5 × 3	Nil	Nil
11	Male	21	Upper third	3 × 3	Nil	Nil
12	Female	35	Middle third	7 × 5	Partial graft loss	Dressing
13	Male	32	Lower third	3 × 4	Nil	Nil
14	Male	28	Upper third	4 × 3	Nil	Nil
15	Female	36	Lower third	6 × 2	Nil	Nil
16	Male	49	Middle third	8 × 3	Partial graft loss	Regrafting
17	Male	28	Lower third	4 × 4	Nil	Nil
18	Male	46	Middle third	7 × 3	Nil	Nil
19	Female	53	Upper third	5 × 2	Nil	Nil
20	Female	24	Upper third	8 × 3	Nil	Nil



Figure 2 (A and B): Preoperative defect.



Figure 5: After flap elevation.



Figure 3: After debridement.



Figure 6: After inset of flap.



Figure 4: After de-epithelialization.



Figure 7: After split thickness skin grafting.

and the other patient managed with regular dressings. One patient had complete flap loss and required surgical intervention with cross leg flap. One patient who required re-grafting had co-morbidities in the form of diabetes mellitus. According to the protocol, these patients were followed up to 3 months postoperatively (Table 1).

Discussion

The de-epithelialized turn over flap was first described by Dr. Thatte RL in the year 19811 in two cases with peritibial defects in proximal one third area [1]. He subsequently demonstrated the efficacy of turnover flaps in hand injuries and thigh injuries [2,3]. The flaps described by him were vertically pedicled de-epithelialized random pattern flaps which were rolled over like a page of a book to cover the defect (Figure 2). The turned over flap and the adjacent secondary donor defect were covered with a split-skin graft provided by the skin used in the manoeuvre of de-epithelialization (Figure 3). As an alternative to other techniques, turnover dermal fat flaps and turnover adipofascial flaps were used for reconstruction of the defects and the utility of these adipofascial turnover flap or turned over skin flap is now well established [1,4-8]. These flaps are easy to perform with minimal dissection in the leg.

The largest study on the efficacy of the turn over flaps was done by Mitra et al. [9]. In this study 103 cases in which turn over flap was used over a span of 16 years i.e., between 1987 to 2004 were studied.



Figure 8 (A and B): At follow up.

Out of 103 cases, partial and complete graft loss was seen in 10 and 8 cases respectively and most of which had end stage vascular disease. In their study, the turn over fasciocutaneous flaps were flap of choice in a variety of situations rather than being a last option (Figure 4). They concluded that the turn over flaps should be given higher priority as a reconstructive option, especially in patients with small wounds, wounds without the option for free flaps, wounds in end-stage vascular disease, in the lower third of the leg, the ankle, and in wounds with exposed Achilles tendon.

Sharma et al. [10] described use of proximally based de-

epithelialized fasciocutaneous flap for coverage of defects in the lower thigh and knee joint. These flaps were based on a number of perforators around the knee joint and can be based either posteriorly, postero-medially or postero-laterally depending upon the location of the defect (Figure 5). The whole of the flap including the bridge segment is de-epithelialized and turned over by 180 degrees and a split thickness graft is placed over the flap and the donor site. They concluded that the flaps can be raised quickly, have minimum morbidity and are reliable even in the presence of extensive injuries (Figure 6). These flaps remained stable and trouble free during a follow up period of 2 to 4 years. Panagakos et al. [11] also used a de-epithelialized fasciocutaneous turnover flap to cover defects over calcaneum.

Taking a cue from above studies, a de-epithelialized perforator based turnover flap was performed in 20 patients with lower limb defects over a period of three years (Figure 7). Comparable to the study conducted by Mitra et al. [9] who used these flaps in their routine reconstructive armamentarium, it was also among the first line options for reconstruction of defects in the lower limb. Unlike the random pattern flap used by Mitra et al. [9] as a turn over flap, perforators and its overlying fascia were included in these turnover flaps similar to the study conducted by Sharma et al. [10] and Panagakos et al [11].

In our study of 20 patients undergoing de-epithelialized perforator based turnover flap over period of 3 years, 4 patients had complications with 2 being major requiring cross leg flap and re-grafting (Figure 8). The 16 patients had completely uneventful postoperative course. In the study conducted by Mitra et al. [9], a total of 10 partial flap losses and 8 complete flap losses were present whilst in our study one patient had complete flap loss. Comparable to the study conducted by Sharma et al. [10], inclusion of deep fascia and perforators in the flap resulted in better outcomes with regard to flap viability and survival.

De-epithelialized perforator based turn over flaps are one of the less explored flaps for coverage of lower limb defects and are generally placed below the routine pedicled flaps, free flaps, propeller flaps in the reconstructive armamentarium.

The pedicled flaps such as cross leg flap require multiple stages and long period of immobilization which is cumbersome, reverse sural flap frequently is complicated by issues of venous drainage leading to venous congestion, distally based fasciocutaneous flaps at the site of pedicle are bulky with large 'pig ear' and may need secondary flap division later. Propeller flaps, on the other hand, require perforator dissection and is technically demanding requiring surgical expertise. Free flaps are useful in patients with extensive defects or in whom the vascular supply precludes use of local flaps. Although free-tissue transfer avoids the above limitations, it requires pro- longed operative time, is technically demanding in this area and may not be suitable in all the patients.

These de-epithelialized perforator based turn over flaps provide certain advantages for reconstruction as they reduce donor site morbidity, site of flap being close to the existing defect, less dissection of surrounding tissues, no need for perforator dissection as in propeller flaps or free flaps, inclusion of perforator and fascia provides good vascularity thus eliminating length breadth ratio considerations and making the flap more 'pliable' with better chance at survival. These flaps also provide us with ease of transfer, minimal invasiveness, more acceptable cosmetic result, short duration of surgery, no need of microvascular anastomosis and good patient tolerance as compared to long duration and multi-staged surgery. Also these flaps are particularly useful for coverage of long vertical defects.

Conclusion

Various reconstructive options are available for coverage of lower limb defects. Traditional flap techniques, free flaps, propeller flaps have their unique challenges in terms of reconstruction. With its reconstructive advantages, the de-epithelialized perforator based turnover flap is a simple, reliable and even a first line option in management of defects of lower limb.

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