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CASE STUDY

Realm of Supramalleolar Flap Cover in Dorsal Foot, Ankle and Leg Defects

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ABSTRACT

Background: Preservation of foot and leg mobility is critical in debilitating traumatic and pathological conditions, such as diabetes and peripheral vascular diseases, which lead to significant foot and leg defects and potential amputations. The supramalleolar flap offers a promising solution for covering defects in the dorsal foot, ankle, and leg, providing a reliable and robust method to preserve tissue and function. **Methods:** This study reviewed patients with dorsal foot, ankle, and leg defects treated at our center from november 2022 to august 2024. The inclusion criteria focused on various defects caused by trauma, diabetes, or post-surgical conditions, excluding those with peripheral vascular disease or severe cardiac illness. The study utilized various assessment tools, including arterial vascular doppler and computed tomography and angiography, to ensure the viability of the flap coverage. **Results:** The study successfully demonstrated the efficacy of the supramalleolar flap in 12 patients with wide range of defects. The flap showed a high survival rate with only one instance of partial necrosis. Most patients showed good postoperative recovery, with the flaps providing satisfactory coverage without significant complications. **Conclusion:** The supramalleolar flap is an effective and reliable option for covering defects in the anterior aspect of dorsal foot, ankle, and leg areas. It offers a significant advantage in reducing the risk of amputation and preserving mobility, particularly in patients who are not candidates for more complex reconstructive options due to systemic health issues.

Keywords: Supramalleolar Flap, Foot Defects, Reconstructive Surgery

INTRODUCTION

Lower limb is an integral part of human life. Upright mobility is bestowed to mankind due to the favourable and stable anatomy of lower limbs. Many disease and trauma are leading to amputation of foot and leg causing disability, hence to maintain normal mobility and living, preservation of foot and leg is important.

Traumatic and pathological diseases like diabetes, peripheral vascular diseases and post surgically created defects for tumours are common causes of foot defects.[1,2] These defects are increasing over years due to increasing trauma and uncontrolled diabetes. These defects add to the morbidity of the patient and also lead to further loss of foot to amputation.[3]

Salvaging the foot and preserving the mobility of patient is of utmost importance to allow the patient to lead a near normal life.[4]

There are multiple options for the coverage of defects, it may be local flap, regional flap, free flap or at-last cross-leg flap. Each flap has its own benefits and flaws. Lower rungs of reconstruction provide less donor and surgical morbidity, at the same time provide reliable coverage. Whereas, higher rungs are fraught with higher donor and systemic morbidity.[5]

It is a fascio-cutaneous flap with advantage of sparing muscle, not being bulky, malleable and with similar texture of tissue to the lower leg and foot.[2] Posterior leg and plantar foot defects have readily available reverse sural flap for cover, whereas this is lacking to the dorsal lower leg, ankle and foot defects.[6]

Ankle and foot are in frequent motion, hence any defect in these region requires a good reliable and robust flap cover. Restriction of movements due to foot and ankle defects hinder normal mobilization and inability to perform basic works.

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Hence, though old enough yet less utilized, a regional flap – so called supramalleloar flap is used in studying the extent to which the foot defects can be covered and salvaged.

METHODOLOGY

All patients visiting the out patient department of Plastic surgery department at our centre with foot defects irrespective of the cause were thoroughly assessed and included in the above study after fulfilling the requirements.

Inclusion criteria

1. Dorsal foot defects including dorsomedial and dorsolateral defects.
2. Traumatic/ diabetic/ post surgical defects.
3. Crush injuries.
4. Defects less than 5cms in width.

Exclusion criteria

1. Patients with peripheral vascular disease.
2. Defects more than 5cms in width.
3. Severe cardiac illness.
4. Patients not willing for surgery

Each patient with foot defects were classified according to the site of defect and their respective size and the condition of the underlying tissues was documented. The extent of the flap that can be procured was measured. All other routine investigations for the pre-surgical work up was done. patients underwent assessment of peripheral vascular disease clinically and when required only selected patients underwent arterial vascular doppler ultrasound and computed tomography angiography

Table 1: Patient demography

Sl. no	Age (yrs)	Gender	Defect site	Etiology	Result
1	17	M	DISTAL DORSAL FOOT	TRAUMATIC	HEALTHY FLAP
2	19	M	PROXIMAL DORSAL FOOT	TRAUMATIC	HEALTHY FLAP
3	60	M	MIDFOOT STUMP-ANTERIOR	DIABETIC FOOT	HEALTHY FLAP
4	58	F	LOWER LEG -ANTERO MEDIAL	DIABETIC FOOT	HEALTHY FLAP
5	62	M	DISTAL DORSO-MEDIAL FOOT	DIABETIC FOOT	HEALTHY FLAP
6	56	M	DISTAL MEDIAL FOOT	DIABETIC FOOT	HEALTHY FLAP
7	48	F	FOREFOOT	TRAUMATIC	HEALTHY FLAP
8	44	M	ANTERIOR ANKLE	DIABETIC FOOT	HEALTHY FLAP
9	27	M	PROXIMAL MEDIAL FOOT	POST SNAKE BITE	HEALTHY FLAP
10	52	F	MIDFOOT STUMP-ANTERIOR	DIABETIC FOOT	HEALTHY FLAP
11	49	M	DISTAL DORSO-MEDIAL FOOT	DIABETIC FOOT	FLAP NECROSIS
12	44	M	DISTAL MEDIAL FOOT	TRAUMATIC	HEALTHY FLAP

The patients involved in the study were followed upto 6 months post surgery in terms of any recurrence of wound, flap dehiscence or flap loss and donor site complications like graft loss and non healing of wound.

CASE SCENARIOS

Case 1: **Distal dorsal foot defect**

A 17 year old young male had sustained road traffic accident following which he had avulsion injury to his left forefoot involving proximal great toe.

The defect had exposed the first metatarsal and proximal phalanx with tangential loss of bone as shown in figure 1a.

Patient underwent debridement of the wound and the defect was covered with supramalleolar flap which survived well.

Case 2: **Distal medial foot defect**

Similar to the above case, a 56 year old male had medial forefoot debridement and great toe disarticulation as shown in figure 2a. As the vital structures,-the tendon and bone were exposed, flap cover was inevitable and supramalleolar flap was done to salvage foot.

Case 3: **Distal dorsomedial foot defect**

A 62 year old male with wet gangrene of left great toe with proximal progression associated with fever had undergone wide debridement leaving the tendons and exposing first metatarsal. Wound was not improving with bone and tendon getting dessicated . Hence, supramalleolar flap was done to save the foot, both healed flap and donor site are shown in figure 3c and 3d.

Case 4: **Midfoot anterior defect**

A 60 year old woman with uncontrolled diabetes for over 2 weeks had developed wet gangrene of the forefoot with associated features of sepsis.

Patient underwent midfoot amputation with exposure of tarsal bones.

She underwent a flap cover once the infection was under control. Supramalleolar flap was selected in this case to close the defect, as the reach and size was reliable. Defect, flap and donor site are shown in figure 4.

Case 5: **Proximal dorsal foot defect**

A young 19 year old male with proximal dorsal foot defect with exposed underlying bone underwent supramalleolar flap cover and had a good post -op recovery.

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Case 6: **Anterior ankle defect**

A 44 year old male patient had developed a small wound over the anterior aspect of lower one-third of right leg, which over time increased in size and had exposed the tendon of anterior compartment with widening and non healing of wound.

The location over antero-medial aspect of leg just above the ankle made it necessary to provide a reliable flap of adequate size. Hence, supramalleolar flap was done.

Case 7: proximal medial defect

A 27 years old young male had survived a viper snake bite to his foot, and suffered from soft tissue gangrene and tissue loss of his left proximal medial foot.

He underwent conservative management for wound healing post debridement of his necrosed soft tissues exposing the tarsal bone of his left foot.

The patient had spent 5 months with non healing wound for which he was referred to plastic surgery department. Supramalleolar flap was done in two stages and flap divided, and both donor and recipient areas healed well without any complications.

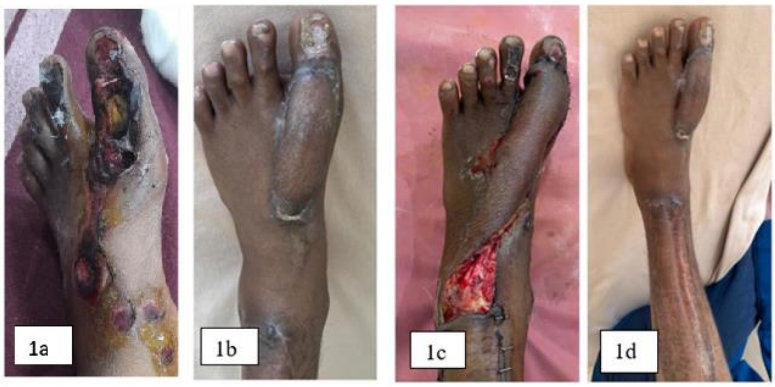

Figure 1: Young male patient with traumatic defect post road traffic accident, had sustained a dorsal great toe defect with tangential dorsal bone defect which was covered with the supramalleolar flap and healed picture of the flap and healed donor site is shown in figure 1d .

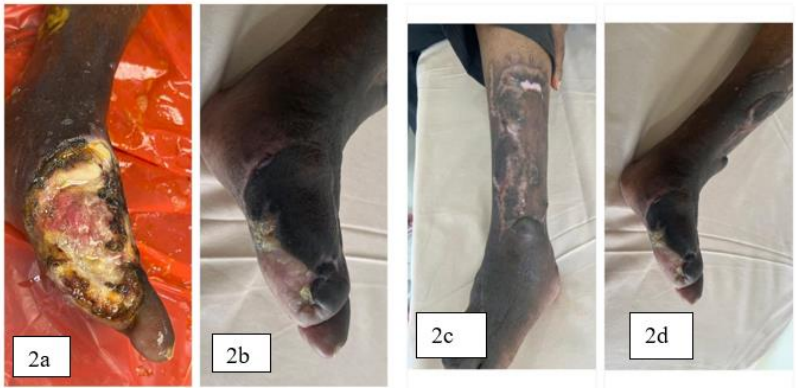

Figure 2: Elderly male with forefoot defect with necrotic bone and loss of tendons of great toe with debridement with flap cover shown in figure 2a and 2b , with healed donor and flap in figure 2c and 2d

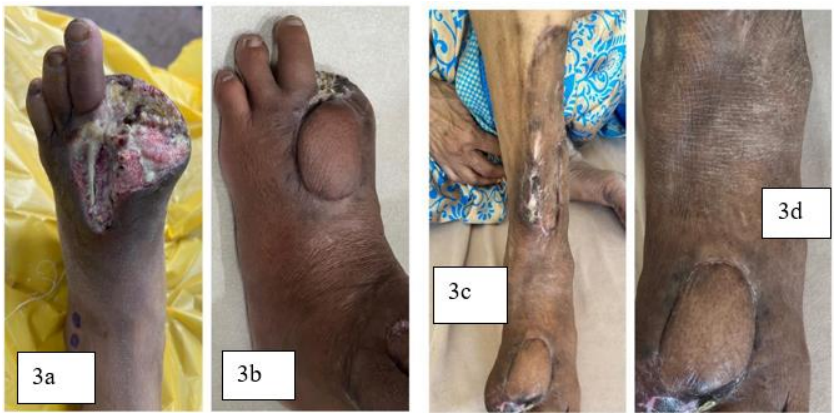

Figure 3: Elderly female with distal anteromedial dorsal foot defect had flap cover with preservation of foot. Figure 3c and 3d are the photos of flap and donor site.

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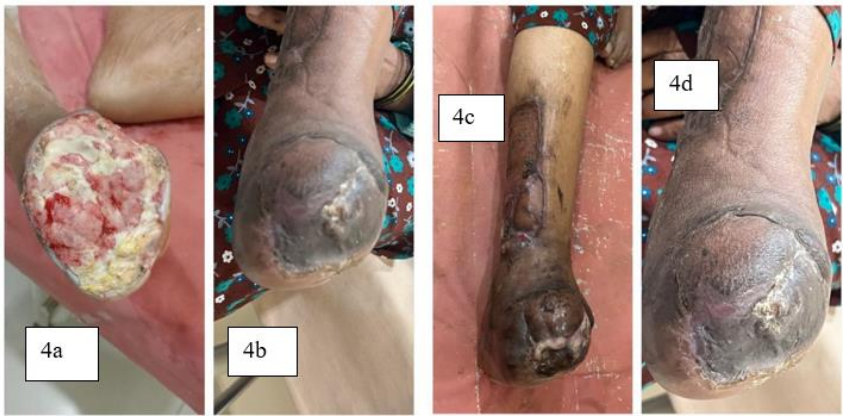

Figure 4: Elderly female with mid foot amputation with supramalleolar flap cover had successful wound healing.

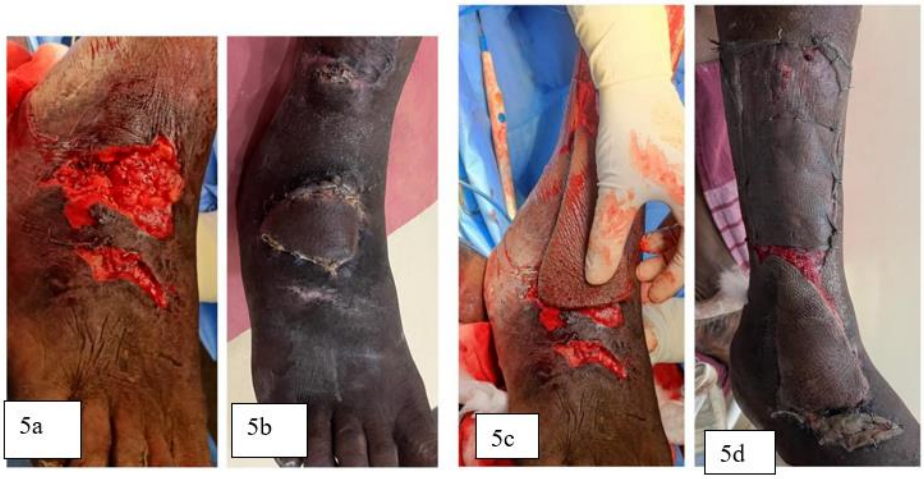

Figure 5: Young male with proximal dorsal foot defect post trauma underwent supramalleolar flap and had healthy post operative period.

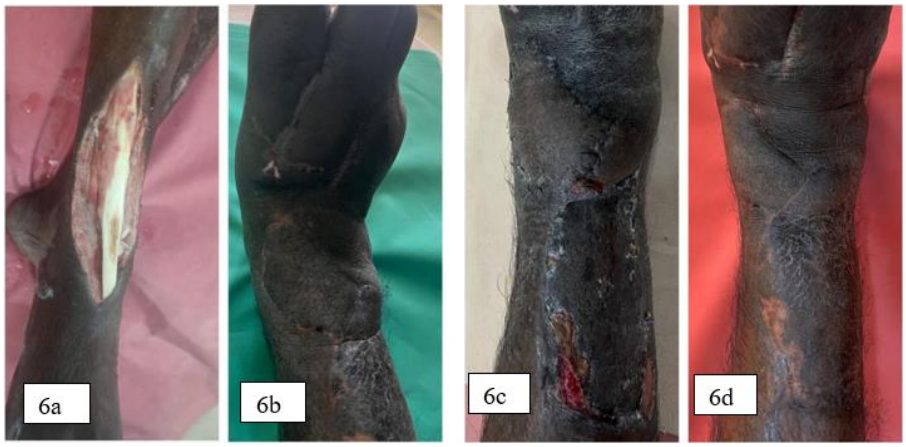

Figure 6: Elderly male patient with anterior ankle defect due to infectious tissue loss had supramalleolar flap cover. Flap and graft picture shown in figure 6b-6d.

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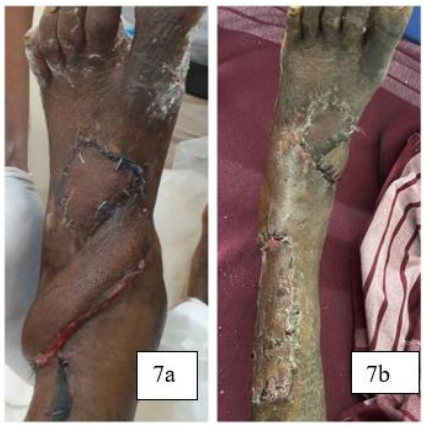

Figure 7: Young male post snake bite with proximal medial foot defect underwent flap cover. Above photos of flap inset(figure 7a) and divided flap with graft in figure 7b.

RESULT

A total of 12 patients were operated, among which 8 were males and 4 were females. Age ranged from 19 to 65 years. Two females and five males were diabetic. Other four patients were of traumatic injury and one patient with post snake bite defect. One of the diabetic male had partial necrosis of flap, except that all other flaps survived and healed well. The perforator position for the flap ranged from 2 - 5 cm above the lateral malleoli.

Distal cover of foot required to be based on anastomotic branch from anterior tibial artery branch. Proximal cover could be easily based on the peroneal perforator. All flaps were peninsular and largest harvest was 21 x 4 cm^2 and the smallest of 10 X 5 cm^2. All patients were followed upto 6 months and all the flaps except one with partial necrosis, had taken well without any further complications.

DISCUSSION

Foot trauma and infections are common causes leading to large and non-healing wounds or defects. These causes are fraught with amputations and morbidity.

Treating these wounds in time and providing cover is quintessential in saving the limbs to decrease mortality and morbidity associated with it.[1]

There are simple to complex flaps to cover foot defects. Simple or local flaps are the most reliable with less deformity and complications.[7,8,9] Hence this study is to focus on readily available robust reliable flaps for dorsum of leg foot and ankle.

The reverse sural flap is commonly used for posterior leg and foot defects, whereas such reliable and regular flap is lacking for dorsum of foot and leg defects.[8] We have studied the reliability, feasiblity and extent of the flap to cover dorsal ankle, foot and lower leg anterior defects. One such flap which is less utilised is supramalleolar flap. It has a constant and reliable vascularity with favorable adjacent location to foot and ankle. It has less donor site morbidity and complications.[10]

The flap was first discovered by Masquelet et al in 1988.[11] This flap is designed between anterior tibial border and posterolateral border of fibula and proximally upto mid-leg. The peroneal perforator emerges through the interrosseous membrane above tibiofibular ligament. There are other communicating arteries like anterior malleolar artery from anterior tibial artery which also supply the flap. Distal pedicle to increase the reach of the flap to the defect may require ligation of these proximal perforators.[12]

It can be selected as the initial flap for moderate anterior lower one-third leg, ankle and dorsal foot defects. Patients with cardiac ailments who cannot withstand long procedures of microvascular surgery and where it is not feasible may undergo this flap cover.

This flap has the advantage of being salvage flap too when there is loss of major flaps or microvascular flaps.[13] The anterolateral region of lower leg is spared in most of the cases making it available for cover and its multiple anastomosis around the ankle renders it favourable to utilise it when it is near the trauma zone.[14]

There are different regions in foot which may be injured and covering those regions with local flap especially the distal toes and forefoot is a challenge, we had a similar case where a young man had sustained trauma to the great toe with tangential loss of skin, subcutaneous tissue and partial parallel bone loss with exposed matatarsal and proximal phalanx which was covered with supramalleolar flap which healed well rehabilitating his foot into normalcy.

CONCLUSION

Supramalleolar flap is a readily available, robust and reliable to cover the anterior lower leg, ankle and dorsal foot defects upto distal great toe.

Though use of free flap has become common in foot defects,[15] it is a lengthy procedure, and the associated complications makes it impossible to follow in old debilitated patients with cardiac comorbidity and peripheral vascular diseases.

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Whereas supramalleolar flap is a local flap, easy to harvest and not associated with major complications. It is available in most of the situations with constant perforator and modifications to improve the reach to distal dorsal foot. With these flaps there are lot of opportunities to save foot from undergoing amputations after traumatic and infected foot defects.

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