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PROPELLER PERFORATOR FLAP FOR PROXIMAL DEFECTS OF THE LEG: A TEN YEAR EXPERIENCE
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ABSTRACT

Background: **Compound fractures of the leg require reconstruction with flaps to ensure faster recovery and prompt return to functionality. Compared to the other flaps, propeller perforator flaps are the most recent discovery. They have been used to cover defects of the distal leg with few cases reported for the proximal third of the leg probably due to the fact that many options are already available. We present our experience with the use of these flaps for defects of the upper third leg.**

Objective: **To prospectively audit patients with defects of the proximal leg operated on with propeller flaps**

Study Design: **This was a prospective review of patients operated on with propeller perforator flaps to cover defects of the proximal third of the leg between January 2014 and December 2024. An appropriate perforator was identified with the use of hand held Doppler in the proximity of the wound after which a propeller flap was raised and rotated into the defect. The donor site was then either closed primarily or with a skin graft. Post operatively patients were reviewed at a regular interval for at least one year to determine on the outcomes.**

Study Setting: **The study was carried out at various facilities in Nairobi including Kenyatta National Hospital, Coptic Mission Hospital and the Nairobi Hospital**

Study Subjects/Participants: Thirty five (35) patient with defects involving the proximal third of the leg covered with propeller flaps.

Results: **A total of 35 patients were operated on with perforator flaps in the said study duration. 31 patients had wounds with exposed bone with 4 patients below knee amputation stumps. The mean age for the patients was 46.7 years with a range of 18 to 67 years. Forty seven (47) percent of the flaps were based on the posterior tibial vessels with the rest on the peroneal and anterior tibial vessels. Flap success rate was more than 91 percent with only three flaps having partial necrosis. There was no case of complete flap failure.**

Conclusion: **Perforator flaps are reliable flaps for reconstruction of defects in the proximal leg. They have less donor and recipient site morbidity. They should thus be considered in armamentarium of reconstruction options.**

INTRODUCTION

Propeller perforator flaps have revolutionized management of wounds of the lower extremity since inception in the last two decades (1-4). These flaps are now workhorse flaps in many centers for covering defects of the legs (1-4). Among the advantages is the relatively ease of flap elevation, less donor site morbidity and ease in monitoring. As a result of this, they have been widely advocated for as the first options in the reconstruction of the defects of the distal leg more so in centers where microsurgery is unavailable (5).

Defects of the proximal leg on the other hand has had many options of reconstruction. They have traditionally been managed by muscle and fascio-cutaneous flaps (6.7). Muscle flaps commonly used have been gastrocnemius and soleus muscles while facial flaps include saphenous and sural flaps (5,6). Though quite reliable they do require extensive dissection leading to undesirable donor site

morbidities. They are also limited on the extent of the flaps reach since they rely on a fixed pedicle. Raising these muscles could also compromise blood supply to overlying subcutaneous tissue that may result in skin necrosis. Inadvertent damage to the nerves and the lymphatic vessels are also likely complications. We therefore opted to use perforator flaps as the default flaps for reconstructing defects of the proximal third of the leg . We share our experiences and outcomes in the last ten years.

MATERIALS AND METHODS

Patients with wounds of the proximal leg requiring coverage with local flaps were followed up during the study. For all patients the etiological cause of the wound was noted. Conventional wound bed preparation was done using surgical debridement followed by either gauze dressings or negative pressure wound therapy. Once wounds were ready for closure a perforator was identified in the proximity of the wound with the source vessel noted. A propeller flap of dimension slightly larger than the defect was then meticulously raised on the perforator. The dimensions of the flaps were noted. The flap was then advanced into the wound and secured with sutures or staples. The donor site was covered with a skin graft. Post operatively patients were monitored closely to note for any complications such as flap failure, skin graft loss or donor site morbidity for at least one year. Captured data was summarized and presented in terms of table with most frequently used flaps noted.

RESULT

A total of 35 patient with defects of the proximal leg were operated on with propeller perforator flaps. The male to female ratio was 4:1. The mean age for the patients was 46.7 with the range from 18 to 65 years. The mean surface area of the flap was 62.5 cm^2, with a range of 32 to 84cm^2. Etiological causes of the defects were trauma leading to compound fractures in 31 patients, diabetic patients and four amputation patients (Table 1). Seventeen flaps utilized posterior tibial vessels as source vessels with 14 peroneal vessels and the remaining 4 anterior tibial vessels. Overall complete flap survival was 32 out of 35 flaps. (Figures 1-4).

Figure 1A: Patient with below knee amputation, with wound ready for closure after Negative pressure wound therapy

Figure 1B, Propeller flap raised based on the posterior tibia vessels .

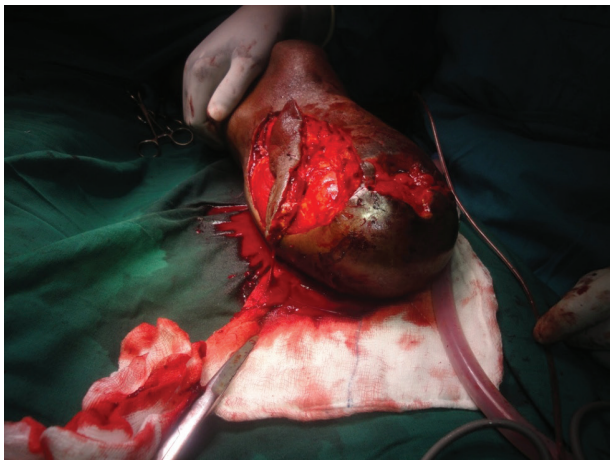

Figure 1C, Propeller flap advanced into the defect .

Figure 1D , Skin graft used to cover the donor site

Figures 2 and 3: Propeller flap based on the posterior tibial vessels used to cover the wound.

FIgure 2A , patient with proximal defect of the left tibia ready for closure with a propeller perofrator flap based on posterior tibial perforators

FIgure 2B . wound adquately covewred with a propeller flap.

Figure 3: Patient with propeller flap at one year of follow up for coverage of proximal tibial defect .

Partial flap necrosis was noted in three patients. There was no complete flap loss in any patient. All donor sites had good skin graft take. Partial flap loss wounds were managed by dressing until they healed

Table 1: summary of the results

Flap Source vessel	Frequency	Percentage
Posterior Tibial Vessel	17	47
Peroneal vessel	14	42
Anterior tibial vessel	4	11
Mean flap surface area	62.5	
Etiology		
Diabetic foot	4	11
Trauma	31	89

DISCUSSION

Propeller perforator flaps first described by Hyakosuku and refined by Teo have been in use since the late 20th century (6,). These flaps raised on perforators that pierce the fascia from the source vessels have considerably changed management of wounds of the extremities. Although popularized mainly for the middle and distal third of the legs, there use have been widespread with virtually any part of the body benefitting. The selling points for the flaps have been ease of dissection, best colour match, (replacing like with like) and reduced donor site morbidity. Further preservation of main blood vessels which are otherwise sacrificed in free flaps as well as avoiding need for anastomosis has made them popular more so in centers where microsurgery is not practiced routinely (3,7-11).

Despite this, muscle flaps especially gastrocnemius and soleus have still remained Workhorse flaps for the proximal defects of the leg (5). These two muscles have been reported widely for coverage of wounds

of the proximal leg including coverage of orthopedic hardware's. They are however limited by the extent of their reach. In many cases they are also within the zone of injuries making them unreliable. Raising them requires extensive dissections of the subcutaneous tissues that may be de- vascularized in the process leading to a bigger and more complex wound to reconstruct. In view of this we opted for propeller perforator flaps as the flap of choice for defects of the proximal tibia.

In our series we demonstrate the reliability of propeller perforator flaps for reconstructing defects of the proximal third of the leg. The overall flap success rates was over 90 percent with the mean defect covered being 62.5cm^2 with a range of 32 to 88cm^2. Most of the flaps raised were from the posterior tibial artery followed by the peroneal and anterior tibial vessels. The donor site in all cases healed without any complications.

This findings closely mirrors previous studies on the reliability of the propeller perforator flaps Hifnry *et al* in there series reported posterior tibial artery as the most common vessel utilized in raising the perforators (8). They had a high flap success rate with the common complication being partial flap necrosis. A systematic review by Gir P *et al* reported total flap failure in only 1.1 percent of the patients. Partial flap necrosis was noted in 8.1 percent of the cases (12). Another series by Tugril Yildrim *et al* had similarly good outcomes with the most common complication reported being partial flap necrosis . (3) Flap complications were not influenced by age, anatomical location or size of the defect being reconstructed . Koh *et al* in a comparative study between free and pedicle perforator flaps for defects of the leg noted similar success rates between them. They however recommended perforator flaps if adequate healthy soft tissues remain adjacent to the defect, forecast a continuance of the evolution in seeking simplicity yet reliability by the best flap possible for soft tissue closure of the lower limb wound (9).

Other than reconstruction of the traumatic wounds a significant proportion of the patients reconstructed in our series were patients with below knee amputation as result of diabetic mellitus.

In this patient the propeller flap was used in covering the amputated distal stump so as to provide well-padded soft tissue in anticipation of an artificial prosthesis use. As a result of this a long stump was preserved ensuring faster ambulation by the patient (Figures 1A-D).

CONCLUSION

Propeller flaps provides a reliable option in reconstructing wounds of the proximal tibia. The flaps have a reliable blood supply, are easy to raise and have a less donor site morbidity. They should therefore, be considered as the first option in reconstructing defects of the proximal tibia. Other uses for these flaps should be in covering below knee post amputation stumps.

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