

Experience with Perforator Based Flaps for Wound Cover of the Leg and Foot at Nakuru and Eldoret in Kenya.

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Background: Open fractures of the distal third of the tibia and fibula offer a challenge to the orthopedic surgeon because of skin coverage. The reconstructive surgeon's help is often required in trying to achieve this. There are several options: - local flap, free flap or a cross leg flap. Local flaps have always had limitations because of the doctrine of length breadth ratio. Perforator vessels have widened the scope for local flaps. The main objective of this study was to study to evaluate ipsilateral perforator-based fasciocutaneous flaps as a modality for covering leg and foot defects.

Method: A prospective study was conducted from June 2009 to July 2010. A total of twelve procedures on eleven (11) patients who presented with Grade III open fractures of the distal third of the tibia/fibula had their wounds debrided. Three days later a perforator based flap was used to cover the exposed bone. The perforators were identified using a hand held Doppler machine. The secondary defect was skin grafted with a split thickness skin graft.

Results: There were 7 males and 4 females with their ages ranging from 4 to 56 years. All the flaps settled well except for two. One flap had minimal marginal necrosis which granulated well and healed with dressing changes, while another flap suffered total necrosis.

Conclusions: Perforator based flaps are a useful and cheap option in management of Grade IIIB fractures especially in the distal third of the tibia.

Introduction

Soft-tissue cover of the lower extremity is a formidable challenge and the difficulty is more pronounced in the most distal area of leg and foot¹. The tight skin envelope around the leg means that fractures in the leg are likely to be open and also limits the options for wound coverage.

The options available for cover include:

- Split thickness skin graft
- Vacuum assisted closure (VAC) dressing
- Local flaps
- Cross leg flaps
- Muscle flaps
- Free flaps

Free flap is the Gold standard especial in the distal third of the leg since it provides a soft tissue cover that is aesthetically pleasing. The limitations are the equipment and skills required which are enormous. The classical approach for repair of proximal defects has been via the transposition of the neighboring soleus or gastrocnemius muscles^{2, 3}. If the zone of injury includes these muscles any substantial skin necrosis may require the microsurgical transfer of tissue in order to obtain wound healing^{4, 5}. Even within the best medical centers, these are lengthy procedures with an inherent rate of major complications in the lower extremity^{6, 7}. This is a technique that is not readily available in the region.

Previously local flaps had been considered to be inadequate because of the 1:1 of length to width ratio which limited the size of the flap. Ponten in 1981 showed that the inclusion of the deep fascia with local skin flaps enhanced their survivability⁸. A 3:1 or larger so-called super flap could be designed with greater reliability⁸⁻¹⁰. These flaps were referred to as perforator flaps. Wei defined a "perforator flap" as one where the skin vessel comes from the main pedicle through the muscle¹¹. The perforator vessels are now defined as direct to skin or indirect (musculocutaneous/septocutaneous)¹². A local perforator flap is considered as a cutaneous flap based on a single perforator, raised and transferred locally¹³.

Perforator flaps in the leg and foot are based on the perforators from the major vessels of the leg, anterior and posterior tibial arteries and the popliteal artery. In the distal third of leg most of the perforators are based 4-8cm above the malleoli. Preoperative color Doppler study¹⁴ helps in locating the main vessel and the site and size of perforators which in turn helps in designing the fasciocutaneous flap. Bedside audio-Doppler is a useful alternative to color Doppler¹⁵.

The advantages of perforator flap are:

- It has a safe vascularity
- A less complicated procedure
- Applicable in both acute and chronic wounds
- Provides a stable and pliable soft tissue cover
- Allows tendon gliding
- Can be used as a free flap
- The post operative care is less complicated
- Does not require any special setup or training
- External fixator does not preclude their use
- Future surgery can be performed through them
- No muscle function is expended¹⁵.

The disadvantages are

- Split thickness skin graft of the secondary defect alters the normal contour of the leg and the resultant hyper pigmentation of the graft may give a poor cosmetic result especially in females.
- May require two stages for inferiorly based flap with intervening normal tissue where division of the pedicle is performed under local anesthesia¹⁶.
- The flap is raised within the zone of injury and that its vascularity could be compromised¹⁷.

Patients and Methods

This was a prospective study based on patients operated upon by the author during the period of June 2009 to July 2010. The setting was The Rift Valley Provincial General Hospital, Nakuru and Moi Teaching and Referral Hospital, Eldoret. The patients were referred by primary care doctors who had performed the initial surgeries.

The patients included in the study were those with:

- Open fractures of the tibia including distal third,
- Degloving injuries with exposed calcaneus, and
- Exposed tibial implants

Any patient who had unhealthy tissue adjacent to the wound was excluded from the study. The surgery was performed after an average of 3-5 days and lasted between one hour and two hours and was performed under tourniquet control.

The soft tissue cover around the wound was assessed to confirm tissue viability for local flaps.

Perforators adjacent to the wound were identified using a hand held Doppler.

Reverse planning of the flap was then performed using lint cloth. The flap was raised based on the perforator(s). In case of two perforators being identified the smaller one was sacrificed if it interfered with the flap transposition. Once the flap had been raised the tourniquet was released to confirm flap viability and also achieve hemostasis. The flap was then transposed to the wound and inset. A tube drain was placed under the flap and the secondary defect covered with split thickness skin graft harvested from the ipsilateral thigh. The average tourniquet time was one and a half hours. The dressings were performed with a window left for assessing flap viability.



Figure 1. Hand held Doppler

Post operatively the limb was kept elevated. None of the patients were put on any anticoagulants. The flap was reviewed at 24hrs and then daily until the 7th post operative day when the skin graft site was exposed. The drain was removed on the 3rd to 4th post operative days.

Results

The age range was 4-56 years, with a sex ratio of 1.75:1. 12 flaps were performed on the 11 patients with one patient having surgery performed on both legs. 58% of the flaps were based on posterior tibial artery, with 25% and 17% being based on the peroneal and anterior tibial arteries respectively.

Patient	Age	Sex	Diagnosis	Flap type	Outcome
1	36	M	Gustillo IIIB Left Tibia	Posterior Tibial	Good
2	50	M	Gustillo IIIB left Tibia	Posterior Tibial	Good
3	25	M	Gustillo IIIB right tibia	Posterior Tibial	Marginal necrosis
4	18	F	Degloved right heel	Peroneal	Good
5	11	M	Degloved right heel	Posterior tibial	Good
6	4	M	Compound fracture dislocation left ankle	Peroneal	STSG infection
7	32	F	Gustillo IIIB Right proximal tibia	Tibialis anterior	Good
8	13	F	Gustillo IIIB distal third left tibia	Islanded tibialis anterior	Flap loss
9	12	F	Gustillo IIIB distal third right Tibia Gustillo IIIB proximal third tibia with bone loss	Peroneal Posterior tibial artery	Good Good
10	56	M	Gustillo IIIB proximal left tibia	Tibialis posterior	Good
11	42	M	Exposed implant proximal left tibia	Tibialis posterior	STSG infection

Patient 1



1A. Preoperative: granulation tissue over the tibia at the fracture site



1B. Wound after debridement



1C. Flap transposed to cover exposed bone



1D. Immediate postoperatively



1E. 4 weeks post operatively

Patient 6



6A. Wound after debridement



6B. Intra operatively with flap in situ

11A. Wound with exposed tibia and screw



6C. 4weeks post operatively

11B, Immediate post operatively



Patient 11



11C. Two weeks postoperatively

The age range was 4-56 years, with a sex ratio of 1.75:1. 12 flaps were performed on the 11 patients with one patient having surgery performed on both legs. 58% of the flaps were based on posterior tibial artery, with 25% and 17% being based on the peroneal and anterior tibial arteries respectively. Only 2 out of the 12 flaps had complications with one having marginal necrosis and the other a total flap loss. The wound with the total flap loss was managed with negative pressure dressing and subsequently skin grafted with split thickness skin graft. 2 of the skin grafted areas had some infection which responded well to dressings

Discussion

A total 73% of the patients managed had Gustillo IIIB fractures of the tibia. In the series of Quaba et al, they had 47% of their patients with Gustillo IIIB injuries¹⁷. In our case series 64% of the perforators had their source vessel as the Posterior tibial artery. The Posterior tibial artery has been found to be the most versatile source vessel for perforators for lower leg reconstruction¹⁷. These perforators although small in number, are of larger diameter than those from the anterior tibial and peroneal axes¹⁸.

We had one total flap loss which occurred in an islanded flap. This represents a necrosis rate of 8% which compares with the results of Chatre and Quaba¹⁸. Our flap loss could have been because the flap which was large was based on a small perforator. It has been identified that the best Perforators to sustain a flap are the intermediate or large ones¹⁶. This perforator was also close to the zone of injury. It has been found that the flaps raised within the zone of injury are likely to have a compromised vascularity¹⁷. This wound was eventually managed with negative pressure dressing and skin grafting. The fracture healed well despite this complication

Conclusions

- Fasciocutaneous flaps are a simple, safe and reliable option for covering leg and foot wounds
- They should be considered where facilities for free flaps are not readily available like in most places in this country.
- Hand-held audio Doppler is a cheap and useful tool in identifying perforators for designing these flaps.

References

1. Hallock GG. The skin graft. *Contemp Surg* 25: 46-48, 1984.
2. Hallock GG. Cutaneous coverage for the difficult lower extremity wound. *Contemp Orthop* 10: 17-26, 1985.
3. Hallock GG. Function preservation with the soleus muscle flap. *Orthop Rev* 14: 472-477, 1985.
4. Hallock GG. Microsurgical tissue transfer in traumatic wounds. *Emergency Care Quarterly* 4: 67-82, 1988.
5. Hallock GG. Severe lower extremity injury: The rationale for microsurgical reconstruction. *Orthop Rev* 15: 465-470, 1986.
6. Godina M. Early microsurgical reconstruction of complex trauma of the extremities. *Plast Reconstr Surg* 78: 285, 1986.
7. Tsai T, Werntz JR, Kirkpatrick DK, et al. Free tissue transfers in type III open lower extremity fractures. *Surg Rounds Orthop* 21: 17, 1988.
8. Ponten B. The fasciocutaneous flap: Its use in soft tissue defects of the lower leg. *Br J Plast Surg* 34: 215, 1981.
9. Thatte RL. One-stage random-pattern deepithelialised "turn-over" flaps in the leg. *Br J Plast Surg* 35: 287, 1982.
10. Thatte RL, Laud N. The use of the fascia of the lower leg as a roll-over flap. Its possible clinical applications in reconstructive surgery. *Br J Plast Surg* 37: 88, 1984.
11. Wei FC, Jain V, Suominen S, and Chen HC. Confusion among perforator flaps: What is a true perforator flap? *Plast Reconstr Surg* 107: 874, 2001, 1981
12. Blondeel PN, Van Landuyt KH, Monstrey SJ, et al. The "Gent" consensus on perforator flap terminology: Preliminary definitions. *Plast Reconstr Surg* 112: 1378, 2003.
13. Blondeel Philip et al. Perforator flaps. *Anatomy, Technique and Clinical Applications*. QMP 2006
14. Blondeel PN, Beyens G, Verhaege R, et al. Doppler flowmetry in the planning of perforator flaps. *Br J Plast Surg* 51: 202, 1998.
15. Raghavendra, T. V. Joshua & J. Kamath: Prospective Study Of Ipsilateral Perforator-Based Fasciocutaneous Flaps Of The Leg. *The Internet Journal of Surgery*. 17:2,2008
16. Bhattacharya V, Watts RK. Ipsilateral fasciocutaneous flaps for leg and foot defects. *Indian Journal of Plastic Surgery* 2003;36(1):30-35.
17. Omar Quaba MA and AWF Quaba, Pedicled Perforator Flaps for the Lower Limb. *Semin Plast Surg*. 20(2): 103-111, May 2006
18. Taylor GI, Palmer JH. The vascular territories (angiosomes) of the body: experimental study and clinical applications. *Br J Plast Surg*;40:113-141,1987
19. Chatre MG, Quaba AA. Fasciocutaneous flaps in lower leg reconstructions: experience with 100 flaps. Presented at the British Association of Plastic Surgeons, Summer Meeting; July 2, 1987; Edinburgh, Scotland.