

## RECONSTRUCTIVE ALGORITHM FOR SOFT TISSUE DEFECTS AROUND ANKLE REGION

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**ABSTRACT**

**Background:** Soft tissue defects around ankle region are common following road traffic accident (RTA) and implant exposure following surgery. They are more challenging for reconstruction because of poor vascularity of skin and its limited mobility and availability. Free tissue transfer may be a good option in most circumstances. But still different types of local and regional flaps are available. **Material and Methods:** A total number of 20 patients who had undergone reconstructive procedures for soft tissue defects around ankle region were studied during the period from January 2019 to December 2019 in the Department of Burns, Plastic and Reconstructive Surgery, Kilpauk Medical College, Chennai. **Results:** RTA was the most common cause of soft tissue defect. 18 patients underwent flap cover while 2 patients were treated with Split skin graft. All flaps survived except two flaps which developed partial necrosis. **Conclusion:** A simple reconstructive algorithm based on the size and site of the defect, is provided for reconstruction of soft tissue defects around ankle which is evolved from our experience at the Department of Burns, Plastic and Reconstructive Surgery, Kilpauk Medical College, Chennai.

**KEYWORDS :** Ankle soft tissue defects, Pedicled flaps, Free flaps, Reconstructive algorithm

**INTRODUCTION:**

Reconstruction of the ankle soft tissue defects remains a challenging problem for reconstructive surgeons due to thin nature of coverage tissues and poor blood supply and also lack of large muscle bellies that could be used to cover the defects<sup>1</sup>. Hence, among the options for reconstruction of defects around the ankle, direct closure or skin grafting may not be applicable in many cases. Free flap transfer, has often been accepted as the operation of choice in cases where the local tissues of the foot and ankle were severely compromised. Further progress in the studies of the microsurgery, especially the concept of angiosomes<sup>2,3</sup>, loco-regional flaps have been popular tool in the armamentarium of plastic surgeons for covering defects around ankle region.

**MATERIALS AND METHODS**

Period of study: January 2019 to December 2019. Total number of patients- 20

Patient inclusion criteria- All of them having isolated soft tissue defects around ankle

Exclusion criteria- Patients with associated injury to same limb were excluded from this study.

This retrospective study was done in the Department of Burns, Plastic and Reconstructive Surgery, Kilpauk Medical College, Chennai.

Preoperatively the age and sex of each patient, etiological factor, size and site of the defect, exposure of bone or tendons, presence of chronic osteomyelitis, and any other co-morbid conditions were noted. X-ray of the concerned limb was taken to assess the status of the bone and alignment of fracture segments if any. Hand-held doppler examination done to locate the perforators and also to locate recipient vessels for

anastomosis in case of free flap. All patients were operated under tourniquet control. Pre-wash given in cases with external fixators and exposed implant. Planning in reverse done, Flap raised based on perforators, transferred and inset given into the defect, donor area covered with split skin graft. Flap monitoring was done on a daily basis and first look dressing done on 5<sup>th</sup> post-operative day for skin graft site. Suture removal done on 10<sup>th</sup> post-op day.

Follow-up period ranged from 4 months to 1 year.



Fig. 1a. Defect exposing hardware

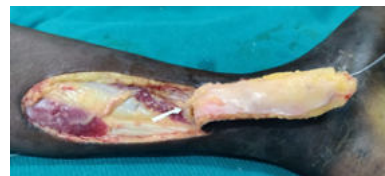


Fig. 1b. Flap based on posterior tibial artery perforator



Fig. 1c. Flap propelled and inset given.



Fig. 1d. 6 months post-op



Fig. 2a. Anterior ankle defect



Fig. 2b. Reverse sural artery flap cover



Fig. 2c, d. Two weeks post-op



Fig. 3a. Tumour- Soft tissue sarcoma



Fig.3b. Defect after tumour excision



Fig. 3c. Marking for Free ALT Flap

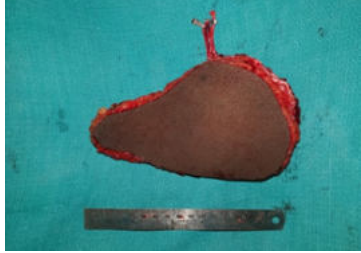


Fig. 3d. Free ALT Flap



Fig. 3e. Flap inset



Fig. 3f. Late post-op



Fig. 4a. Defect posterior ankle



Fig. 4b. Marking for lateral supramalleolar flap

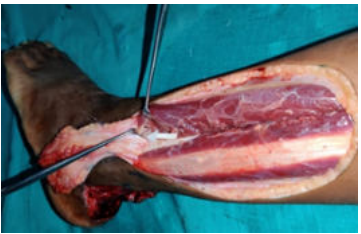


Fig. 4c. Flap elevation





Fig. 4d. Flap inset



Fig.5a. Defect on posterior and lateral ankle



Fig. 5b. Elevation of Peroneus brevis muscle flap



Fig. 5c. Muscle flap covered with skin graft



Fig. 5d. Late post-op



Fig. 6a. Medial ankle defect



Fig. 6b. Transposition flap marked



Fig. 6c. Flap inset.



Fig. 7a. Anterior and lateral ankle defect



Fig. 7b. Free LD muscle flap



Fig. 7c. Muscle covered with skin graft.

**RESULTS**

18 patients were males while 2 were females (Figure 8). Their age ranged from 16 to 72 years.

Road traffic accident was the cause of soft tissue defect (Figure 9) in 10 patients (50%), post-surgical implant exposure in 4 patients (20%), closet injury in 4 patients (20%) and following oncological resection in one patient (5%). Burn injury was the cause of defect in remaining one patient (5%).

The site of the defect (Table 1) was medial aspect of ankle including medial malleolus in 9 patients (45%), tendo-achilles (TA) region in 5 patients (25%), lateral aspect of ankle in 4 patients (20%), anterior aspect of Ankle in 2 patients (10%).

The Lateral supramalleolar flap (Figure 4) and Posterior tibial artery perforator-based propeller flap (Figure 1) were each used in 4 cases while Reverse superficial sural artery (RSA) flap (Figure 2) was used in 2 cases. Peroneus brevis muscle flap (Figure 5) with skin graft was used in 3 patients and local transposition flap (Figure 6) in 2 patients. In 3 cases where defect extending either to leg or to dorsum of foot were covered with free flaps (Figure 3 & 7) as local tissue was inadequate to cover entire defect. Two cases accepted split skin graft (SSG) only as they were superficial wounds (Table 2).

Primary skin grafted wounds settled well. Among 18 flaps two flaps developed partial distal necrosis (one reverse superficial sural artery flap and one peroneus brevis muscle flap), which were debrided and later covered with skin graft.

Only one patient had a diabetes mellitus as co-morbid condition.



Fig. 8. Sex distribution

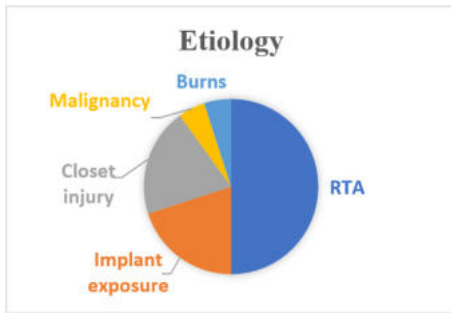


Fig. 9. Etiology of defect

Table 1. Site of the defect

Site Around Ankle	No
Medial aspect	9
Lateral aspect	4
Anterior aspect	2
Posterior aspect	5

Table 2. Flap used to cover the defect

Flap	No.
Lateral supramalleolar flap	4
Posterior tibial A perforator propeller flap	4
Peroneus brevis muscle	3
Reverse sural artery flap	2
Transposition flap	2
Free flap	3
Skin graft	2
Total	20

**DISCUSSION**

Reconstruction of the soft tissue defects around the ankle continues to be one of the most challenging tasks for any reconstructive surgeon because of poor vascularity of lower leg, relatively tight skin, and limited local flaps. If the defect is large and complicated by exposed bone free tissue transfer of skin and muscle is a well-established method of reconstruction, with satisfactory results. However, in small to moderate soft tissue defects with a simple fracture, exposed bone, tendon or joint only, local flaps are more convenient because of their simplicity, minimal donor site morbidity, low cost and with shorter time for operation and hospitalization<sup>4</sup>.

The most commonly used loco-regional flaps in the reconstruction of distal leg, ankle and foot defects are Reverse sural artery flap, Lateral supramalleolar flap and distally based Peroneus brevis muscle flap. All three were reverse flow

flaps while the first two were neurocutaneous flaps which include a sensory nerve within the flap. The Reverse sural artery flap<sup>5</sup> and Lateral supramalleolar flap<sup>6</sup> carry adequate amount of skin to cover moderate size defects while Peroneus brevis muscle flap<sup>7</sup> has limited application due to less muscle volume and bulk. A distally based peroneus brevis flap is ideal for defects over the lateral malleolus down and up to the calcaneum and is probably the flap of choice for such defects<sup>8</sup>.

Posterior tibial artery-based (PTA) perforator propeller flaps<sup>9,10</sup> is good choice for covering small to medium size defects especially over medial malleolus.

For larger defects extending to leg or dorsum of foot and where microsurgical facility is available free flaps (like Antero-lateral thigh flap and Latissimus dorsi muscle flap with skin graft) are useful.

In our study, the defect was over ankle region in 15 patients (75%), in two cases extending into lower 1/3 leg (10%), and extending into heel in 2 patients (10%) and in one case extending into dorsum of foot (5%). Two patients had wound without exposing bone or tendon were treated with split skin graft only which settled well.

In this study, PTA perforator-based propeller flap was used more commonly (4 cases) to cover the defect over medial malleolus. Lateral supra malleolar flap (4 cases) and peroneus brevis muscle flap (3 cases) used for lateral and posterior defect of ankle including Tendo Achilles region.

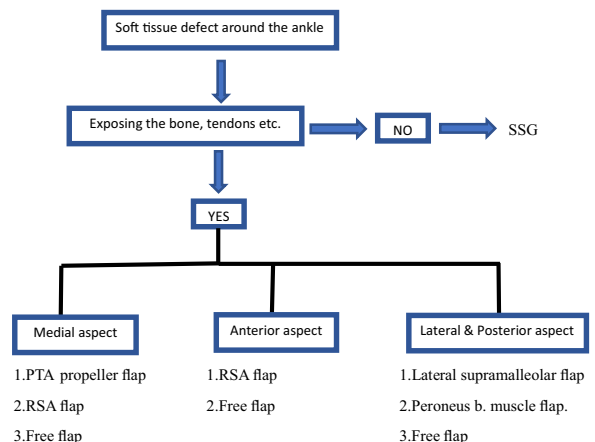
Reverse sural artery flap and local Transposition flap each was used in 2 cases. This includes one patient who had diabetes mellitus and burns over TA region exposing calcaneum which was covered by RSA flap.

Free Antero-lateral thigh flap was used for defect following tumour resection and free Latissimus dorsi muscle (2 cases) with skin graft was used for the defect extending into dorsum of foot.

Regarding complications, one RSA flap and one peroneus brevis muscle flap developed partial flap necrosis. They were managed by debridement and skin grafting.

Muscle flaps with SSG showed shrinkage in size over a period of time whereas the fascio-cutaneous flaps were bulky and required thinning in second stage. Using only adipofascial component in fascio-cutaneous flaps will give better cosmetic result<sup>11</sup>.

**Reconstructive algorithm: (Figure 10)**



**CONCLUSION**

Defect over ankle region without exposing underlying

structures can be treated with SSG. PTA based propeller flap was useful to reconstruct defect over medial malleolus. Lateral supramalleolar flap was good enough to cover the defect over lateral aspect of ankle region and TA region whereas RSA flap gives adequate cover to anterior and medial aspect of the ankle. Any large defect can be covered with free flap. A simple reconstructive algorithm (**Figure 10**) is provided based on our experience at the Department of Burns, Plastic and reconstructive Surgery, Kilpauk Medical College, Chennai.

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