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**Dr. Rakesh Kumar Jain**  
Department of Plastic,  
Reconstructive and Burns  
Surgery, SMS Hospital and  
Medical College Jaipur,  
Rajasthan, India

**Dr. Prabhu Dayal Sinwar**  
Department of Plastic,  
Reconstructive and Burns  
Surgery, SMS Hospital and  
Medical College Jaipur,  
Rajasthan, India

**Dr. Milan Pumbhadiya**  
Department of Plastic,  
Reconstructive and Burns  
Surgery, SMS Hospital and  
Medical College Jaipur,  
Rajasthan, India

**Dr. Preeti Yadav**  
Department of Plastic,  
Reconstructive and Burns  
Surgery, SMS Hospital and  
Medical College Jaipur,  
Rajasthan, India

**Corresponding Author:**  
**Dr. Rakesh Kumar Jain**  
Department of Plastic,  
Reconstructive and Burns  
Surgery, SMS Hospital and  
Medical College Jaipur,  
Rajasthan, India

## Soft tissue reconstruction of foot and ankle defect using various flap cover: single centre experience

**Dr. Rakesh Kumar Jain, Dr. Prabhu Dayal Sinwar, Dr. Milan Pumbhadiya and Dr. Preeti Yadav**

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### Abstract

**Introduction:** Soft tissue defect at ankle and foot region are very common following road traffic accident. Reconstruction in this region is challenging to surgeon because of poor vascularity and paucity of available surrounding tissue. Purpose of study is to evaluate various ankle and foot defect, advantage and disadvantages of different methods of management, future prospective of suitable method according to defect.

**Materials and methods:** Retrospective study of 65 patients with soft tissue defects around foot and ankle region underwent various reconstructive procedures at SMS hospital Jaipur from January 2020 to December 2020. Study enumerates various etiological factors and describes different reconstructive surgical procedures.

**Results:** Age at presentation range from 8 to 63 years and males were more common. Road traffic accident is most common cause for defect at foot and ankle region followed by diabetic foot and orthopedic implant exposure. Most common site of defect in foot and ankle defect were dorsum of foot followed by lateral malleolus region. Free ALT flap cover performed most frequently followed by cross leg flap.

**Conclusion:** Reverse sural flap is reliable option for small ankle and foot defect near ankle. Cross leg flap is also most reliable option for large defect in opposite healthy limb. Reverse saphanous flap also used for small defects on medial side ankle. Larger defect of ankle and foot can be covered by free fasciocutaneous or myocutaneous flaps where microsurgical expertise available.

**Keywords:** Foot and ankle defects, reconstruction, flap cover

### Introduction

Ankle and foot region are particularly very prone to injury following road traffic accident, prone for infection due to diabetes or chronic osteomyelitis, implant exposure following orthopedic surgery. Soft tissue reconstruction of ankle and foot region are challenging due to poor vascularity and insufficient soft tissue<sup>[1]</sup>. Successful reconstruction of ankle and foot defect is critical because of unique function of standing, walking and weight bearing of foot. Various options for reconstruction of ankle and foot defect are local flap, regional flap, distant flap/free flap. For local flap fasciocutaneous flap described by Ponten is useful due to easy design and can construct for large defect<sup>[2]</sup>. Medial planter artery flap described in 1980 and good option for weight bearing heel reconstruction<sup>[3]</sup>. Local muscle flap from intrinsic muscle of foot i.e. abductor hallucis and abductor digiti minimi developed from Ger can be used but have limitation of arc of rotation and inadequate tissue<sup>[4]</sup>. Distally based sural artery flap supplied by vascular axis of sural nerve used extensively for ankle and dorsum of foot defect<sup>[5]</sup>. Cross leg flap can be another option for patients with large defect on ankle or dorsum of foot. Free flap reconstruction require microvascular technique and suitable for patient with good vascular supply in affected limb.

### Materials and Methods

Retrospective study conducted at SMS hospital Jaipur, Tertiary care centre from January 2020 to December 2020. Study enumerates various etiological factors and describes different reconstructive surgical procedures in 65 consecutive patients with soft tissue defects around foot and ankle region underwent various reconstructive procedures.

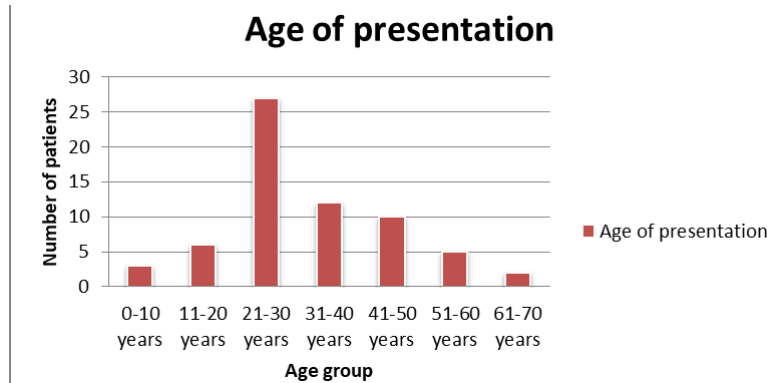
Study performed in accordance with the institutional ethics committee and the ethical standards as laid down in the 1964 declaration of Helsinki and all its later amendments. Written informed consent has been obtained from all individuals for use of their clinical photographs in this study.

Patient data was obtained from hospital record. Patient demographic data (age, sex, associated co-morbid conditions eg. Smoking, hypertension, diabetes), Local wound condition (site of injury, defect size, duration of injury, radiograph for associated bony injury), and operative procedure related data (procedure performed, early postoperative complications, delayed complications, secondary operation required, hospital stay) were evaluated.

All patients of foot and ankle defect admitted in trauma centre initially evaluated for associated neurovascular injury, bony injury, and neurological components. Complete history and physical examinations with relevant local examination performed. Early intervention performed after wound debridement and bony fixation. Patients of diabetic foot and exposed orthopedic implant require initial debridement than final wound cover once wound is free from infection.

**Results (Table 1)**

Age at presentation range from 8 to 63 years (Fig.1) and 52 patients were male and 13 females.



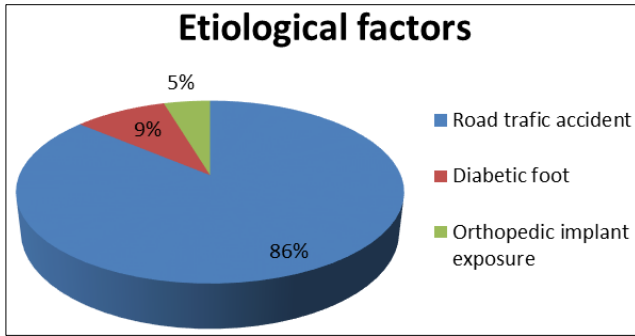
**Fig 1:** Bar diagram showing number of patients according various age groups

**Table 1:** Patients, wound, flap and outcome analysis

Patient characteristics	Number of patients
<b>1. Age</b>	
• 0-10 years	3
• 11-20 years	6
• 21-30 years	27
• 31-40 years	12
• 41-50 years	10
• 51-60 years	5
• 61-70 years	2
<b>2. Sex</b>	
• Male	52
• Female	13
<b>3. Etiology of foot and ankle defects</b>	
• Road traffic accident	56
• Diabetic foot	6
• Orthopedic implant exposure	3
<b>4. Site of defect</b>	
• Dorsum of foot	22
• Lateral malleolus	19
• Medial malleolus	15
• Planter surface	6
• Posterior aspect ankle	3
<b>5. Various soft tissue reconstruction methods performed</b>	
• Free flap cover	
▪ Free Anterolateral thigh flap	18
▪ Free Latissimus dorsi flap	7
• Cross leg flap	
▪ Conventional cross leg	16
▪ Reverse saphanous cross leg	5
• Reverse sural flap	12
• Reverse Saphenous flap	7

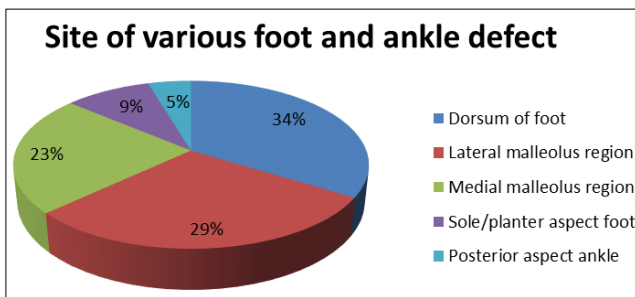
Road traffic accident is major cause for defect at foot and ankle region and implicated in 56 patients followed by

diabetic foot in 6 patient and orthopedic implant exposure in 3 patients (Fig.2).



**Fig 2:** Pie diagram shows percentage distribution of patients according to various etiology

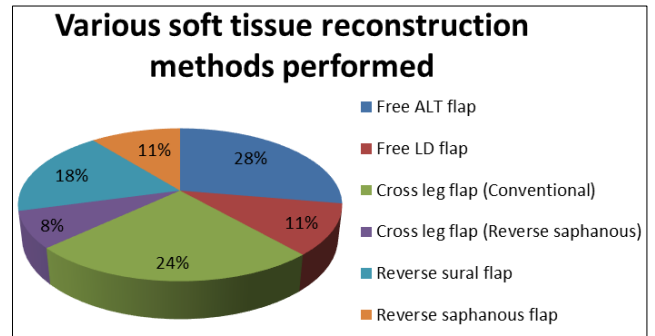
Site of defect in foot and ankle defect were dorsum of foot in 22 patients followed by lateral malleolus region in 19 patients, medial malleolus region in 15 patients, sole or plantar aspect foot in 6 patients, posterior to ankle in 3 patients (Fig.3).



**Fig 3:** Pie diagram shows distribution of defect according to various sites of foot and ankle

Free ALT flap cover performed most commonly in 18

patients followed by cross leg flap in 16 patients, reverse sural flap in 12 patients, reverse saphanous flap in 7 patients, free LD flap in 7 patients, cross leg reverse saphanous flap in 5 patients (Fig.4).



**Fig 4:** Pie diagram shows different reconstructive methods performed

Post operative complication in the form of wound infection, partial flap necrosis and complete flap necrosis occurred in various proportions in different reconstructive strategy. Defect covered with free flap developed early thrombosis at anastomosis site in 4 patients and leads to re-exploration and revision anastomosis. Partial flap necrosis at margin observed in 2 patients and one patient developed complete flap necrosis. Conventional cross leg flap cover developed wound infection in 2 patients and partial flap necrosis in one patient. Reverse sural flap developed major problem of flap venous congestion and leads to partial necrosis of distal flap in 4 patients and complete flap necrosis in one patient. Venous congestion also observed in distally based reverse saphenous flap and leads to partial flap necrosis at distal margin in one patient (Table 2).

**Table 2:** Post operative complication

Serial No.	Type of procedure performed	Wound infection	Partial flap necrosis	Complete flap necrosis
1	Free flap			
	• Free ALT flap	1	1	0
	• Free LD flap	1	1	1
2	Cross leg flap			
	• Conventional	2	1	0
	• Reverse saphenous	0	1	0
3	Reverse sural flap	3	4	1
4	Reverse Saphenous flap	0	1	0



**Fig 5:** Reverse saphanous flap cover for ankle defect. (a) Intra-operative picture shows defect over anterior aspect of ankle and incision for reverse saphanous flap elevation. (b) Patient on 7<sup>th</sup> post-operative day shows healthy flap with good flap inset. (c) Patient on 3 week post operative follow-up before detachment. (d) After detachment and flap inseting shows good defect cover with well healed donor site.





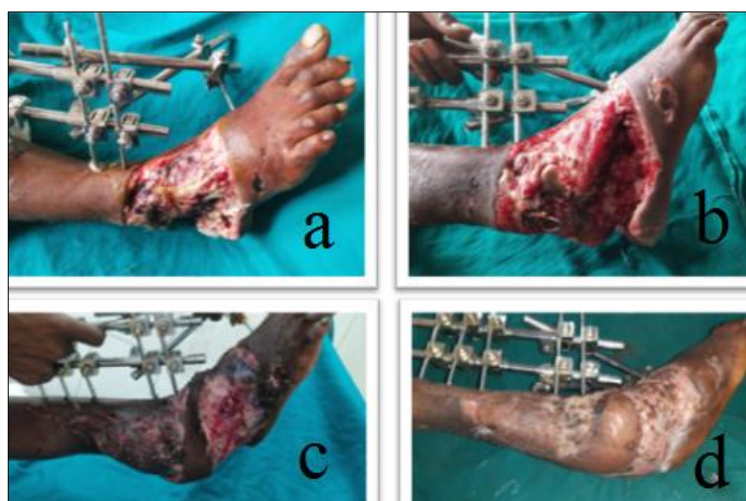
**Fig 6:** Cross leg reverse saphanous flap cover for dorsum of foot defect. (a) Preoperative picture showing defect over dorsum of foot. (b) Intra-operative picture immediate after cross leg reverse saphanous flap cover and inseting. (c) Post-operative day 7<sup>th</sup> show good inseting and healthy flap. (d) Patient on 3 weeks follow-up before detachment and inset.



**Fig 7:** Cross leg flap cover of dorsum of foot defect. (a) Preoperative picture showing defect over dorsum of foot. (b) Patient on 3 months follow-up of cross leg flap cover with well healed contra-lateral limb donor site. (c) Good flap cover of defect at 3 months post-operative.



**Fig 8:** Free anterolateral thigh fasciocutaneous flap cover of dorsum of foot defect (a) Pre-operative picture showing defect over dorsum of foot. (b) Harvested free antero-lateral thigh flap with vascular pedicle. (c) Post-operative day 7<sup>th</sup> show good flap cover of defect with healthy flap. (d) Patient at 3 week follow-up.



**Fig 9:** Latissimus dorsi free flap cover of large ankle defect (a) Preoperative view shows defect at ankle region over lateral malleolus. (b) Lateral view with large defect cavity. (c) Post operative view at 1 week duration of free Latissimus free flap cover. (d) Result after 6 week follow up.

## Discussion

Soft tissue reconstruction of foot and ankle defect remains most challenging task for any reconstructive surgeon due to thin skin cover and poor blood supply. Trauma and other etiologic factor can involve soft tissue, bone, ligaments around ankle and foot. Heel is weight bearing area so effective heel padding with like tissue should be replaced in reconstructive approach.

Skin grafting is limited role in ankle and foot reconstruction due to requirement of thick heel pad and gliding movement of ligaments and tendon of foot.

In 1981, Pontén described the fasciocutaneous sural flap as a reconstructive option for soft tissue loss of the lower extremity. The fasciocutaneous flap is very useful in the repair of soft tissue defects on the lower leg. It is easy to design and construct large flaps that are safe because of good circulation [2].

Donski and Fogdestram presented the distally based fasciocutaneous flap from the sural region [6]. Reverse/Distally based sural flap remains workhouse flap for local cover of defect around ankle on posterior and lateral aspect, also for dorsum of foot defect. In 1992, Masquelet *et al.* introduced the concept of neurocutaneous island flap [7]. The distally based superficial sural flap is vascularised by a median superficial sural artery with reverse flow as this artery takes septocutaneous perforators from peroneal and tibial arteries in the distal part of leg with sural nerve's intrinsic arterial system [8]. The use of reverse pedicle-based greater saphanous neuro-veno-fasciocutaneous flap in reconstruction of lower leg and foot presents a viable alternative to free flap and cross-leg flap. The vascular axis of the flap is formed by the vessels accompanying the saphanous nerve and the greater saphanous vein [9]. In 1854, Hamilton first introduced the cross-leg flap. During the Second World War cross leg flap was used extensively. In 1950, Stark standardized the procedure and summarized its usefulness for lower extremities defect [10]. In 1970, with introduction of free flap indications for cross-leg flap declined. Still many situations arise where cross leg flap is a simple and reliable alternative method for limb salvage. Free flap is continuing to gold standard reconstructive method for ankle and foot defect when peripheral vascularity of limb is optimum. Free flap have ability to cover larger defect and can provide like tissue requirement as lost. Free latissimus dorsi procedure was described by Baudet in 1976 [11]. Because of large flap size repair of wide foot and ankle defect were advocated by latissimus dorsi flap. The latissimus dorsi flap can be harvested as a pure muscle flap or as a myocutaneous flap, based on the thoracodorsal artery. Its advantages are large dimensions, easy dissection, long pedicle and large diameter of the vessels. Its main disadvantages are thickness of the flap and sacrificing of a major muscle. The anterolateral thigh flap (ALT) first described by Song *et al.* in 1984 [12] and become popular due to its long pedicle length, sizable vessels for microvascular anastomosis, good donor-site profile, large cutaneous surface. Patients with axial vessel damage, history of thrombosis in vessels, peripheral vascular disease are contraindications for free flap reconstruction. Prerequisite for free flap are surgeon must familiar with microsurgery procedure, preoperative clinical and radiological vascularity assessment, no evident vascular disease or history of thrombosis in patient, anastomosis should be away from trauma zone.

## Conclusion

Reconstruction of ankle and foot defect is major challenge and appropriate reconstructive option is selected on individual condition of local wound, site of defect, requirement of defect, condition of limb vascularity, availability of local surrounding tissue etc.

**Conflict of interest:** None

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