Original Research Paper

Volume - 11 | Issue - 08 | August - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Plastic Surgery

COMPANDIUM OF MICROVASCULAR FREE FLAP FOR DISTAL LOWER EXTRIMITY SOFT TISSUE DEFECT

Ankit Disawal* Senior Resident, Department Of Plastic & Reconstrucrtive Surgery, SMS Medical College, Jaipur, India. *Corresponding Author

Pradeep Goil Senior Professor, Department Of Plastic & Reconstrucrtive Surgery, Sms Medical College, Jaipur, India.

ABSTRACT

Introduction: Management of post traumatic distal lower limb injury poses challenging problems. Goals of lower extremity reconstruction include wound coverage, reconstruction of function, prevention of infection, and optimal cosmesis. Indications for free flap in lower extremity reconstruction include large defect that are not amenable to pedicle options, a large zone of injury, and large complex defects.

Methods: We performed a retrospective study of single surgeon case log during 2 year period in our institute. A total of 100 patients underwent reconstruction with a free tissue transfer for soft tissue coverage of lower extremity. We evaluated cause and sites of defects, types of flaps , recipient vessels, types of anastomosis , survival rate and complications.

Results: There were 88 male and 12 women with mean age of 36.8. The common sites of defect included dorsum of foot(37), distal third of leg(21). The common types of free flaps included anterolateral thigh flap(46), latissimus dorsi muscle flap(31). There are 9 cases of vascular compromise out of which 5 flaps were survived after intervention. There were other complications at recipient site such as partial necrosis of flap(13), partial graft loss(15) and infection(11). Success rate of free flap is 96% in our study.

Conclusion: In complex posttraumatic distal lower limb injury, free tissue transfer is preferred modality. Complete debridement and the selection of appropriate recipient vessels and flaps according to recipient site is key behind to achieve good outcome. Long term results of microsurgical reconstruction of lower extremity show good long term results and reasonable rates of limb salvage.

KEYWORDS : Lower extremity reconstruction, soft tissue coverage, traumatic injury, free flap, microsurgery.

INTRODUCTION

Injury to lower extrimities causes extensive damage to soft tissue and bone. Soft tissue defect of lower limb exposes underlying bone, joints, tendon, nerve and/or vessels. Defect of lower extrimities is difficult to repair due to paucity of soft tissue and blood supply.

Among the methods for reconstructing defects of the lower extrimities, there are direct closure, skin grafting, and local flaps including the muscle flap, cross leg flap, and free flap.[1]

The traditional rules of thirds recommends the pedicled gastrocnemius for proximal third defect , the soleus for middle third defect and free flaps for distal third of defects.[2]

Pedicle flaps are used when possible but has a disadvantage of limiting mobility.

Free flaps transfer is indicated in the repair of injuries that are highly complex, involves a large surface area, and that preclude the use of local, pedicles flaps. Exposure of vital structures such as bone, joint, nerves or blood vessels additionally warrant free flap coverage.[3]

Microsurgical flaps transfer provide healthy and well vascular tissue and good environment for bone healing.

Free flap transfers allows restoration of meaningful function and favourable aesthetic outcome in lower extremity reconstruction . Free flap has its disadvantage as it requires microsurgical techniques and a good vascularity of blood vessels of recipient site and it may prolong operation time.

Microsurgical free flap transfer s successfully repair the unsalvageable limb and subsequently prevent the amputation.[4]

MATERIAL AND METHODS

We perform a retrospective review of cases operated from dec 2018 to jan 2021 at department of plastic and reconstructive surgery in our institute.

Included patients were those who underwent free tissue transfer for lower extremity reconstruction regardless of age and sex. Patients with uncontrolled diabetes mellitus and occlusive vascular disease are excluded from this study.

Patients age, sex, comorbities, etiology, size and localization of the defects were noted.

Evaluation of wound defect is done. To have idea of bone defect, plain radiography performed. If there is suspicion of vessel injury, we go for CT angiography. At our institution, we apply routine use of hand held Doppler to access perforators with use of preoperative angiography in the trauma setting.

Types of flap used for coverage, recipient vessel, methods of vascular anastmosis were analysed .

In current study we analyse survival and complications of free flap.

Mean follow up period was 1 year.

We received institutional review board approval for the study.

A statistical analysis was performed using SPSS ver 20.0 (IBM corp,Armomk, NY,USA).

RESULT

A total of 100 patients were identified requiring free tissue transfer for lower extremity reconstruction. There are 86 male and 14 female, showing a male predilection, whose mean age was 36.8 yr.

Mean size of the free flap was 11 * 13 cm.

Sites of defects

The site of defect included the dorsum of foot 37 patient which was the most prevalent site, distal leg area in 19 patient, ankle in 18 patient.

Table 1: Sites Of Defects

Sites of defects	No of cases
Foot dorsum	37
Distal third leg	21
Ankle	18
Planter forefoot	14
Heel	10

Types Of Free Flaps

The choice of free flap should be individualized following these factors: 1) The size and location of the defect, 2)the type of the tissue defect, 3) the available recipient vessels and the length of pedicle needed 4) and Whether or not sensory re-innervation is necessary.

There were 46 patients who underwent lower extremity reconstruction using anterolateral thigh flaps, 31 with lattisimus dorsi flap.

Table 2: Types Of Free Flaps

Types of free flaps	No of cases
ALT Fascio-cutaneous flap	38
ALT Myocutaneous flap	08
LD Muscle flap	25
LD Myocutaneous flap	06
Gracilis flap	08
RAFF flap	05
Groin flap	05
Profunda artery perforator flap	02
Medial sural artery perforator flap	02
Scapular flap	01

Recipient artery include anterior tibial artery in 73 patients and posterior tibial artery in 27 patients . For micro arterial anastomosis, end to end technique was performed in 78 case, 19 case received end to side anastomosis. 3 patients receive vein graft.

All vein anastomosis were performed using end to end technique. Two venous anastmoses were performed in 30 patients.

The donor sites were closed by a skin graft in 25 cases in whom the width of donor site defect was more than 12 cm.

COVERAGE OUTCOME

Table 3: Coverage Outcome

Complications	No of cases (%)
Revision surgery	10
Total flap failure	04
Partial flap necrosis	13
Infection	11
Partial graft loss	15

Revision surgery was performed in 10 cases where 9 cases presented with vascular complications. These included 3 case of arterial thrombosis , 1 case of arterial spasm ,and 5 case of venous thrombosis. One flap were re-explored for hematoma evacuation and salvaged. One cause of total failure as identified during reexploration was inadvertent injury to vessel during dissection. In cases of arterial thrombosis , on reexporation , thrombus was removed at sites of anastomosis and re-anastomosis was attempted; 1 flaps survived, 1 suffer partial loss while 1 flap fail to survive . In patient of arterial spasm, after re –anastomosis, reperfusion achieved and flap survived. 2 patient with venous thrombosis ,reanastomosis after removal of thrombus at anastmosis site results in reperfusion which leads to survival of flap, however 2 flap failed to reperfuse. In another patient of venous thrombosis, following removal of thrombus, reanastomosis was performed but skin and subcutaneous tissue had necrotized.

There were a total of 39 cases of other complications (other than vascular complication) at recipients sites. These includes 13 cases of partial necrosis of flap and 15 cases of partial graft loss at sites(where muscle are inset or residual defect after flap inset was primary grafted) Early postoperative infection occurred in 11 patients and surgical debridement was required for four of them while others treated nonsurgically with antibiotic therapy.

Complications at recipients sites were treated with secondary skin graft.

Donor site morbidity requiring surgical intervention was observed in 2 patients. Partial wound dehiscence was observed in donor site of 1 patient.

DISCUSSION

Lower extrimities have always been known as a scare source of flaps and for usual wound healing challenges associated with decreased distal perfusion. The leg vessels may have pre-existing atherosclerotic disease,futhur limiting options.

Early wound closure with use of vascularised tissue has long been a prerequisite for optimal rehabilitation of function for extensive and complex injury of lower limb. Godina advocate for early reconstruction(within 72 hrs) which resulted in significant decrease in flap failure and post operative infection compared to the late reconstruction.[4] Yaremcuk et al recommended early coverage between day 7 and 14 after several debridement to allow better identification of zone of injury.[5]

In our study ,Mean time to coverage defect from injury is 12.6 days.

The primary aim of lower extremity reconstruction is to recover function and maintain it, for which skeletal reconstruction with stable soft tissue coverage is essential. The goal of microsurgical free flap transfer is both the soft tissue coverage and improvement of functional outcome.

Ideal soft tissue free flap donor for lower extremity reconstruction characterized as having a large skin territory, good color and texture match with the recipient site, a long and large calibre vascular pedicle, reliability for different flap designs, constant pedicle anatomy, acceptable donor site morbidity, suitability for sensate reconstruction, feasibility for a two team approach, no requirement for major artery or muscle sacrifice, applicability as a flow through flap and suitability for usage as a thin flap.[6]

Donor muscles in the distal lower extrimities is almost non existence therefore a free flap transfer becomes procedure of choice. The latissimus dorsi muscle flap is a good option of larger defect and gracilis flap is used for smaller defect. In our institute anterolateral thigh flap is the workhouse flap for medium and larger defect.

The skin over dorsum of foot is thin and flexible and devoid of subcutaneous adipose tissue. To certain that the patient can wear shoes , surgeons should elevate thin flaps. For the coverage of dorsum foot soft tissue defects, fasciocutaneous flaps, free anterior lateral thigh flap, paracapsular flap and free groin flap are indicated and most commonly employed.

The planter area being weight bearing area, characterized by thick skin and a larger amount of fat. Moreover it also requires a protective sensation for weight bearing during walking. For soft tissue defect over weight bearing surfaces on the distal planter or hindfoot a free muscle flap or musculo-cutaneous flap is always indicated.

Muscular flaps have been preferred because of their ability to obliterate dead space and their ability to decrease the risk of infection by improving vascularity in the contaminated wound. Muscle flaps are used in reconstruction of cases in which the wound were infected, the hardware was exposed, or osteomyelitis was concurrently present. Muscle flaps have the advantage that they atrophy over time and contour very nicely. Muscle flap may be more difficult to raise again later for further reconstruction (bone grafting,transport etc.)

Fasciocutaneous flap provide supple and thin soft tissue coverage .Fasciocutaneous flaps are much easier to raise and operate in future.

In recent years, however it has been reported not only that therer is no significant difference in surgical outcome between the muscle flap and the fasciocutaneous flap, but also that there is no need to sacrifice muscle tissue at donor sites.

Recent work has shown that salvage rate of fasciocutaneous flaps and muscle flaps with skin paddle are higher than split thickness skin grafts, probably due to easier monitoring of flow to the flaps.

Selection of appropriate recipient vessel is an essential element for achieving successful treatment outcome in reconstruction of lower extremity using free flap.[10] The most important factor in selection of recipient vessel are the site of injury and vascular status of lower extremity.

Anterior tibial artery sits on the interosseous membrane and is usually injured with fracture of tibia and fibula. Posterior tibial artery protected from trauma due to its position in front of soleus and injury to this vessel is unusual.

The Anterior tibial artery is easier to access than the posterior tibial artery and should be the first choice if the defect is located and anterior and lateral compartment of leg while the posterior tibial artery is indicated as recipient artery in defect of inner and posterior areas of leg.

Venous comitantes are the first option as recipient veins because they are located in same surgical field and less vulnerable to injury. Superficial veins are more vulnerable to damage campared to deep veins because of the anatomical locations. The saphenous vein can be accessed with a medial lower incision along with posterior tibial artery, which gives another options for venous drainage of the flap

Dual vein outflow is practical ways to reduce overall complications and increase flap successful rate. We selected superficial vein whose end are not exposed to defect site.

Anastmosis out of the zone of injury is ideal. Traditionally anastmosis was performed proximal to zone of injury.

Several authors have reported that there was no significant difference in flap survival between end to end anastmosis and end to side anastmosis. [11] Literature shows that there was no significant correlation between survival of flap and vein graft.[12] We also seen same in our study.

Success rate of free flap is 96% in our study. Success rate of free flap was reported to be 96% (48/50) by Basheer et al[10]., 85% (46/54) by Percival et al[13],90%(63/70) by Small and Mollan[14]. High success rate in our study might be based on the mandatory use of preoperative debridement, the selection of the appropriate free flap for the recipient site, and the use of appropriate, intact recipient vessels.

Our prefered (probably best) options for lower extremity in terms of soft tissue coverage are the ALT and lattissimus dorsi flap. Both LD and ALT flaps offer a long vascular pedicle with an easily suturable diameter which facilitates microsurgical anastmosis outside of the extended zone of injury. They can both cover larger defects and can be harvested in the supine position which facilitates a two team approach .

ALT flap replace most soft tissue free flaps in most clinical situations.

Pollak et al.reported that a better prognosis would be achieved in reconstruction surgery using a free flap even in case in which the reconstruction could be performed sufficiently using a local flap.[15] We also noted the same.

We concluded that incorporation of microsurgery in treatment modality of lower limb reconstruction, injuries that would have previously been deemed unsalvageable and subsequently required amputation are being successfully repaired.

CONCLUSION

Lower extremity traumatic injury are highly complex , involves a large surface area and exposure of vital structures.

Adequate soft tissue management and flap reconstruction are very much important in successful limb salvage attempts with meticulous debridment and early flap transfer .Most of reconstructed lower limbs were able to achieve satisfactory results. Long term results of microsurgical reconstruction of lower extrimities shows good long term results and reasonable rate of limb salvage.

Fig1: Functional Reconstruction Of Ankle Done With ALT Myocutaneous Flap

Fig 2: Soft Tisuue Wound Over Dorsum Of Foot Covered With LD Myocutaneous Flap.

Fig 3: Ankle Soft Tissue Defect Reconstructed With Fasciocutaneous ALT Flap.

REFERENCES

1. Gottlieb LJ, Krieger LM. From the reconstructive ladder to the reconstructive elevator. Plast reconstr Surg 1994;93:1503-4.
2. Bajantri B, Bharathi RR, SabapathySR. Wound coverage considerations for defects of the lower third of the leg. Indian J Plast Surg. 2012;45(2):283-90.
3. Kim SW, Youn S, Kim JD, Kim JT, Hwang KT, Kim YH.reconstrction of extensive lower limb defects with thoracodorsalaxis chimeric flaps. Plast Reconstr Surg 2013;132(2):470-9.
4. Godina M. early microsurgical reconstruction of complex trauma of the extrimities. Plast Reconstr Surg, 1986;78(3):285-92.
5. Yaremchuk MJ, Bartlett RJ, Manson PN, et al. aacute and definitive management of traumatic osteocutaneous defects of the lower extremity. Plast Reconstr Surg. 1987 80:1-14.
6. Yildirim S, Gideroglu K, Akoz T. anterolateral thigh flap choice for lower extremity soft

tissue reconstruction. J Reconstr Microsrg 2003;19:225-233.
7. Basher MH, Wilson SM, Lewis H, et al. microvascular free tissue transfer in reconstruction of the lower limb. J Plast Reconstr Surg. 2008;61:525-528.
8. Samaha FJ, Oliva A, Buncke GM, et al. a clinical study of end-to-end versus end-to-side techniques for microvacular anastomosis. Plast Reconstr Surg.1997;1109-1111.
9. Germann G, Steinau HU. The clinical reliability of vein grafts in free flap transfer. J Reconstr Microsurg 1996;12:11-17.
10. Percival NJ, Sykes PJ, Eaeley MJ. Free flap surgery: the Welsh Regional Unit experience. Br J Plast Surg 1989;42:435-40.
11. Small JO, Mollan RA,. Management of the soft tissues in open tibial fractures. Br J Plast Surg.1992;45:571-577.
12. Pollak An, Mc Carthy ML, Burgess Ar. Short term wound complications after application of flaps for coverage of traumatic soft tissue defects about the tibia. J Bone Joint Surg Am 2000;82:1681-91.