

Expose Tibia Coverage Options

1Ajay Kumar Pathak, 2Pragati Awasthi, 3Akash Jaiswal
1Senior Resident, 2Senior Resident, 3Assistant Professor

1,2Department of Plastic Surgery, Institute of Post Graduate Medical Education and Research, SSKM Hospital, Kolkata, West Bengal

3Department of Medicine, J K Medical College, Bhopal (M.P.)

Abstract - Among the most widely used techniques direct closure, skin grafting, local flaps, pedicled flap and free flap are worthy of note. The reconstruction of traumatic soft tissue defects in the distal third of the leg is one of the most challenging problems in lower limb surgery. Usually, the low mobility of the surrounding skin does not make a direct closure possible. **Aim:** Different surgical options in management of lower third leg defects. **Material and method:** The study was conducted in the Department of Plastic & Reconstructive Surgery Institute of Post Graduate Medical Education and Research (IPGME&R) and SSKM Hospital, Kolkata during January 2018 to December 2019. **Result:** Several patients were admitted to the Department of Plastic & Reconstructive Surgery and referred patients from Department of General Surgery & Orthopaedic Surgery, IPGME&R and SSKM Hospital, KOLKATA. From these patients, we have taken 70 patients in which 30(42.9%) patients were female and 40(57.1%) patients were male. The mean age (mean± s.d.) of patients was 38.2286 ± 18.4651 years. **Conclusion:** Fasciocutaneous flaps may represent a good alternative to the free flaps in the areas where other local reconstructive procedures are not possible.

keywords - Lower third leg, Lower limb, Skin grafting, Local flaps.

INTRODUCTION

The common etiological causes are trauma, tumor resection, chronic infection. The surgical correction of lower third leg defect varies from skin grafting, secondary suturing, local, pedicle flaps to free microvascular tissue transfer. Exposed Lower third of leg is common cause of non-ambulation of majority of patients. It can also lead to osteomyelitis, sepsis, vascular injuries etc. Each procedure has its own merits and demerits. By which we can reduce the further complications and improve quality of life.

The reconstruction of traumatic soft tissue defects in the distal third of the leg is one of the most challenging problems in lower limb surgery. Among the most widely used techniques direct closure, skin grafting, local flaps, pedicled flap and free flap are worthy of note. Usually, the low mobility of the surrounding skin does not make a direct closure possible. However, wound edge approximation shows a high percentage of failure or requires long time to achieve complete healing¹. Skin graft compared to wound edge juxtaposition shows an advantage in success rate and in healing time¹. However, for major defects skin graft does not provide optimal coverage of the underlying structures (vessels, nerves, and tendons). Even the coverage with flaps shows some disadvantages. A random flap has an indistinct perfusion pattern which requires a careful assessment of length-to-width ratio to ensure viability. These features make random flaps difficult to perform in the lower leg and anyway associated with a high rate of necrosis². Musculocutaneous flaps are widespread in leg reconstruction for their reliability. However, these flaps have few indications in the distal third of leg due to the impossibility to reach the site of injury³. Local fasciocutaneous flaps can be harvested without a careful assessment of length-to-width ratio but still show a considerable necrosis rate in the lower third of the leg⁴. Local perforator flaps and free flaps are good options in reconstruction of traumatic defects of lower third of the leg. Local perforator flaps have a similar perfusion to musculocutaneous flaps but save the underlying fascia and muscles, resulting in less postoperative morbidity of donor site. In this type of flaps, the main risk is related to vascular complications associated to pedicle torsion and deformation. To reduce this risk, it is necessary to identify perforator with at least 1 mm in diameter⁵. Before or during surgery, the handheld doppler probe and the color doppler are reliable techniques to determine the size of the perforator^{6,7}. As free flaps, local perforator flaps require a microsurgical procedure but the microanastomoses are not needed. Therefore, these flaps have a shorter operating time compared to free flaps. Free flaps require more operating time, special equipment, and adequate training. In addition, Melissinos and Parks⁸ reported that success rate of free flap was only 95.6% in reconstruction of defects of lower extremities (versus 96.8%, 100%, and 98.8% of head and neck, trunk, and upper extremities reconstruction, resp.).

MATERIAL AND METHOD

Patients admitted to the Department of Plastic & Reconstructive Surgery and referred patients from Department of General Surgery & Orthopedic Surgery, IPGME&R and SSKM Hospital, Kolkata. The study was conducted from January 2018 to December 2019,

Inclusion criteria: Any patient of lower third leg defect admitted in hospital.

Exclusion criteria: Patient of lower third leg defect with

1. Polytrauma with other life threatening injuries
2. Collagen vascular disease

3. Immunocompromised patients
4. Advanced chronic osteomyelitis where an amputation is required

Study technique: Each patient was subjected to detailed history and clinical examination, supplemented by investigative modalities. The treatment was proceed according to prevalent standard of care within the facilities available at the hospital, and findings was note in details in systematic way as per the proforma. The patients would be asked to fill the questionnaires at the aforementioned intervals.

RESULT AND DISCUSSION

70 patients admitted to the Department of Plastic & Reconstructive Surgery and referred patients from Department of General Surgery & Orthopaedic Surgery, IPGME&R and SSKM Hospital, Kolkata. We found that 30(42.9%) patients were female and 40(57.1%) patients were male. The mean age (mean± s.d.) of patients was 38.2286 ± 18.4651 years.

Gad SS et al (2018) found that the study included 20 patients – 15 males and five females – and their ages ranged between 22 and 65 years.

Gopalan G et al (2019) found that most common cause for traumatic leg and foot defects are road traffic accidents followed by accidental fall and others, most commonly in males amounting 73%, children 10% and females 17%, among the skin and soft tissue defects upper and lower 1/3 leg defects are predominant. Among the soft tissue coverage split thickness skin graft dominating about 60% of cases, flaps 30% of cases, among the flaps 70% are fasciocutaneous flaps predominantly inferiorly based and 30% are muscle and musculocutaneous flaps, among the muscle predominantly soleus muscle flapwas used to cover the defect.

MACEDO JL et al (2017) found that a mean age of 25.6 years, predominantly male (62.5%). The most frequent wounds were of the distal third of the lower limb (37.5%). Bone or tendon exposures occurred in 55% had and there was a 35% rate of exposed lower limb fractures. The treatments employed were skin grafting (57.5%), local fasciocutaneous flap(15%), muscle flap(12.5%), cross-leg fasciocutaneous flap, reverse sural flap(12.5%) and microsurgical flap(2.5%). Short-term evaluation showed that 35 patients had excellent or good results (87.5%), four had a regular result (10%), and one had an unsatisfactory result (2.5%). In the long term, of the 18 patients who answered the questionnaire, ten resumed walking, even with support, in the first three months after surgery (55.6%).

It was found that 2(2.9%) patients had Ankle defect, 3(4.3%) patients had Avulsion injury Leg, 2(2.9%) patients had Contracture ankle, 7(10.0%) patients had Degloving injury leg, 1(1.4%) patient had Degloving injury over lateral malleolus, 5(7.1%) patients had Expose calcaneum, 1(1.4%) patient had Expose medial malleolus, 8(11.4%) patients had Exposed tendoachilis region, 18(25.7%) patients had Exposed tibia, 2(2.9%) patients had Exposed tibial implant, 1(1.4%) patient had Heel growth, 2(2.9%) patients had Non healing ulcer, 1(1.4%) patient had Squamous cell carcinoma leg and 17(24.3%) patients had Ulcer over heel.

Mendieta M et al (2018) found that the propeller flaps were based on a single perforator, from the posterior tibial artery in 50%, anterior tibial artery in 39.3%, and peroneal artery in 10.7% of the cases. Complications occurred in 14% of the propeller flaps performed, with 3 partial necrosis of less than 15% of the flaptransposed. Complications of the patients occurred in both sex groups; however, for the female group, there was a 75% of complications with a tendency toward statistical significance of $P = 0.038$. Donor site of the flapwas closed primarily in 85.7% (24) of the cases. In our opinion, the availability and safety of local propeller flaps, justifies its use in cases where microsurgical techniques are not an option for the reconstruction of the middle and distal extremity, in small-to-medium defects of soft-tissue coverage of the lower limb.

It was found that 2(2.9%) patients had Animal bite, 3(4.3%) patients were Diabetic, 7(10.0%) patients were Infective, 2(2.9%) patients had Malignancy, 4(5.7%) patients had Post burn and 52(74.3%) patients were Traumatic. 20(28.6%) patients had surrounding soft tissue induration. We found that 15(21.4%) patients had Skin Grafting and 1(1.4%) patient had Secondary closure. It was found that 1(1.4%) patient had Advancement Flap, 5(7.1%) patients had Bipedicle and 7(10.0%) patient had Transposition.

El-Sabbagh AH et al (2018) found the reconstructive procedures applied five flaps, respectively distally based posterior tibial artery perforator flap(n = 8), distally based peroneal artery perforator flap(n = 4), distally based sural flap(n = 6), medial planter artery flap(n = 2) and cross leg flaps (n = 6). In all cases, there were no signs of osteomyelitis of underlying bones or discharge from the under surface of the flaps. Fat necrosis occurred at the distal end of posterior tibial artery perforator flapin one female patient. The two cases of medial planter artery flapshowed excellent healing with closure of donor site primarily. One cross leg flap had distal necrosis. Would at lower third of leg can be efficiently covered by posterior tibial, peroneal artery and sural flaps. 4(12.9%) patients had Lateral supramalleolar flapwith skin grafting, 5(16.1%) patients had Medial planter artery based flapwith skin grafting, 5(16.1%) patients had Peroneal artery perforator based flapwith skin grafting, 1(3.2%) patient had Peronious brevis muscle flapwith skin grafting, 4(12.9%) patients had Posterior tibial artery perforator based flapwith skin grafting and 12(38.7%) patients had Reverse sural faciocutanious flapwith skin grafting.

Mahesh SG et al (2018) found that most commonly performed procedure was muscle flap(45%), followed by perforator-based fascio-cutaneous flap (25%). No major complications were observed in the post-operative period. Various types of flapcover were adopted to cover the lower-third of leg defects, depending on the nature of the wound. That study delineated that muscle flaps - particularly the reverse hemi-soleus flap, are an ideal flap for lower third of leg defects with fracture site exposed and wound infected. Local muscle flaps have the advantage of being single-staged, faster to perform and technically easier, compared to free flaps, which have long been considered the gold standard.

We found that 30(42.9%) patients had Perforator flap/ Fasciocutaneous, 1(1.4%) patient had Muscle Flap.

In Free Microvascular Tissue Transfer , 4(44.4%) patients had Anterolateral thigh fasciocutaneous free flapwith skin grafting, 1(11.1%) patient had Free gracillis muscle transfer with skin grafting and 4(44.4%) patients had Free latissimus dorsi musclocutaneous flap.

Gad SS et al (2018) found that all defects were covered by the distally based hemigastrocnemius muscle flap. Early complication included graft rejection in two (10%) patients, partial flapnecrosis in two (10%) patients, wound infection in one (5%) patient, postoperative hematoma in one (5%) patient, and delayed graft take in one (5%) patient. Late results during follow-up showed one (5%) patient with hypertrophic scar of the donor area and one (5%) patient with hyperkeratosis. We found that 4(5.7%) patients had Edema and 5(7.1%) patients had Edema, seroma. 8(11.4%) patients had Partial Flap Loss and 6(8.6%) patients had Total Flap Loss. It was found that 9(12.9%) patients had Wound Dehiscence, 21(30.0%) patients had Graft Loss, 10(14.3%) patients had wound sepsis, 4(5.7%) patients had Hypertrophic scar and 1(1.4%) patient had Seroma.

Kumar PS et al (2017) found that the indication for flapcover was exposed tibia (71%), followed by exposed tendon 21% and exposed implant 8%. The most commonly performed procedure is the inferiorly based fasciocutaneous flaps (45%) followed by reverse fasciocutaneous flaps (32%). Edema and infection were the common complications encountered 23 and 18%, respectively. 70% of patients graded the reconstruction as good, 23% as fair, and 7% as poor. Fasciocutaneous flaps may represent a good alternative to the free flaps in the areas where other local reconstructive procedures are not possible.

Mofikoya BO et al (2016) found that Perforator-based fasciocutaneous flaps were the most commonly used (48%;12), while muscle flaps (24%;6) and adipofascial turnover flaps (20%;5) were less utilized. Two patients died and one underwent a below-knee amputation. Late infection persisted in 16% (4) of the patients seen.

Franken JM et al (2010) found that thirty-five patients (67%) have been treated because of posttraumatic soft-tissue defects and, therefore, insufficient fracture coverage. Seventeen patients (33%) were treated because of a chronic osteomyelitis that arose after the trauma. In our study, we did not find a statistically significant difference between the postoperative complications of local and free flaps. A significant increase could be demonstrated in the number of revisions after treatment with a free flap. Treatment with a fasciocutaneous flapin the entire study group was associated with significantly more postoperative complications than treatment with a musculocutaneous flap. There was no significant difference in results after early or late flap coverage. Patients treated with local or free flaps achieved equal outcomes, except for the number of postoperative revisions in which local flaps required lesser revisions. Treatment with a musculocutaneous flap is preferable to treatment with a fasciocutaneous flapregarding postoperative complications. The timing of operation proved not to be a discriminating factor.

In secondary procedure, 1(3.8%) patient had Bone drilling, dressing, 1(3.8%) patient had Debridement, margin postive, rexicion, skin grafting, 2(7.7%) patients had Delayed tendon reconstruction, 1(3.8%) patient had Dressing ,debridement, grafting and delayed tendon reconstruction, 13(50.0%) patients had Dressing, debridement, skin grafting, 1(3.8%) patient had Dressing, debridement and transposition flap with skin graft, 1(3.8%) patient had Dressing, healing by secondary intension, 2(7.7%) patients had Nerve reconstruction(nerve graft), 2(7.7%) patients had Silicon gel sheath, pressure garment, 2(7.7%) patients had Tendon reconstruction.

We found that 8(11.4%) patients had Good cosmesis, 36(51.4%) patients had Average cosmesis and 26(37.1%) patients had Poor cosmesis. 26(37.1%) patients had Good outcome, 24(34.3%) patients had Fair Outcome and 20(28.6%) patients had Poor outcome. It was found that 17(24.3%) patients had Gait disturbed, physiotherapy advised, 5(7.1%) patients had Gait disturbed, walk with support, physiotherapy advised, 36(51.4%) Patient can walk, 2(2.9%) patients had Planter flexion, patient can walk, physiotherapy advised and 10(14.3%) patients can walk with support.

CONCLUSION

Based on the results obtained in my study, we consider that perforator propeller flaps are ideal in reconstructing small-medium defects of the middle and distal third of the leg, being safe, easy to perform, providing similar tissue in texture and thickness of damaged tissues, with low donor-site morbidity. Various types of flap cover were adopted to cover the lower-third of leg defects, depending on the nature of the wound in repair of defect according to reconstructive ladder (Skin grafting, Secondary suturing, Local Flap, Pedicled flap and Microvascular reconstruction) Fasciocutaneous flaps may represent a good alternative to the free flaps in the areas where other local reconstructive procedures are not possible.

Table 1: Distribution of DIAGNOSIS, Hematoma /Seroma/Edema, Wound Dehiscence, Graft Loss, Wound sepsis and Cosmesis.

		Frequency	Percent
DIAGNOSIS	Ankle defect	2	2.9%
	Avulsion injury Leg	3	4.3%
	Contracture ankle	2	2.9%
	Degloving injury leg	7	10.0%
	Degloving injury over lateral malleolus	1	1.4%
	Expose calcaneum	5	7.1%
	Expose medial malleolus	1	1.4%
	Exposed tendoachilis region	8	11.4%
	Exposed tibia	18	25.7%
	Exposed tibial implant	2	2.9%
	Heel growth	1	1.4%
	Non healing ulcer	2	2.9%

	Squamous cell carcinoma leg	1	1.4%
	Ulcer over heel	17	24.3%
	Total	70	100.0%
Hematoma /Seroma/ Edema	Edema	4	5.7%
	Edema,seroma	5	7.1%
	No	61	87.1%
	Total	70	100.0%
Wound Dehiscence	NO	61	87.1%
	YES	9	12.9%
	Total	70	100.0%
Graft Loss	NO	49	70.0%
	YES	21	30.0%
	Total	70	100.0%
Wound sepsis	NO	60	85.7%
	YES	10	14.3%
	Total	70	100.0%
Cosmesis	Good	8	11.4%
	Average	36	51.4%
	Poor	26	37.1%
	Total	70	100.0%

REFERENCES

[1] C. Wong, F. Cui, B. Tan et al., “Nonlinear finite element simulations to elucidate the determinants of perforator patency in propeller flaps,” *Annals of Plastic Surgery*, vol. 59, no. 6, pp. 672–678, 2007.

[2] D. C. Haiart, A. B. Paul, R. Chalmers, and J. M. T. Griffiths, “Pretibial lacerations: a comparison of primary excision and grafting with “defatting” the flap,” *British Journal of Plastic Surgery*, vol. 43, no. 3, pp. 312–314, 1990.

[3] E. G. Melissinos and D. H. Parks, “Post-trauma reconstruction with free tissue transfer—analysis of 442 consecutive cases,” *The Journal of Trauma*, vol. 29, no. 8, pp. 1095–1103, 1989.

[4] El-Sabbagh AH. Non-microsurgical skin flaps for reconstruction of difficult wounds in distal leg and foot. *Chinese Journal of Traumatology*. 2018 Aug 1;21(4):197-205.

[5] Franken JM, Hupkens P, Spauwen PH. The treatment of soft-tissue defects of the lower leg after a traumatic open tibial fracture. *European journal of plastic surgery*. 2010 Jun 1;33(3):129-3.

[6] G. G. Hallock, “Lower extremity muscle perforator flaps for lower extremity reconstruction,” *Plastic and Reconstructive Surgery*, vol. 114, no. 5, pp. 1123–1130,

[7] Gad SS, Kishk TF, Elkashty SM, Bassam MK. Reconstruction of the middle third of the leg by distally based hemigastrocnemius muscle flap. *Menoufia Medical Journal*. 2018 Oct 1;31(4):1369.

[8] Gopalan G, Dhanaraju S. An analysis of post traumatic leg and foot defects. *International Surgery Journal*. 2019 May 28;6(6):2041-5.

[9] Kumar PS, Srinivas ER, Anandan H. Reconstruction of lower one-third leg soft tissue defects. *Int J Sci Stud*. 2017;5(7):80-5.

[10] Lower extremity reconstruction: epidemiology, management and outcomes of patients of the Federal District North Wing Regional Hospital. *Revista do Colégio Brasileiro de Cirurgiões*. 2017 Feb;44(1):9-16.

[11] M. F. Almeida, P. R. Da Costa, and R. Y. Okawa, “Reverse-flow island sural flap,” *Plastic and Reconstructive Surgery*, vol. 109, no. 2, pp. 583–591, 2002.

[12] MACEDO JL, ROSA SC, BOTELHO DL, SANTOS CP, QUEIROZ MN, GOMES TG.

[13] Mahesh SG, Ramji AN, Balaji R, SM MC. Reconstructive strategies for lower one-third leg soft tissue defects. *International Surgery Journal*. 2018 Nov 28;5(12):4016-21.

[14] Mendieta M, Cabrera R, Siu A, Altamirano R, Gutierrez S. Perforator Propeller Flaps for the Coverage of Middle and Distal Leg Soft-tissue Defects. *Plastic and Reconstructive Surgery Global Open*. 2018 May;6(5).

[15] Mofikoya BO, Ugburo AO, Enweluzo GO. Early outcomes of reconstructing complex distal leg defects in Lagos, Nigeria. *Journal of Clinical Sciences*. 2016 Jan 1;13(1):2.

[16] P. N. Blondeel, G. Beyens, R. Verhaeghe et al., “Doppler flowmetry in the planning of perforator flaps,” *British Journal of Plastic Surgery*, vol. 51, no. 3, pp. 202–209, 1998.

[17] R. G. Jakubietz, M. G. Jakubietz, J. G. Gruenert, and D. F. Kloss, “The 180-degree perforator-based propeller flap for soft tissue coverage of the distal, lower extremity: a new method to achieve reliable coverage of the distal lower extremity with a local, fasciocutaneous perforator flap,” *Annals of Plastic Surgery*, vol. 59, no. 6, pp. 667–671, 2007.

[18] U. D. Khan and J. G. Miller, “Reliability of handheld Doppler in planning local perforator-based flaps for extremities,” *Aesthetic Plastic Surgery*, vol. 31, no. 5, pp. 521–525, 2007.