

Original Research Article

A clinical study on reconstruction of small and medium sized defects of tendo Achilles and heel regions with fascio cutaneous flaps

Ravikumar Gopalakrishnan*, Manoharan Rajalingam,
Balamuralee Rajagunasekaran, Ramya Esakimuthu

Department of Plastic and Reconstructive Surgery, Thanjavur Medical College, Dr. M. G. R. Medical University, Tamil Nadu, India

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*Correspondence:

Dr. Ravikumar Gopalakrishnan,

E-mail: gravikumar1962@gmail.com

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ABSTRACT

Background: Soft tissue defects of tendo Achillis and heel regions are difficult to reconstruct because of less vascularity and limited mobility of the skin. Most of these defects result from trauma, infection and excision of malignancy. Well vascularized tissues with sensation are needed to cover these defects as these regions are more prone for repeated friction and weight bearing. Aim was to study the versatility and applications of various flaps in the reconstruction of soft tissue defects of tendo Achillis and heel regions

Methods: This retrospective study was conducted in the Department of Plastic and Reconstructive Surgery, Thanjavur Medical College, Tamil Nadu, India from 2015-2019. About 22 patients with soft tissue defects of tendo Achillis and heel regions were studied. The aetiology of the defect, size of the defect and the outcome of treatment with various flaps were evaluated.

Results: Of the 22 patients 20 patients were males and 2 patients were females. The age group ranged from 12 years to 68 years. Most of the defects were due to road traffic accidents. The soft tissue defects were classified into small, medium and large sized defects based on the area of the defects. Reverse sural artery flap extended lateral calcaneal artery flap, posterior tibial artery perforator flap and lateral supra malleolar flap were the various flaps used to cover these defects.

Conclusions: Fascio cutaneous flaps play a major role in the reconstruction of tendo Achillis exposed defects and heel defects. Long term follow-up with physiotherapy is essential to achieve excellent function of tendo Achillis.

Keywords: Fascio cutaneous flaps, Soft tissue defects, Tendo Achillis and heel region

INTRODUCTION

Soft tissue defects of tendo Achilles and heel regions are difficult to reconstruct due to the bony prominence, limited availability of local tissue, requirement for specialized tissue, and the limitations imposed by donor site morbidity.¹ Most muscles become tendons at this level, and hence, flap cover becomes mandatory in case of soft tissue loss.² An ideal solution for soft tissue coverage should shorten wound healing time, reduce

wound complications, provide satisfactory function, minimize morbidity and if possible, provide better cosmesis.³

Stable skin cover over exposed tendo Achilles is essential for proper healing and recovery of tendo Achilles function. The heel area is subject to weight-bearing and shearing forces that exceed those of any other area of the body. Therefore, a defect of the heel can be a difficult problem for the patient because of the inability to wear

normal shoes. On the other hand, reconstruction of a defect on the heel has been a challenging problem to the plastic surgeon.

The basic principle is, “tissue defects should be replaced with like tissue”. This is very difficult in the case of heel because of paucity of expandable local tissue. Skin grafts may not take or may be inappropriate. Local rotation, advancement, and transposition flaps are limited by the availability of mobile skin. Many reports have been published on methods of reconstructing a soft tissue defect of the heel, which include skin grafts, local skin flaps, cross-leg flaps, muscle flaps, musculocutaneous flaps, and free flaps.⁴

Various flaps have been described in literature for cover over tendo Achilles like distally based skin flaps, advancement flap, free tissue transfers and islanded flaps.⁵⁻⁷ The use of free flaps has improved the ability to cover soft tissue defects. However, the flap bulk, the need for secondary procedures, and the risk of vascular failure are considerable drawbacks.⁸ Hence distally based fascio cutaneous flaps, distally based reverse neuro fascio cutaneous flaps are very useful, reliable and safe for the coverage of soft tissue defects of the tendo Achilles and heel regions.

Here we present our experience in the reconstruction of small and medium sized defects of tendo Achilles and heel regions with fascio cutaneous flaps.

METHODS

A retrospective study was conducted in the Department of Plastic and Reconstructive Surgery, Thanjavur Medical College, Tamil Nadu, India from 2015-2019. About 22 patients with soft tissue defects of tendo Achilles and heel regions were included in the study. Among these, 20 patients were males and 2 patients were females. The patient's age ranged from 12 to 68 years (mean=43.3 years). Detailed history was taken on the mechanism of injury, the time since injury and history of neurological deficits. Then, all the patients were subjected to a full general and local clinical examination to rule out other coexisting injuries and to assess the site and size of the defect, the presence or absence of exposed bone, tendons or neurovascular structures, the degree of wound contamination, and the condition of surrounding skin. Tendo Achilles integrity was tested clinically by asking the patient to stand on toes and by Thompson test. Soft tissue defects were classified as small sized if the area was less than 30 cm², medium sized if the area was between 30 cm² and 90 cm² and large sized if the area was more than 90 cm².

Inclusion criteria

All patients with small and medium sized defects of tendo Achilles and heel regions who required soft tissue cover were included in the study.

Exclusion criteria

Patients with associated bony injuries, degloving injuries, arterial injury, head injury, abdominal injury, thoracic injury and large sized soft tissue defects. Any disease or condition which might compromise the hematopoietic, renal, endocrine, pulmonary, central nervous, cardiovascular, immunological, dermatological, gastrointestinal or any other body system, history of allergic conditions like asthma, urticaria, eczema, history of autoimmune disorders, history of psychiatric disorders and recent history of alcoholism (<2 years) and smokers were excluded from the study.

Ethics committee approval was obtained. After getting informed consent the patients were investigated to assess them for surgery. Both qualitative and quantitative bacteriological study was done to rule out infection. X-ray of the limb was taken to rule out fractures. Doppler examination was done to know the status of the perforators of the peroneal and posterior tibial vessels in the affected leg so as to plan for the flap coverage. Timing of coverage was classified into acute- within 72 hours, subacute- 3 days to 6 weeks, and chronic- >6 weeks.

Sixteen patients with tendo Achilles region defects (ten medium size and six small size defects) and six patients with heel defects (four medium size and two small size defects) were covered with fascio cutaneous flaps. Reverse sural artery flap extended lateral calcaneal artery flap, posterior tibial artery perforator flap and reverse lateral supra malleolar flap were the various flaps used to cover these defects.

Post-operative management included adequate antibiotics, analgesics and anti-oedema measures. Limb was elevated and immobilized with below knee Plaster of Paris slab with ankle joint in plantar flexion. Window was created in the dressing to monitor the flap which was done once in 24 hours. Graft site inspection was done on 4th and 6th post-operative day. Sutures were removed on the 10th day. Patients were allowed to walk with support on the 15th day. Regular physiotherapy with gradual weight bearing had been advised to the patients. Passive and active movements of ankle joint had been initiated and done for 3 weeks. After 6 weeks non weight bearing walking and after 10-12 weeks weight bearing walking had been advised.

Postoperative complications like suture dehiscence, hematoma, wound infection, partial or total flap loss and graft loss were being monitored. Patients were on regular follow up from 6 months to 3 years.

Values were reported as mean±SD. Skewed variables were transformed to normality using the log to the base 10 transformation. Independent t test was used to compare mean values of the various parameters.

The data were analysed using the SPSS/PC+ package (Version 20, Chicago, IL, USA).

RESULTS

In our study 20 patients (91%) were males and 2 patients (9%) were females. The patient's age ranged from 12 to 68 years (mean=43.3 years). Among the 22 patients five

(23%) of them were from 30-40 and 60-70 age groups each and four (18%) of them were from 50-60 age group and three (14%) of them from 10-20 and 40-50 age groups each. Only two (8%) patients were from 20-30 age group.

Table 1: Patient demographics and clinical information.

Sex/ Age (years)	Aetiology	Defect area	Defect size	Type of flap	Follow up (months)	Result	Complications
Male 63	Diabetic ulcer	Tendo Achilles	Medium	Lateral supra malleolar flap	06	Complete healing	Minimal graft loss
Male 37	Road traffic accident	Tendo Achilles	Medium	Lateral supra malleolar flap	12	Complete healing	Suture site infection
Male 36	Road traffic accident	Tendo Achilles	Small	Extended lateral calcaneal artery flap	14	Complete healing	
Male 61	Diabetic ulcer	Heel	Medium	Reverse sural flap	22	Complete healing	Suture site infection
Male 13	Road traffic accident	Tendo Achilles	Small	Extended lateral calcaneal artery flap	04	Complete healing	
Female 57	Road traffic accident	Tendo Achilles	Medium	Posterior tibial artery perforator flap	30	Complete healing	Suture site infection
Male 44	Road traffic accident	Heel	Small	Extended lateral calcaneal artery flap	36	Complete healing	
Male 29	Road traffic accident	Tendo Achilles	Small	Extended lateral calcaneal artery flap	09	Complete healing	
Male 68	Road traffic accident	Tendo Achilles	Medium	Lateral supra malleolar flap	06	Complete healing	Minimal graft loss
Male 27	Road traffic accident	Tendo Achilles	Medium	Lateral supra malleolar flap	11	Complete healing	
Male 36	Road traffic accident	Tendo Achilles	Medium	Posterior tibial artery perforator flap	24	Complete healing	
Male 12	Road traffic accident	Tendo Achilles	Small	Extended lateral calcaneal artery flap	07	Complete healing	
Male 52	Road traffic accident	Tendo Achilles	Medium	Reverse sural flap	28	Complete healing	Tip necrosis
Male 59	Post SCC Exc. defect	Heel	Medium	Reverse sural flap	16	Complete healing	Tip necrosis
Male 49	Road traffic accident	Heel	Medium	Reverse sural flap	08	Complete healing	
Male 33	Road traffic accident	Tendo Achilles	Medium	Lateral supra malleolar flap	22	Complete healing	Minimal graft loss
Female 31	Road traffic accident	Tendo Achilles	Medium	Lateral supra malleolar flap	15	Complete healing	
Male 65	Road traffic accident	Heel	Medium	Reverse sural flap	07	Complete healing	Suture site infection
Male 67	Road traffic accident	Tendo Achilles	Medium	Reverse sural flap	11	Complete healing	Tip necrosis
Male 15	Road traffic accident	Tendo Achilles	Small	Lateral supra malleolar flap	13	Complete healing	
Male 52	Road traffic accident	Tendo Achilles	Small	Lateral supra malleolar flap	09	Complete healing	Suture site infection
Male 47	Road traffic accident	Heel	Small	Extended lateral calcaneal artery flap	18	Complete healing	Suture site infection

The soft tissue defects were due to road traffic accidents (86%), diabetes (13%) and post excisional defect (1%). 16 patients (73%) had defect in the tendo Achilles region and 6 patients (27%) had defect in the heel region. The most common indication for flap cover was exposed tendon (71%) and exposed bone (29%). The most common size of defect was medium-sized defects 30-90 cm² (63.64%) followed by small-sized defects <30 cm² (36.36%) (Table 1).



Figure 1: Reverse sural flap (A) A heel defect of 49-year-old male with avulsion injury of right heel; (B) The soft tissue defect 8x7 cm² was covered with reverse sural flap; (C) Eight months after surgery.



Figure 2: Extended lateral calcaneal artery flap for a tendo Achilles defect (A) 29 years old male with small tendo Achilles raw area for whom the extended lateral calcaneal artery flap raised; (B) Post-operative picture showing good take of the flap and skin graft.

Reverse sural artery flap was done for 6 patients (Figure 1). Extended lateral calcaneal artery flap was done for 6 patients (Figure 2). Posterior tibial artery perforator flap was done for 2 patients (Figure 3). Lateral supra malleolar flap was done for 8 patients (Figure 4). Tendo Achilles repair was done for 4 patients.



Figure 3: Reverse lateral supra malleolar adipo-fascial flap for tendo achilles defect, (A) 37-year-old male with medium sized tendo achilles raw area for whom the reverse lateral supra malleolar adipo-fascial flap was raised; (B) When the patient visited 6 months after flap surgery the flap and graft were well taken; (C) 12 months post-operative follow up.

Post-operative complications were infection in 6 patients (27.27%), partial tip necrosis in 3 patients (13.64%) and minimal graft loss in 3 patients (13.64%).



Figure 4: Posterior tibial artery perforator flap for tendo Achilles defect (A) 36-year-old male with soft tissue defect on the right tendo Achilles following road traffic accident for whom Posterior tibial artery perforator flap was raised; (B) 10 days after surgery both flap and graft were well taken; (C) Follow up of the patient after 12 months.

DISCUSSION

Reconstruction of soft tissue defects overlying the Achilles tendon and heel region is challenging, as this area is predisposed to damage and chronic ulceration. Poor vascularity of the Achilles tendon, paucity of available local tissue and the need to preserve anatomical contour to allow shoe fitting all add to the difficulty of reconstruction.⁹ Various factors which increase the challenge in reconstruction in these two areas are unreliable lower leg subdermal plexus which frequently results in poor wound healing, Achilles tendon in the bed which is relatively avascular, tight local tissues compared

to that of upper leg, tendon or bone gets frequently exposed due to presence of very minimal subcutaneous tissue.¹⁰

To preserve the function of the Achilles tendon, soft tissue reconstruction must cushion the tendon and permit gliding. For treating such patients, the priorities would be prevention of infection, re-establishing tendon continuity, and obtaining durable soft tissue coverage.¹¹ To minimize unstable scar formation, transferred tissue must resist shearing forces, pressure and friction exerted by the footwear during ambulation. Wound healing by secondary intention in this highly mobile area is significantly prolonged and leads to chronic, intractable wounds. Skin grafting is also contraindicated as secondary contracture will tether the tendon.¹² Perforator flaps have revolutionized the practice of modern reconstructive plastic surgery. With greater understanding of vascular anatomy, distribution of perforating vessels and flap perfusion, the concept of perforator flaps emerged. These flaps represent an evolutionary milestone in reconstructive surgery and have been successfully used to reconstruct soft tissue defects in the lower leg and foot. Perforator-based flaps for reconstruction of skin and soft tissue overlying the Achilles tendon can be based on the multiple perforators that emerge from either side of the tendon.

Reverse sural flap is a useful and versatile reconstructive method in patients with soft tissue defects of the overlying the Achilles tendon and heel region foot. In practice, the flap size and pivot point position are determined by the geometric contour of the defects. The flap should be free of pressure and other mechanical forces.¹³ This flap has the largest arc of rotation compared to the regional flaps and does not require sacrifice of any major artery, and moderate to large sized defects can be covered adequately.¹⁴ We must place a light dressing on the flap and limb elevation is crucial in the prevention of venous congestion.

The extended lateral calcaneal artery flap is an axial pattern fascio cutaneous flap that is simple, stable and sensate. It is nourished by the lateral calcaneal artery, which is a terminal branch of the peroneal artery, is drained by the lesser saphenous vein and is innervated by the sural nerve.¹⁵ It is preferred in small sized isolated posterior heel defects with exposed Tendo Achilles or Calcaneum and normal skin in flap vicinity. Peroneal vessels are last to be affected by age, diabetes mellitus or smoking, making it a safe flap in these patients.¹⁶

Reverse lateral supra malleolar adipo-fascial flap preserves the skin, leave the main artery intact, lower the morbidity of the donor site, elevate in a thin flap and provide good aesthetic results to the donor site.¹⁷

A distally based pedicled perforator flap from the posterior tibial artery for covering defects around the ankle, heel, and lower third leg is a reliable, easy, less

time-consuming, and versatile procedure.¹⁸⁻²⁰ Our study found the presence of a constant perforator of the posterior tibial artery within 7 cm above the medial malleolus in all the patients.

In our clinical study out of the six reverse sural flaps two of them had suture site infection, three had minimal flap tip necrosis. Among the six extended lateral calcaneal artery flaps and eight lateral supra malleolar flaps there were no complications apart from minimal graft loss. The patients with posterior tibial artery perforator flaps had infection at the suture site. All these patients were treated conservatively.

CONCLUSION

Patients with small and medium sized defects of tendo Achilles and heel regions can be effectively covered with fascio cutaneous flaps. Rehabilitation following surgery with adequate immobilization and effective physiotherapy is very important for good functional outcome.

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REFERENCES

1. Levin LS. Foot and ankle soft-tissue deficiencies: who needs a flap? *Am J Orthop* (Belle Mead NJ). 2006;35(1):11-9.
2. Kumar PS, Srinivas ER, Anandan H. Reconstruction of lower one-third leg soft tissue defects. *Int J Sci Stud.* 2017;5(7):80-5.
3. Mahipathy V, Rao SR, Ranganathan S, Murugesan S, Durairaj AR, Sundaramurthy N, et al. A Clinical study on islanded reverse sural artery flap for the reconstruction of defects over the lower third of leg and foot. *J Clin Diagn Res.* 2017;11(12).
4. Cheema TA, Saleh ES, De Carvalho AF. The distally based sural artery flap for ankle and foot coverage. *J Foot Ankle Surg.* 2007;46(1):40-7.
5. Yu AX, Deng K, Tao S, Yu G, Zheng X. Anatomic study and clinical application of distally based neuromyocutaneous compound flaps in the leg. *Microsurgery.* 2007;27(6):528-32.
6. Jammula SS, Rangachari S, Panagatla P. Propellar flap: safe, reliable option for coverage of exposed tendo Achilles. *Int J Res Orthop.* 2018;4:572-6.
7. Upadhyaya DN, Khanna V, Kohli R, Tulsani SPS, Garg S. Functional reconstruction of complex tendo

- Achilles defect by free latissimus dorsi muscle flap. *Indian J Plastic Surg.* 2012;45;3:572-5.
8. Lu TC, Lin CH, Lin CH, Lin YT, Chen RF, Wei FC. Versatility of the pedicled peroneal artery perforator flaps for soft-tissue coverage of the lower leg and foot defects. *J Plast Reconstr Aesth Surg.* 2011;64(3):386-93.
 9. Raveendran SS, Perera D, Happuharachchi T, Yoganathan V. Superficial sural artery flap- a study in 40 cases. *Br J Plast Surg.* 2004;57:266-9.
 10. Cavadas PC, Landin L. Reconstruction of chronic Achilles tendon defects with posterior tibial perforator flap and soleus tendon graft: clinical series. *Plast Reconstr Surg.* 2006;117:266-71.
 11. Costa-Ferreira A, Reis J, Pinho C, Martins A, Amarante J. The distally based island superficial sural artery flap: clinical experience with 36 flaps. *Ann Plast Surg.* 2001;46:308-13.
 12. Tang M, Mao Y, Almutairi K, Morris SF. Three-dimensional analysis of perforators of the posterior leg. *Plast Reconstr Surg.* 2009;1;123(6):1729-38.
 13. Zhang F, Lin S, Song Y, Zhang G, Zheng H. Distally based sural neuro-lesser saphenous veno-fasciocutaneous compound flap with a low rotation point: microdissection and clinical application. *Ann Plast Surg.* 2009;62(4):395-404.
 14. Chen SL, Chen TM, Chou TD, Chang SC, Wang HJ. Distally based sural fascio musculocutaneous flap for chronic calcaneal osteomyelitis in diabetic patients. *Ann Plast Surg.* 2005;54(1):44-8.
 15. Chung MS, Baek GH, Gong HS, Rhee SH, Oh WS, Kim MB, et al. Lateral calcaneal artery adipofascial flap for reconstruction of the posterior heel of the foot. *Clin Orthop Surg.* 2009;1(1):1-5.
 16. Omokawa S, Yajima H, Tanaka Y, Ryu J. Long-term results of lateral calcaneal artery flap for hindfoot reconstruction. *J Reconstr Microsurg.* 2008;24(4):239-45.
 17. Lee JH, Chung DW. Reverse lateral supramalleolar adipofascial flap and skin grafting for one-stage soft tissue reconstruction of foot and ankle joint. *Microsurgery.* 2010;30:423-9.
 18. Akhtar MS, Khurram MF, Choudhary R, Khan AH, Ahmad I. Distally based posterior tibial artery perforator flap for coverage of defects around the ankle, heel and lower third of leg. *Eur J Plast Surg.* 2014;37(10):547-54.
 19. Hafeez K, Siddiqui A, Haroon-ur-Rashid CSI, Cheema TA. The posterior tibial island flap for coverage in complex injuries of the lower extremity. *Microsurgery.* 2012;32:539-45.
 20. Schaverien MV, Hamilton SA, Fairburn N, Rao P, Quaba AA. Lower limb reconstruction using the islanded posterior tibial artery perforator flap. *Plast Reconstr Surg.* 2010;125(6):1735-43.

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