Original Research Article

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

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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 Stably skin cover over exposed tendo Achillis is essential for proper healing and recovery of tendo Achillis 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.

Various flaps have been described in literature for cover
over tendo Achilles like distally based skin flaps, advance
ment flap, free tissue transfers and islanded flaps. 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. 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
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 tendon 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.

Figure 4: Posterior tibial artery perforator flap for tendon 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. 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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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.\textsuperscript{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 tendon 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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