



OUTCOME OF PERONEAL ARTERY FLAP IN ACUTE TENDOACHILLES INJURY AS COMPARED WITH SURAL ISLAND FLAP

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ABSTRACT

Tendoachilles injury is a major complication affecting day to day life and this injury is more common in younger age group and most often is caused by Indian type of lavatory injury in the subcontinent. But unfortunately large meta-analytical analyses of these epidemiological facts are lacking and will be a demand of future. The treatment of such an acute condition demands innovation. Practice of using flaps to treat these modes of injuries is an important mode of treatment. Plastic surgeon nowadays must think about the donor site outcome both functional and aesthetic which is much better in case of perforator flap than tibial flap and give early treatment for the expectation of Hypertrophic scar particularly in our country were evaluated in the present study.

INTRODUCTION:

The term Achilles tendon bears its name from a tragic but touching Greek myth involving the great warrior Achilles, his mother Thetis and Paris, Prince of the Trojans¹. Similarly the Achilles tendon is the most commonly ruptured tendon in the human body². Tendo-achilles cut injury is most common tendon injury. Most of the cases are due to fall in the lavatory, followed by cut injury over the tendo-achilles. Other causes are road traffic accident (RTA) and direct trauma (accidental cut).³

Soft tissue defects of lower 1/3rd tibia and dorsum of foot presents a challenging problem to the plastic surgeons particularly in developing countries where infrastructural facilities are yet to develop. This issue is further complicated when there is an exposed Tendo-Achilles tendon with or without injury. This arises from the fact that the tendon itself is relatively avascular. This tendon is a vital organ of locomotion, when exposed requires early coverage to avoid impediment, like infection, dessication and susceptibility to future tear and delay in coverage makes reconstruction of the tendon and subsequent coverage difficult.⁴

The vast array of reconstructive methods should be used judiciously, considering the characteristic of the defect and the functional and aesthetic requirements, choosing the best solution for each patient.⁵

Random local flaps are usually not available, due to damage of the tissue from the vicinity and to the anatomical particularities of the area (there is no skin excess and an increased risk of exposure of noble elements within the secondary defect). Pedicled regional flaps are a good option for relatively small to medium size defects.

The "classical" regional options include fasciocutaneous and muscle/musculocutaneous flaps. One of the most used is the neurosensory distally based island sural flap⁶. It includes the superficial and deep crural fascia, the sural nerve and superficial sural artery, the short saphenous vein and the skin island. The most recent and modern option of regional flaps for coverage is represented by perforator flaps⁷. Since first description, their use in coverage of the Achilleal region increased in popularity. They spare the main vascular trunks of the leg causing minimal donor-site morbidity, require relatively rapid dissection and provide a reliable territory⁹. Free tissue transfer is technically more demanding, requires microsurgical expertise and longer operative time, usually general anaesthesia, adequate postoperative monitoring and moderately increased rate of failure, so it is not the first option of treatment for simple coverage of the Achilles region if loco-regional flaps are available⁵.

MATERIAL AND METHODS

STUDY AREA

A comparative study was undertaken in the Department of Plastic Surgery and patients were selected from the Out Patient Department (OPD) of The Medical College and Hospital, Kolkata.

STUDY POPULATION

Patients having repaired Achilles tendon injury with an overlying soft tissue defect at the follow up visit which is usually after 1 wk of primary repair of Tendoachilles, attending the Department of Plastic Surgery, Medical College and Hospital.

Patients having soft tissue defect over repaired Achilles tendon who were willing to participate in the study were taken as cases.

Patients with Diabetes Mellitus, Atherosclerosis, Tuberculosis, IHD, cigarette smokers and other co-morbid diseases were excluded.

SAMPLE SIZE

The study was conducted in a series of 40 patients with soft tissue defect over the repaired Tendoachilles who attended Dept. of Plastic Surgery in the study period to have a statistically significant data.

SAMPLE DESIGN

As there is no significant difference in the outcome of two different flaps based on their individual study, total sample population divided in two equal arms (patients having Sural island flap and patients having Perforator flap) selected on the basis of random number table and the outcome of the study compared between two groups and accepted standards.

STUDY DESIGN

The study was designed to be a prospective, interventional, comparative and analytical trial.

PARAMETERS STUDIED

The parameters studied in this research article are clinical outcome of the perforator flap and complications in reference to healing of flap itself and of the donor site.

STUDY TECHNIQUE

After stabilizing the patient and after preparing the defect for flap coverage, the flap raised according to the anatomical landmark, rotated around its pedicle and covered the defect. Daily monitoring of the flap will be done up to 7th POD (post operative day). Dressing changes will be done on 1st, 3rd, 5th and 7th POD. Stitches will be removed on 15th POD. All the patients will be followed up to average of 6 months (4 months to 8 months).

Posterior Tibial Artery Perforator Flap:

Preoperatively, the posterior tibial artery perforators are identified and marked on the skin using a hand-held Doppler probe. Identification of the surrounding perforators enables the surgeon to delineate the angiosome supplied by a single perforator and the extent of its perfusion. The patient is placed in the supine position with the leg slightly abducted and externally rotated. A thigh tourniquet is used without fully exsanguinating the leg to allow easier identification of the perforators during exploration. After surgical excision of any necrotic or infected tissue, the size of the defect is revealed. A potential flap is then drawn adjacent to the defect. The side of the flap closer to the defect is raised first in a subfascial plane and until at least one of the perforators is found. The shape of the flap can then be re-evaluated and adjusted according to the location of the perforator. The remaining outline of the flap is then incised and the flap is undermined until it is completely islanded. The perforating artery and the concomitant veins are dissected directly or close to the posterior tibial artery, long enough to prevent kinking of the vessels when the flap is repositioned. The raised flap can now be rotated around the perforator into the defect in an angle of 90° to 180°. A PVC drain is placed subcutaneously which is removed after 48 hrs. Donor area was either covered with a split thickness skin graft harvested from the thigh or closed primarily. Hydration of the patient, leg elevation, and maintenance of adequate blood pressure and temperature (to prevent spasm of the perforating artery) are critical for the first postoperative 48 hours. Clinical monitoring of the flap to detect intrinsic vascular problems (vasospasm) as well as extrinsic causes of perfusion compromise (hematoma, oedema, and external pressure) is essential for the patient's

successful outcome. This involves close monitoring of the skin colour, capillary refill, skin temperature, and evidence of postoperative bleeding. The flap is monitored hourly during the first 24 hours and every 4 hours for the next 24 hours. The first skin grafting dressing is usually performed on the 5th postoperative day and flap sutures are removed on the 15th postoperative day.

Peroneal Artery Perforator Flap:

A hand-held Doppler machine was used to identify perforators of the peroneal artery. They were along the lateral aspect of lower legs from the lateral malleolus. Once the perforators were identified, the propeller flap was designed around the major perforator proximal to the defect. An anterior incision can be employed depending on the location of the defect. Incision was initially made from one side to make sure the major perforator was adequate in caliber. The design of the flap could be modified depending on the location of the chosen perforator. Usually the skin from the proximal portion of the lateral leg was harvested, with the major perforator acting as the pivot point. The size of flap was designed based on the defect size. The most proximal part of flap was used for the coverage of the defect, therefore, the width should be equal to the defect, and the length should be at least equal to or more than the distance from the perforator (pivot point) to the distal edge of the defect. Usually the perforator had to be dissected for several centimetres to allow easier rotation or advancement. Once the perforator was mobilized a fasciocutaneous flap could be islandized, then rotated (up to 180°) as a 'propeller' to cover the defect. The donor site was closed primarily or skin grafted depending on the size of the defect.

DATA ANALYSIS

The data of outcome were analysed and expressed as percentages (%).

RESULT AND DISCUSSION

Amongst the 40 patients equally divided but randomly chosen two groups are created, one for distally based Sural Island flap and Perforator flap. Though in delayed presentation, where the repaired tendon covered with viable paratendon and granulation tissue, skin graft can be done. However it is excluded in our study as we comparing various aspects of two above mentioned flaps.

Our study showed that the peak incidence occurred mostly at 19-29 yrs of age and overall proportion of males (70%) was significantly higher than that of females (30%).

Behind most of the cases revealed that 62.5% were due to toilet pan injury in Indian style pan which is severely uncommon in the West.

The overall mean area of defect in our study is ranging between 20 to 24 sq. cm. with the extremes 9.6 to 36 sq.cm.

Due inadequate tissue respect at the time of primary repair mostly the wound complication with soft tissue defects occurred and some of the cases wounds covered with slough (22.5%) at the time of presentation. Average area of defect of over Tendoachilles region is about 22 sq. cm.

Overall 12.5% patient lost to review at the end of 6m but 87.5% of them completed 6 month follow up as well they fulfil almost all the parameters to be checked.

Regarding operating time the median value for distally based sural island flap is 117 min and for perforator it is 119 min.

We have done Distally based sural island flap for larger defect such as for median 24 sq.cm defect, a median 26 sq.cm Distally based sural island flap done and median 21 sq.cm perforator flap taken to cover a median area of defect 20 sq.cm

Anteriorly based POP cast is required for distally based sural island flap though most cases it serves dual purpose for immobilization of tendoachilles and stability of flap. Perforator flaps do not require strict immobilization.

Our study yielded that the proportion of partial necrosis was higher for sural island flap (30%) than that of perforator flap (20%). On the other hand proportion of complete necrosis was higher for perforator flap (10%) than that of sural island flap (5%). But in both the cases proportions were not significant.

Donor site outcome has got one of the main differences between the two different groups as proportion of grafting was significantly higher for sural island flap (95%) than that of perforator flap (65%). On the other hand proportion of primary closure was significantly higher for perforator flap (35%) than that of sural island flap (5%). Subsequently donor site complication as graft failure, insensate donor area, proportion of hypertrophic scar etc found in increased amount in sural flap group.

Ankle Hindfoot scale was an important tool for our study to evaluate the outcome. Half of the patients (50%) having perforator flap get a score of 100 whereas 30% having sural flap amounting to that excellent outcome.

Greater than 2 week stay was evident in 30% patient of sural flap but it is only 5% in perforator flap which renders 40% patients to go home within a week. Post

operative recovery is quicker in perforator flap.

65% of perforator flap and 40% of sural flap patients are very satisfied, depicting that perforator flap has got definitely better aesthetic outcome than sural one.

There is few more incidence of hypertrophic scar in donor area in sural flap.

Sural flap has got more chance to be sensate than perforator flap and it is relatively easy to dissect. That is why it has been often kept as an option in hand as a conventional work-house flap in cases of failure of perforator flap which demands meticulous dissection but spares main vascular axis of limb.

Irrespective of comorbidity wound complication can be seen in 2.4–20% of the cases (Maagaard Mortenson and Pedersen 1990, Paavola et al 2000, Wills et al 1986). It is important to note that soft tissue handling is something that cannot be measured, as it only comes with practice. Both in the Achilles tendon surgery and especially in the calcaneal fracture surgery it is necessary to handle soft tissue meticulously (Saxena et al 2008)¹⁰. In both of these types of surgery, the most important factors in the postoperative healing of the wound are the placement of the incision and the timing of the surgery. The higher incidence of wound complications after these operations as compared to other ankle surgery indicates both the complexity of the soft-tissue envelope and the possibility of secondary tissue trauma due to oedema and an operative intervention (Levin and Nunley 1993)¹¹.

As well in our study all the defect occurred due to wound complication as dehiscence etc. We have 22.5% wound covered with slough without necrosis of tendon as the complication of tissue insult either at the time or due to mode of injury or tissue disrespected at the time of Achilles tendon repair. As the skin in the ankle and Achilles region is thin, pliable, sensate, and provides a gliding surface for the Achilles tendon, a gentle technique with a standardized procedure having a good tissue respect over the region of Tendoachilles needs to be evaluated by a prospective trial.

The skin envelope is especially tight around the ankle and foot. An injury and operation cause oedema and those factors make the skin closure after surgery demanding. There is also usually very little fat under the skin and even a small soft tissue defect can create a major complication if the underlying bone, tendons, joint or hardware become exposed. This is why a free skin graft is seldom a good choice for soft tissue reconstruction¹².

We have also excluded the option for skin graft over the exposed tendon though some of the cases paratendon remained viable. But to be on safer side and better prognosis we have chosen the option of flap in all cases.

In the series of 20 perforator flaps we have randomly done 15 Posterior tibial perforator flap and 5 Peroneal perforator flaps as we had an inclination to keep Peroneal perforators for any future use as main key for Distally based Sural island flap which can be used as second locoregional flap.

The use of propeller perforator flaps in distal lower leg allow them the coverage of small and medium size defects, but their dimensions have to be sometimes sensibly larger to cover these defects. That explains the large dimensions of flaps used by some surgeons. Rad et al. successfully used a peroneal artery propeller perforator flap of 22×8 cm to cover a defect of 6×8 cm at the ankle and Achilles region¹³, Koshima et al. used a posterior tibial artery propeller perforator flap of 19×13 cm, and Quaba and Quaba extended the length of the same flap to within 10 cm of the popliteal skin crease. Alexandru V. Georgescu et al also extended proximally some of our flaps based on a single perforator, and the largest flap in lower leg in their experience was a posterior tibial artery propeller perforator flap of 28×13 cm.⁷

Our study median 21 sq.cm Perforator flap taken to cover a median area of defect 20 sq.cm and for median 24 sq.cm defect, a median 26 sq.cm Distally based sural island flap done. The size after mapping the flap outline was greater than the area of defect to compensate primary contraction of flap. In a case report Ting Chen Lu et al mentioned 22 sq. cm peroneal perforator flap for Tendoachilles coverage¹³. Sural flap is usually bigger in size but It should not extend beyond the line drawn 6 cm proximal to lateral malleolus. This flap has some limitations like maximum safe length: breadth yet to be defined. There are no studies regarding maximum flap dimension (specifically, width) and safety, but usually a relatively large flap can be harvested with little donor site deformity or morbidity⁴.

Alexandru V. Georgescu et al commented that local perforator flaps reduce morbidity of the donor site, because the source artery and underlying muscle are preserved, and scars are limited to only one region. For defects less than 6 cm wide, the donor site can be primarily closed¹⁴, but even bigger defects can be partially direct sutured.

In our study Proportion of grafting was for Perforator flap (65%). On the other hand Proportion of primary closure was for Perforator flap (35%). The higher proportion of primary closure in perforator flaps gives obvious advantage of better anatomical closure, retention of sensation in donor site and better aesthetic outcome which ultimately boost patient's satisfaction. Donor site outcome is one of

the mainstays. The perforator flap from different areas of lower leg can be used in a free style fashion without damaging the main vascular axis of leg. Among the cases of perforator flaps only one required secondary suturing due to wound dehiscence.

Ioannis et al reported 6 patients from 2004 to 2009 with Posterior Tibial Artery perforator flap for Achilles tendon coverage with 1 case (17%) partial marginal necrosis. In the study conducted by Ting Chen Lu et al on 16 patients, the incidence of partial necrosis were 2 which is even lower (12.5%).

Our study yielded that the Proportion of partial necrosis was 20% for Perforator flap. On the other hand Proportion of complete necrosis was 10% for Perforator flap. Partial necrosis of perforator flap is marginally higher than the previous studies. The fact can be due to exceeding the usual territory. The little higher incidence of perforator flap complete necrosis may result from venous insufficiency and lack of meticulous dissection. Out of 4 partial necrosis of Perforator flap 1 skin graft required.

REFERENCES:

1. www.wordfocus.com/achilles-heel-story
2. Jozsa L, Kvist M, Balint JB, Reffy A, Jarvinen M, Lehto M, Barzo M. The role of recreational sports activity in Achilles tendon rupture : A clinical, patho-anatomical and sociological study of 292 cases. *Am J Sports Med* 1989 ; 17 : 338-343
3. Local flap coverage for soft tissue defects following open repair of Achilles tendon rupture. S. M. KUMTA, N. MAFFULLI. *Acta Orthopædica Belgica*, Vol. 69 - 1 – 2003
4. Sural island flap – a good option for coverage of the exposed heel (Tendoachilles) . ALAM MK, SHAHEEN MS, HOSSAIN S, ANAM S, RAHMAN S. *J Dhaka Med. Coll.* 2010; 19(1): 19-24.
5. Single stage Achilles tendon coverage and reconstruction Mihaela Mastacaneanu, Zorin Crainiceanu, Shruti Kaushal, Adriana Opris, Adrian Tirla, Alina Helgiu, Alina Cradigati, Mirela Sarandan, Adrian Caramida, Tiberiu Bratu. *Timisoara Medical Journal* 2010, Vol. 60, No. 2–3. Romania
6. Boopalan PR, Jepeganam TS, Titus VT, et al. Open infected Achilles tendon injury – Reconstruction of tendon with fascia lata graft and soft tissue cover with a reverse flow sural flap. *Foot Ankle Surg* 2008;14:96-9.
7. Quaba O, Quaba AA. Pedicled perforator flaps for the lower limb. *Semin Plast Surg* 2006;20:103-11
8. Propeller Perforator Flaps in Distal Lower Leg: Evolution and Clinical Applications. Alexandru V. Georgescu Clinic of Plastic Surgery and Reconstructive Microsurgery, University of Medicine Iuliu Hatieganu, Cluj Napoca, Roumania. *Arch Plast Surg* 2012;39:94-105
9. Pirwani MA, Samo S, Soomro YH, Distally Based Sural Artery Flap: A workhorse to cover the soft tissue defects of lower 1/3 Tibia and Foot. *Pak J Med Sci.* 2007; 23(1): 103-7
10. Saxena A, Maffuli N, Nguyen A, Li A: Wound complications from surgeries pertaining to the Achilles tendon: an analysis of 219 surgeries. *J Am Podiatr .Med Assoc.* 2008 Mar-Apr;98(2):95–101
11. Levin LS: Principles of definitive soft tissue coverage with flaps. *J Orthop Trauma.* 2008 Nov–Dec; 22(10 Supl):S161–166
12. Thordarson DB, Greene N, Shephard L, Perlman M: Facilitating edema resolution with a foot pump after calcaneus fracture. *J Orthop Trauma.* 1999 Jan;13(1):43–46.
13. Rad AN, Singh NK, Rosson GD. Peroneal artery perforator-based propeller flap reconstruction of the lateral distal lower extremity after tumor extirpation: case report and literature review. *Microsurgery* 2008;28(8):663-70
14. Jakubietz RG, Jakubietz MG, Gruenert JG, Kloss DF: The 180-degree perforatorbased propeller flap for soft tissue coverage of the distal, lower extremity. *Ann Plast Surg* 2007;59:667–671.