

SURAL ISLAND FLAP – A GOOD OPTION FOR COVERAGE OF THE EXPOSED HEEL (TENDO-ACHILLIS)

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Abstract:

A prospective observational study was carried out in DMCH and some other private clinics in Dhaka from January 2008 to March 2010. A total of 15 patients with exposed Tendo-Achillis with or without tendon injury were taken in this study. M:F= 13:2. Age range was 18- 45 years. In 13 cases Tendo-achillis (TA) were cut and repaired in emergency department of DMCH and other Hospitals followed by loss of skin over the TA. In 2 cases skin over the TA were lost due to direct trauma. Mode of injury was cut injury in toilet pan 9(59.99%), RTA 4(26.66 %) and direct cut injury without tendon injury 2 (13.33%). All the patients were treated with surgical toileting after admission and wound were covered by distally based sural island flap. Average follow up period was 36 weeks. Flap coverage were done within 5 days to 25 days from the day of injury. Outcome was evaluated by flap vascularity and skin colour. Majority of the patients were returned to normal activity after 20 weeks of operation. The purpose of the study was to find out the way of coverage of the exposed TA(Tendo-Achillis) by orthopaedic surgeons without any special training.

Key words: Sural Island Flap, Repair of Tendo-Achillis.

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Introduction:

Soft tissue defects of lower 1/3 tibia and dorsum of foot presents a challenging problem to the orthopaedic surgeons particularly in developing countries where infrastructural facilities are yet to develop. The problem becomes worse because of the limited mobility and availability of the skin at the distal third of the leg region, unique weight bearing requirements and relatively poor circulation of the skin. This issue is further complicated when there is an exposed Tendo-Achillis 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.

The patients are being treated by Plastic Surgeons.¹ Most open fractures of lower 1/3 of tibia are associated with soft tissue defects, because tibia is subcutaneous bone with almost no muscles around its lower 1/3 with tight skin and poor circulation. Heel is another problem site because of weight bearing properties, hence it needs a full thickness skin cover. Different forms of soft tissue cover are available e.g., muscle flap, fascial flaps, septocutaneous flaps, cross leg flap, axial flaps and free flaps with their own indications and disadvantages.

Tendo-achillies cut injury is most common tendon injury. Most of the cases this is due to fall in the toilet pan, followed by cut injury over the tendo-achillis. Other causes are road traffic accident (RTA) and direct trauma (accidental cut). After the cut patient always attend in the emergency department and repair done by

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junior doctors, followed by skin loss either due to tight closure (post-operative wound dehiscence) or due to infection.

Superficial sural artery island flap is a "island flap" based on vascular axis of the sural nerve which gets reverse blood flow through communication with the perforating branch of the peroneal artery situated in the region of lateral malleolar gutter. Achilles' Tendon can be exposed due to trauma, post-operative wound dehiscence, infection etc. This exposed tendon requires immediate coverage to avoid complications. This versatile flap provides an excellent coverage for the exposed tendoachilles and has definitive advantages such as being easy to raise, having a wide range of arc of rotation, not compromising major arteries of the leg, requiring minimal expertise and infrastructural facilities, and having less morbidity to donor site and being a single staged surgery.

The distally based sural artery flap, first described as a distally based neuro-cutaneous flap by Masquelet et al,² in 1992, is skin island flap supplied by the vascular axis of sural nerve. The sural flaps provide good coverage of the defects, both from a functional

and an aesthetic point of view. The major advantage of this flap is its easy and quick dissection. Because the major arterial axis is not sacrificed, this flap can be used in a traumatic leg with damaged major arteries. This axial pattern flap depends on the vascular axis of the superficial sural artery which is usually constant. Duplex scan could be of added advantage in the planning but is not mandatory.

Materials & Methods:

15 Patients with exposed Achilles' tendon were treated with superficial Sural island flap in the Department of Orthopaedic Surgery & Traumatology, Dhaka Medical College, Dhaka, a tertiary level hospital and some other private hospitals in Dhaka. There were 13 males, 2 females. The average age of patient was 35.5 yrs with age ranges from 18 to 45 years. The age of the defect on average was 16 days with the range of 5 to 25 days. The cause of exposed Achilles' tendon was post-traumatic in 2 cases,

postoperative in 8 cases, post-infective in 5 cases. Patient with Diabetes Mellitus, Tuberculosis, IHD and cigarette smokers were excluded. After preparing the defect for flap coverage, the flap was raised according to the anatomical landmark, rotated around its pedicle and covered the defect. The donor site defect were covered with split thickness skin graft from the ipsilateral thigh. The limb was immobilized by POP anterior slab with the ankle in gravity equinus for TA injury and neutral ankle in TA intact patients. Daily monitoring of the flap was done up to 7th POD. Dressing changes were done on 1st, 3rd, 5th and 7th POD. Stitches were removed on 15th POD. All the patients were followed up to average of 9 months (6 months to 12 months). Patients were evaluated for flap acceptability, healing of the flap, durability of the flap, ambulation and sensation on the lateral side of the foot and also on the flap. Flap donor site was also examined for scar and keloid formation, pain & neuroma formation.

Operative Procedure :

Positioning of the Patient: After giving spinal anaesthesia, patient was placed in prone position. Tourniquet was used and removed after 60 -90 minutes.

Anatomical landmarks :

- Lateral Malleolus.
- Divide the Posterior aspect of leg into three equal part from above downwards.
- Midline of the posterior surface of the leg

The flap can be outlined and raised according to the requirement of the defect any where from the posterior aspect of lower two-thirds of the leg centred around the midline of the leg. The superficial sural artery island flap is based on the superficial sural artery, which accompanies the sural nerve^{3,4}. The upper limit of the flap is the line between upper third and the lower two-third of the leg. The centre of the flap should be placed in the midline of the posterior surface of the leg with the pivot point of the pedicle located at least 6cm proximal to the lateral malleolus. Direction distal to this point risks damaging the anastomotic connection with the peroneal

artery and consequently of the flap itself. The pivot point is the site of anastomosis of the peroneal artery with the suprafacial sural artery that accompanies the sural nerve. Regardless of the termination, this artery has a constant distal anastomosis with septocutaneous perforators from the peroneal artery, which will supply a reverse flow flap. To preserve the anastomosis within the suprafascial plane, the deep fascia must always be included in the flap and pedicle. This artery has direct cutaneous branches only in its suprafacial portions that are in the lower two thirds of the leg.

Length of the pedicle is the distance from the proximal margin of the wound to the line drawn 6 cm proximal to lateral malleolus. The pedicle must be at least 3 cm wide containing subdermal layer with the sural nerve, accompanying superficial sural vessels, and short saphenous vein. The lower limit of the flap is the line drawn above the desired length of the pedicle. The size of the flap varied depending on the size of the defect. The maximum length and breadth is yet to be determined.

Flap harvesting procedure :

Skin incision was begun at the upper end of the flap to identify the sural nerve^{5,6} and then along the line in which the fascial pedicle will be taken. The subdermal layer was dissected to expose the sural nerve, accompanying superficial sural vessels, and short saphenous vein . At the proximal margin of the flap, the vein was ligated and severed, and the nerve and accompanying vessels were also cut & the skin island was elevated as a flap with the deep fascia. After raising the flap the pedicle was rotated to cover the defect with the flap . The flap was transferred to the defect through a skin tunnel . This donor site defect was covered by split skin graft.

Postoperative care :

The limb was immobilized by POP anterior slab with the ankle in gravity equinus for TA injury and neutral ankle in TA intact patients. Daily monitoring of the flap was done up to 7th POD. Dressing changes were done on 1st, 3rd, 5th and 7th POD. Stitches were removed on 15th POD.

Follow-up :

TA injured patients were kept in POP cast for 3 weeks with ankle in neutral position and further 6 weeks without plaster slab but non-weight bearing crutch walking. TA intact patients were kept with POP cast for 2 weeks more and non-weight bearing crutch walking for further 4 weeks.

All the patients were followed up to average of 9 months (6 months to 12 months). Patients were evaluated for flap acceptability, healing of the flap, durability of the flap, ambulation and sensation on the lateral side of the foot and also on the flap. Flap donor site was also examined for scar and keloid formation, pain and neuroma formation.

Results:

All flaps except one survived without any complication. Most flaps showed slight venous congestion which cleared within a few days. The average healing time and hospital stay time was 20 days and 28 days respectively. One of the patient developed infection, which was controlled with antibiotics and daily dressing later required a small area skin graft. Marginal necrosis was seen among 3 cases. It is probably because of tight suture and venous stasis and these cases were managed by secondary suture. Cutaneous hypo-aesthesia was seen along the distribution of sural nerve in all cases, but this was improved within 7 months. No debulking was needed in any of the flaps. None of the patients had any problem of wearing shoes. Any of the flap did not show any sort of ulceration during the follow up period. Donor area healed without problems like neuroma or ulceration, pain or ugly scar. There was no loss of split skin graft.



Fig.-1: Primary defect with exposed Tendo-Achillies

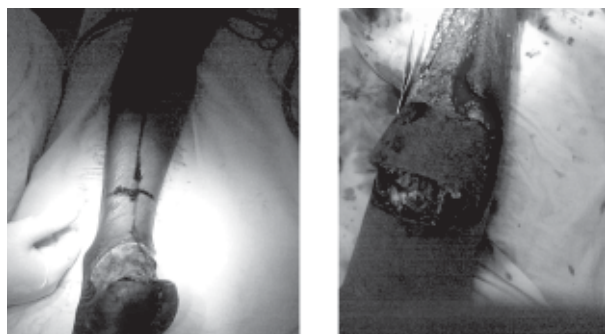


Fig.-2: Skin Incision mark & After raising the sural island flap



Fig.-4: After coverage of the wound by sural flap



Fig.-6: Loss of epidermis with marginal necrosis of about 5mm in distal part of flap

Discussion :

Distal third of the leg is the domain of free flap. Soft-tissue defects of the distal third of the leg and foot are difficult to reconstruct especially when the Achilles' tendon is exposed. There are many options for coverage, including distally based fascio-cutaneous flap, muscle flaps, septo-cutaneous flaps, axial flaps, local transposition flaps and free flaps. Each one has its own specific indications and limitations^{7,8,9,13,14,15}.

Fasciocutaneous flaps first introduced by Ponten in 1981,⁸ are in use for the



Fig.-3: After raising flap showing pedicle & Trial placement of Flap over the Defect



Fig.-5: 2 weeks after flap coverage

reconstruction of soft tissue defects of lower 1/3 leg and foot.

Distally based fasciocutaneous flap based on perforators of either peroneal or post tibial arteries, needs to maintain length- breadth ratio, and is a two staged surgery. A huge amount of tissue is required to cover small to moderate-size defects¹⁰.

Lateral calcaneal flap can cover defect of 3 cm in diameter, so it is not suitable for larger defects.

Cross leg flap is cumbersome and not suitable for elderly patients due to prolonged immobilization. It is also a difficult prohibition for younger patient.

Free flaps may be an alternative but it needs expertise and special centres. . Generally, free flaps are superior to other methods because they allow reconstruction with well-vascularized tissues. However, free flaps are not without disadvantages and as they required sophisticated infra-structure, well-trained surgical team and equipments. It is a lengthy procedure requiring general anaesthesia and it is very costly. It also becomes a big procedure when small to moderate-size defects require to be covered. Free flap has considerable percentage of failure even in the highly advanced centres.

Reversed island flap e.g., peroneal artery flap, anterior tibial artery flap and posterior tibial artery flap can be transferred to the ankle or foot. However it needs sacrifice of a major artery which constitutes a potentially serious disadvantage⁹.

Considering these limitations pedicle flaps can be considered a first-line therapeutic option^{10,11}. The superficial sural artery flap is one of the recently introduced therapeutic modality described by Masquelet and colleagues in 1992. The superficial sural artery based island flap has many advantages¹². The important advantage of the distal sural flap is that the blood supply is reliable, making this flap safe, even in patients with distal arterial-insufficiency and there is no sacrifice of major arteries or nerves. In fact, this

flap can be used in traumatic legs with damaged major arteries. It is necessary to confirmed that the pedicle is at least 3 cm wide containing subdermal layer with the sural nerve, accompanying superficial sural vessels, and short saphenous vein. It should not extend beyond the line drawn 6 cm proximal to lateral malleolus. The superficial sural island flap is a good choice to the management of exposed Achilles tendon. It has wide range of arc of rotation 180° for Achillis tendon coverage and is easy to perform by someone with less expertise. The operative procedure is easy and can be accomplished in a short period of time with regional anaesthesia, which is very advantageous for patients with a generally poor medical condition. The success rate is high and minimal flap loss and other complications. Because this flap is fasciocutaneous, its durability is

excellent, even in weight-bearing areas at the back of the heel on tendo-Achillis. The under surface of the flap provides a good surface for gliding of the tendon. For reconstructions in the Achillis' tendon area, all the flaps used were fasciocutaneous, and no debulking procedure was necessary. This flap has some limitations like maximum safe length-breadth ratio 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 morbidity¹². Kalam et al¹² described a largest flap measured 14x12 cm could be harvested without risk of flap loss. This large flap healed without any complications. Larger flaps are yet to be raised and tested. The main disadvantages of this flap are the sacrifice of the sural nerve and the final scar, mainly when there is a need for skin grafts to close the donor area. This is important particularly in women. When the donor area is closed directly, the final result is aesthetically more acceptable (Fig 8 and 9). Direct closure of the donor area is possible for flaps less than 4 cm in width¹². In all our cases the donor site was closed by split skin graft. It is very important to preserve the paratenon of the Achillis' tendon for a better bed for skin grafting, or there will be delayed healing in the donor area additionally, this flap is insensate. The morbidity of harvesting this flap with the sural nerve is minimal. In our series, all of the cases developed hyposthesia in the distribution of sural nerve area and recovered within 7 months of the harvest of this flap. All cases have recovered despite the fact that the nerve was always cut and raised with flap. There was no neuroma at the donor site as well.

Pirwani et al⁹ showed in their study that all flaps survived except one. Paraesthesia developed on the lateral border of the foot but recovered within two months and most flaps showed venous congestion and disappeared within few days.

Kalam et al¹² described this technique for coverage of the exposed TA and showed that out of 30, 26 flaps taken off without any complication, 4 developed flap oedema and marginal necrosis were seen in 3 cases. One patient developed infection which was controlled by antibiotics and later required split skin graft for coverage of the flap.

Jeng et al.¹⁶ used this technique to cover exposed Achilles tendons and soft tissue defects of the ankle and the heel. Of the 22 patients described, 20 had complete success with two minor complications that were treated uneventfully. Heisinga et al⁵ used this flap on 15 patients for soft tissue coverage in the lower

leg, malleolar, and heel regions. Twelve flaps survived, two partially survived, and one flap failed due to persistent infection. Jeng et al¹⁷ reported their experience with the use of the distally-based sural artery flap for salvage of the distal foot. In seven out of eight patients, the flaps survived completely and only one patient had a partial necrosis of the flap.

Conclusion:

Coverage of exposed Achilles tendon in time is mandatory and essential for prevention of complications, whatever might be the cause. We like to recommend superficial sural island flap as a good choice for treating exposed Achilles tendon because the flap has good number of advantages. It is a one stage operation, which does not require microsurgical techniques. Elevation of the flap is easy and quick. The donor site has minimal morbidity as it can be closed primarily when small flap is raised and skin graft when large flap is raised. The vascular supply to the arterial network of the sural area is constant and reliable, and there is no need to sacrifice any major artery and or sensory nerve. The pedicle is long, and the island flap can be transferred around the ankle. The deep fascia under the flap provides a good gliding surface for excursion of the tendon. Thus the superficial sural artery island flap can be used as a good alternative to microsurgical reconstructions.

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