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Versatility of the Reverse Sural Fasciocutenous Flap for Coverage of Distal Leg, Ankle and Foot

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Abstract

Background: Coverage at distal leg and foot is always challenging for plastic surgeon as it is less vascular and having minimum muscular tissue. Reverse sural fasciocutenous flap is good and reliable alternative at this territory with same important as free flap. Aim of the study to observe and report our experience with versatile use of Reverse Sural Fasciocutaneous Flap (RSFF) at different position of distal leg, ankle and foot to see functional and aesthetic outcome.

Materials and methods: This is a prospective obervational study. Our article contains 20 reverse sural flap coverage at distal leg, ankle and foot from 2019 to 2022, in which we described patient's demography, surgical anatomy, operative technique, flap dimension, complication and follow up from 6 months for 2 years. We kept vascular pedicle with minimum 2 cm skin tag to relieve venous congestion of flap.

Results: All flap cover the defect of traumatic, neoplastic, chronic ulcer, burn and osteomyelitis with good functional and aesthetic outcome. Average flap dimension is 8.95x6.15cm and average wound dimension is 7.95x5.15 cm. only three flap have moderate venous congestion with two show marginal necrosis and one, damaged with skin necrosis in which later on, need skin graft.

Conclusion: RSFF show excellent arc of rotation around the ankle make it versatile and confident option and also equivalent to microvascular free flap in this territory. Flap cover ensure early recovery and almost regain normal walk and foot movement.

Key words: Fasciocutenous; Necrosis; Versatile.

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Introduction

In this South East Corner of the country, which hold residence of forty million people with huge amount of accidental and trauma cases. Plastic Surgery Department of Chittagong Medical College Hospital always deal with huge workload of burn, trauma, cancer and skin related pathology in this densely populated area. Department of Orthopedic Surgery also heavily involved with the management of trauma, bony complication as well as spinal pathologies.

Coverage of distal leg and foot is always challenging for plastic surgeon as it is less vascular and having minimum muscular tissue. Reverse Sural Fasciocutaneous Flap (RSFF) is good and alternative option at this territory with same important and durable as microvascular free flap.

In 1983, a group of Scandinavian plastic surgeon, Donski and Fogdestram first described elaborately about the reverse sural flap. After that Masquelet and Romana in 1992,describe the flap in details with anatomic study and clinical experience.

A reverse sural flap shows great versatility to cover distal leg and ankle due to simple dissection, durable and less time consuming. (Average time 90 minutes) and less need of technical manpower. Only simple magnifying loupe (About 2.5 magnification) or even normal vision can dissect meticulously and do flap harvest perfectly. Using loupe during dissection can avoid damage of vascular pedicle and save the day. The RSFF does not need to sacrifice or involved major vessels like anterior or posterior tibial vessel. In fact, free flap needs to interfere this great vessel

It is now stablished as common flap and also workhorse to cover at the vicinity of lower leg and foot. RSFF have longer arc of rotation which is about 360^0 angle and long average 10 inch length (Flap +pedicle) which make the flap most reliable, vascular, durable and regional reconstructive solution of this area. It is one of the longest

fasciocutaneous flap of the lower leg based on the direct cutaneous artery (Sural artery branch) in the upper central calf and extending to the Achilles tendon distally[1].

RSFF has some potential complication like flap edema, surgical site infection, pedicle kinking as well as minor and major flap necrosis. Venous congestion is the most common and frustrated complication of this flap. A good surgeon like to monitor flap himself at next morning to rescue the flap from potential flap complication.

Aim of the study to observe and report our experience with versatile use of Reverse Sural Fasciocutaneous Flap (RSFF) at different position of distal leg, ankle and foot to see functional and aesthetic outcome.

Materials and methods

This is a prospective observational study. Our article contains 20 patients with reverse sural flap coverage at distal leg, ankle and foot from 2019 to 2022 done at Department of Plastic Surgery, Chittagong Medical College Hospital. Four operation, which included with in study, done at orthopedic surgery. We did only two patients at 2020 due to COVID situation.

Sampling was carried out on patients with composite tissue loss, expose bony structure and expose neuro vascular structure around the vicinity of lower leg, ankle and foot. Study shows variation of wound like electric burn, tumour excision, road traffic accident, venous ulcer, toilet injury and osteomyelitis are used for RSFF coverage. In this study follow up done from 6 months to 2 years. Mainly seen functional and aesthetic outcome of lower leg, ankle and foot.

Daily flap monitoring done post operatively. Dressing done 3 days interval up to 2 weeks where supporting plaster remove form lower limb at last dressing. Then follow up done 2 week lies for 3 months, monthly for another 3 months. Then last phage of follow up done 3 monthly for 2 years. Departmental permission was obtained in this study.

Surgical technique

Reverse sural fasciocutenious flap is harvested at back of the leg, composed with skin, deep fascia and neuro vascular axis, with a perfect drawing of flap measurement and narrow strip of pedicle skin. We never cross the line proximally, which demark the upper and middle third of leg. In this line vascular axis sink under neath the deep fascia and lies between the two gastrocnemius muscle.

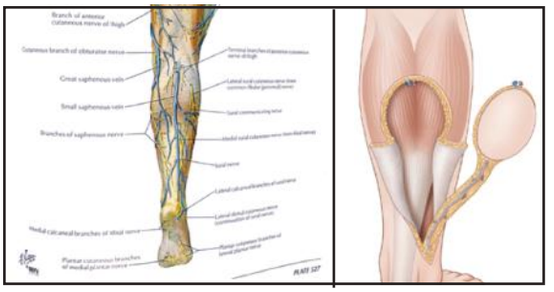

Figure 1 Retrograde sural artery ap (Peter C. Neligan. Plastic surgery

We keep Lesser Saphenous Vein (LSV) at the middle of flap axis along with superficial sural artery and sural nerve.Use of the ap sacri ces the sural nerve, leaving the lateral foot insensate.[2] If any anatomical variation occurs during dissection, we shift total flap axis medial or lateral to accommodate LSV at the center of the flap. Lesser saphenous vein originates near lateral malleolus with close proximity of peroneal perforators which are basically pivot point and vascular continuation of RSFF. The perforators are usually found above the lateral malleolus and are supplied by retrograde flow, so a design with a wide pedicle and a generous arc of rotation are needed to preserve flow.[3] Sural nerve joins with peroneal cutaneous nerve superficial to deep fascia.

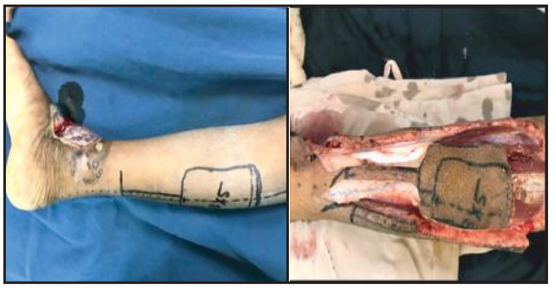

Figure 2 RSFF harvest showing vascular pedicle

We also take 2 cm of skin over pedicle to minimize vascular pedicle kinking and avoid acute twisting pedicle vessels for reduce venous congestion.

Operative position prone while doing operation in every patient. We tailored custom made Optima cast to create a gap for accommodating the pedicle of the flap with in cast. It gives some space between cast and pedicle as well as avoid compression and flap necrosis. So this optimum cast give advantage to keep patient supine and comfortable position post operatively for 2 weeks.

Preoperative Doppler ultrasound perform in every patient to confirm peroneal perforator that communicate with deep peroneal vessels.We give injection ceftazidime during operation in most of the cases and maintain for 3 days. Doppler ultrasound used to identify distal peroneal perforator before operation which anatomically located 6 to 7 cm proximal to lateral malleolus.

During dissection skin, subcutaneous fat, deep fascia and neurovascular structure are included with in flap. Proximal margin of the flap should not cross the line, which lies between upper third and middle third of leg. Anatomically leg is divided into three segments on a line joining from popliteal fossa to corresponding heel. All patients get spinal anesthesia during operation and dissection done under tourniquet control.

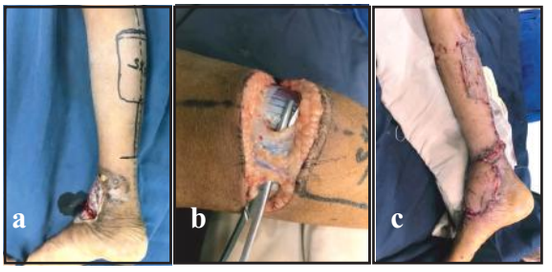

Figure 3 a) Preoperative markings **b)** Identify vascular pedicles **c)** RSF Flap cover medial malleolus.

Results

The study shows wide range of patients age from 8 years to 70 years. Mean age of the study population is 33.60 years. Most of the cases show, they are in working age like 20 to 40 years. Road Traffic Accident (RTA) are the most, 12 cases (60 percent), toilet injury 4 cases (20 percent), tumour excision 2 cases (10 percent), venous ulcer one (5 percent) and osteomyelitis (Debridement and flap coverage in one setting) is one (5 percent). Both of the cases, tumour are squamous cell carcinoma, which excised with margin and base clearance and radiotherapy given at both cases one month after excision and flap coverage.

In this study, wound used for flap coverage at different site of lower leg, ankle and foot. Mean wound dimension is 7.95 cm to 5.15 cm. The most common site of legs used for flap coverage are medial malleolus, 5 cases (25 percent), expose tendo Achilles 5 cases (25 percent), lateral malleolus 4 cases (20 percent), anterior ankle 2 cases (10 percent), proximal dorsum of foot 2 cases(10 percent) and heel coverage 2 cases (10 percent). Time lapse, time duration between incident and flap surgery, mean duration 16.85 days.

Reverse sural fascio cutaneous flap used in the study has different dimension of length and breath. Mean flap dimension is 8.95 cm x 6.15 cm. in a nutshell, all flap theoretically 1 cm long both at length and breath of created wound for flap coverage. That makes flap coverage more stable without tension, sufficient volume, provide more vascular tissue and also give more aesthetic contour.

We measure our functional and cosmetic outcome of 20 patients by a scale jointly developed by plastic and orthopedic surgeon at out patient department, 90 days after operation.The team worked at OPD, are not involved in operative procedure shown in this study. Functional outcome assessed in two categories like walking and ankle movement.

Walking	Limping 2 cases (heel coverage)	Walk with support 2 cases (Tendo Achilles coverage)	Walk without support 16 cases
Ankle movement	No movement/ fixed O cases	Mild restriction 4 cases (Tendo Achilles coverage)	No restriction Free movement 16 cases

Most of our patients, sixteen, are walking without support. Those 2, who are limping and also those 2, who are walking with support, gradually improve their walk over time.Sixteen patients have free ankle movement without difficulty after flap coverage and enjoy their life.

Swelling at flap coverage site	Significant swelling 3	Mild swelling 3	No swelling 14
Foot edema distal to flap	Significant distal edema 2	Mild edema 2	No edema 16
Wearing shoes	Difficulty in wearing shoes 2	Mild tighten 2	Normal fit 16

Cosmetically patients are assessed into 3 categories like swelling at flap site, foot edema and wearing shoes. Most of the patients, that are sixteen, have no foot swelling distal to flap coverage and most of the patients (16 cases) wear shoes with comfort.

Every flap may suffer some critical situation like flap swelling, marginal bleeding, surgical site infection,venous congestion and distal necrosis. Three of our study flap suffers venous congestion. Two flap shows marginal necrosis at distal part actually have 1 cm necrosis from margin. Both flap healed spontaneously with in 2 weeks. One flap suffers venous congestion very critically due to RTA and uncontrolled Diabetes Mellitus (DM). surface skin totally lost from flap. After total control of DM and antibiotic given to patient along with culture sensitivity report, skin graft given over flap after 2 weeks of flap operation.

Discussion

Reverse sural flap shows great versatility and flexibility in case of distal lower limb reconstruction. Why versatile? Because it can be used perfectly at heel, distal leg and also over Tendo Achilles. It also covers as distal as proximal sole and dorsum of foot, when flap is delayed. The flap migrates the area with 360^0 rotations while keeping lateral malleolus as a center of hub. It is very easy to harvest with good reliable and pliable composite tissue when cover at heel, having comfortable and non pain walk. May be used as fascio cutaneous and adipo fascial flap. Zamfirescu dragos et al describes reverse sural fasciocutenous flap permits the soft tissue reconstruction in this territory without the need of microsurgery.[4]

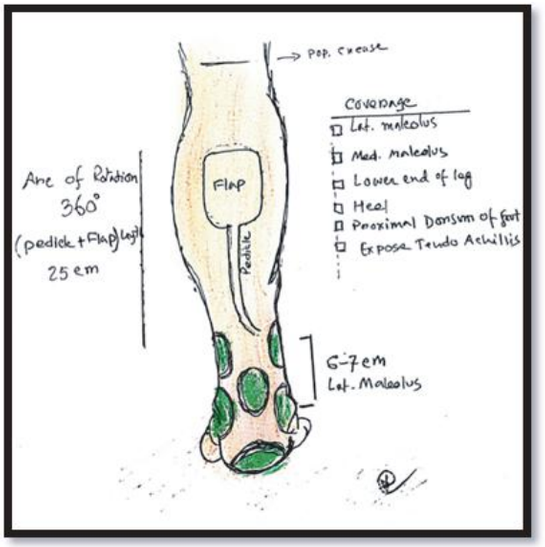

Figure 4 Reverse sural flap coverage area at distal leg, ankle and foot. Also shown average flap+pedicle length with 360degree rotation on lateral malleolus

In this region, it is a superb and reliable alternative to free microvascular flap. Ali Ebrahimi et al compared the sural flap to other covering methods, are the simplicity of the design and dissection of the pedicle flap that can be carried out with loupe magnification.[5] It is very easy to dissect over proximal tendo Achilles and less time consuming than free flap, doesn't need to insult major vessels like anterior tibial or posterior tibial vessel. Athanaselis et al shows their mean operation time 99.03 minutes which is a little bit longer than us.[6] In this study our average operation time is 90 minutes. Aesthetically it is more accepted and less edematous than anterolateral free flap or gracillis muscle free flap. No need of high tech equipment like operative microscope. This pedicle flap does not need any high skilled surgical team and also can do any operative room at peripheral center. Loannis et al shows it can also be combined with various osteosynthesis techniques as external fixation of comminuted fractures and Ilizarov.[7] Lastly it is one stage solution package for any type of wound coverage at distal leg and heel.

To avoid compression over vascular pedicle we modify the plaster by creating a tunnel. This tunnel leaves a favorable space for vessels accommodation. This modifying plaster also allow patients in a supine position postoperatively.

Figure 5 picture shows posterior cast with modify tunnel to accommodate vascular pedicle

We also maintain a window at flap bandage for monitoring the flap post operatively for at least 5 days. First dressing done at 4th post operative day. Olawoye et al shows 5 patients out of 20 (25%) had varying degrees of wound dehiscence and marginal necrosis of the ap at their study, which is a little bit more complication rate than us, ours 3 patients out of 20 (15%).[8] In this study two flap shows marginal necrosis at distal part actually have 1 cm blackening from margin. Both flap healed spontaneously with in 2 weeks. One flap suffers venous congestion very critically due to RTA and uncontrolled diabetes mellitus(DM). surface skin totally lost from flap. After total control of DM and antibiotic given to patient along with culture sensitivity report, skin graft done over flap after 2 weeks of flap operation. Kristoffer B. Sugg et al. shows venous congestion in RSFF treated with leech therapy where mild to moderate venous congestion in our study can successfully managed by conventional leg elevation and heparin dipped needle pricking on flap.[9] There is also some high tech procedure to manage venous congestion like Sheehan et al. describe supercharging lesser saphenous vein to any superficial vein or intermittent drainage by venous cannulation.[10]

Figure 6 Good functional and cosmetic outcome 4 months after surgery acceptable by patient's

This flap covering this territory undoubtedly have some good functional and aesthetic outcome. No bulkiness and distal foot edema with soft, pliable and good grip to walk. Can wear shoes without difficulties and also can enjoy walk as normal without any support. She/he can maintain a good quality of life.

Limitation

This study contains small group of 20 patients that actually does not reflect whole scenario of wound coverage at lower leg in this region.

Conclusion

It is now stablished and common flap and also work house to cover at the vicinity of lower leg and foot. The reverse sural flap has a greater arc of rotation (360^0) and can create a long pedicle and flap length may reach distal part of leg and foot, which make it versatile and confident option and also equivalent to microvascular free flap in this territory. Flap cover ensure early recovery and almost regain normal walk and foot movement. This amazing ability of the flap makes more reliable, robust, durable and lastly versatile regional flap of this area.

Recommendation

All expose tendons, joint space and weight bearing area should cover with flaps. Reverse sural flap can be done at peripheral center to prevent morbidly of patients and maintain quality of life. Future multicenter prospective study with large sample size is recommended.

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Contribution of authors

MSK-Conception, data analysis, critical revision & final approval.
MMI-Design, interpretation of data, critical revision & final approval.
SDG-Acquisition of data, drafting & final approval.
AD-Acquisition of data, drafting & final approval.
LKP-Data analysis, critical revision & final approval.

Disclosure

All the authors declared no competing interests.

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