

Minimizing complications in reverse Sural Artery flaps

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Abstract

Objective: To describe in detail some relevant finer points in the technique of surgery to decrease the complications of reverse Sural Artery flap.

This flap has a very high complication rate as reported in international literature. Some series report very high complication rates.

Study design: Case series

Setting and duration: Department of Plastic Surgery & Burns, KMDC & Abbasi Shaheed Hospital; 5 year study from 2004 to 2009.

Methodology: We report a study of 40 patients with heel and ankle defects. All cases were treated surgically with reverse sural flap under general anesthesia. In our hands we have been able to reduce the complication rate by adhering to a strict protocol and minutely following the details in execution of surgery.

The preoperative and postoperative photographs of relevant cases of reverse Sural Artery flap have been included to show the complications and also how to avoid them. Patients were followed in the immediate post-operative period upto one year after surgery.

Results: 40 patients aged 7 years to 65 years were included in this study with a mean age of 24 years. Amongst them 37(92.5%) were males and 3(7.5%) were females. Indications for reverse Sural Artery flap were wounds secondary to road traffic accidents, spoke wheel injury, old crush injury with unstable scar and trophic ulcers. Complications were observed in 8 cases who were operated initially. One patient each developed infection, discharging sinus & complete flap necrosis (7.5%). Two patients each developed partial flap necrosis (5%) and partial graft rejection (5%), respectively; and late recurrent ulcer on the flap occurred in one patient (2.5 %). In our experience, the results of reverse Sural Artery flaps are encouraging. From the complications which occurred in our patients earlier, we improved on the minute details in the technique of the surgery and observed a better outcome subsequently in terms of flap survival and patient satisfaction.

Conclusion: If performed properly, the reverse Sural Artery flap has rich dividends and few complications.

Keywords: Sural fasciocutaneous flap, reverse flow Sural Artery flap, distally-based sural flap, heel and ankle defects, minimizing complications

Introduction:

The reverse Sural Artery flap is a versatile fasciocutaneous flap for coverage of soft tissue defects involving the distal one third of the leg, ankle and heel^{1,2}, but some series report a very high complication rate, as high as 36% as described by Baumeister et al³. If performed properly, RSA

Flap has rich dividends⁴. The main advantage of RSA Flap is that it can be done in a single stage; is a reliable alternative to free tissue transfer and carries minimal donor site morbidity^{5,6,7,8}. In addition, it has a reliable and constant blood supply from multiple sources with a broad range of rotation and provides a less bulky coverage

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compared to free muscle flaps. Flap dissection is technically less demanding, less time consuming and spares major vessels of the lower limb^{6,9,10}.

Moreover, there is no proper replacement for this flap as wounds around the ankle and heel are difficult to treat by any other flap. A study conducted by Baumeister in 2003 reports a very high complication rate for the RSA flap, therefore, minimizing complications in this flap is the key to success of the procedure and that is the purpose of our article.

Methodology:

Surgical Anatomy: Flaps raised on a distally based pedicle possess a retrograde or reverse flow and hence the name distally-based Sural flap or reverse Sural Artery flap. The RSA flap is based on multiple sources of retrograde arterial blood supply viz. fasciocutaneous perforators of the Peroneal artery and the Posterior Tibial artery, neurocutaneous perforators of the Sural nerve and venocutaneous perforators accompanying the Short Saphenous vein^{11,12,13,14}. These form an anastomotic suprafascial plexus in the leg. The lateral malleolus is an important landmark in outlining flap marking. The fascial base extends from the lateral malleolus anteriorly to the Tendo Achilles posteriorly. The Short Saphenous vein runs below and behind the malleolus and must be preserved in the pedicle as this is the principal source of venous drainage of the skin and fascia of the flap. Small collateral veins running parallel to the short saphenous vein have anastomotic connections with the latter which bypass the valves and retrograde venous flow. These drain into the venae comitantes of the perforators of the peroneal artery¹⁵. Proximally, the short saphenous vein is located between the two heads of the Gastrocnemius muscle. The pedicle should be as short as possible and marked 5-7 cms proximal to the lateral malleolus^{11,16}. This is the location of the distal most perforator of the Peroneal artery supplying the flap^{15,17,18}. Kinking of the pedicle should be avoided. The extent of the deep fascia in the lower one third of the leg is tattooed preoperatively by 4 points extending from the posterior border of the tendo Achilles to the lateral border

of the fibula. This also indicates the width of the pedicle. Lastly, the skin island is outlined over the middle or proximal third of the leg to match the size of the recipient defect. With the patient placed in the prone position, zig zag skin incision begins over the pedicle and then the flap is raised. The sural nerve and the accompanying short saphenous vein at the proximal end of the flap are identified, ligated and cut. The flap is dissected from proximal to distal, followed by the pedicle.

Here are some of the measures which we undertook to minimize the rSA flap complication rate:

1. Taking the fascial base larger than the skin area of the flap¹⁹. Sutures to attach fascia with the skin must not be placed too close to each other as each suture compromises the blood supply of the edge of the flap. Ideally, these fine sutures should only pierce the dermis.
2. When raising the flap, we have to be careful to try and save the Short Saphenous vein distal to the flap and incorporate it into the pedicle. This improves the venous return of the flap and maximizes its safety and reliability²⁰.
3. The maximum "safe" flap dimensions reported in the International medical literature are 17 cms x 16 cms (L x W). Creating a flap larger than this size almost always results in flap necrosis unless the technique of "delay" is employed²¹. Another study reports the use of " Mega-High" flap for coverage of extensive lower limb defects; without delay; where skin of the entire proximal calf is harvested starting 2-3 cms below the popliteal fossa cease line²². We have not included the use of mega high flap in our study.
4. Use other options like split skin graft on the recipient area, if possible, to reduce the size of the flap needed to cover the defect.
5. Avoid the flap for weight-bearing areas extending beyond the "ball" of the heel.
6. The recipient site must be absolutely clean before flap application¹¹. In the presence of unhealthy tissue, it is wiser to debride the site and postpone the case for 48 hours.

7. Avoid in elderly, bed-ridden and patients with backslabs of few weeks' duration because of a locally compromised blood supply.
8. Do not close the pedicle of the flap routinely as it almost invariably compromises the venous return. Instead, cover the pedicle with a split skin graft or
9. Exteriorize the flap pedicle to improve the venous return and preserves flap viability²³.
10. Avoid tension on the pedicle by plantar flexion of the foot, use of light dressings, nursing the patient in prone position and limb elevation to avoid venous congestion¹¹.

Results:

We observed an overall lesser complication rate of 20% for this flap. The complications were encountered in earlier cases where we did not follow the strict protocol in flap surgical technique. Later on, after modifying our techniques we observed a better flap survival and good post operative outcome. This has been documented in the photographs. Distal flap necrosis occurred at one week, when we designed a flap larger than the safe dimensions without delaying and extending it beyond the heel onto the sole (Figure 2). Only the proximal portion survived in this case and the remainder area healed by epithelialization (Figure 3) with unstable scar at 10 months followup. Discharging sinus developed at 4 months after surgery in one patient who had trophic ulcer over the calcaneum (Figure 4) with slough---an avoidable complication if the recipient bed would have been absolutely clean and case postponed in the first instance! This needed opening up the sinus and multiple wound debridements before it finally healed. Superficial marginal flap necrosis was seen in one case (Figure 1) due to application of tight dermal-fascial sutures. The flap skin re-epithelialized with local wound care. Infection rates were not particularly high in our setup, yet we did encounter a few cases leading to partial graft loss. These recovered with appropriate antibiotics and proper wound care. Late recurrent ulcer occurred in one patient who was young and mobile. This problem may be avoided in fu-



Figure 1: (a) Crush injury foot with exposed ankle
(b) Post operative view with marginal flap necrosis

ture by the use of sensate fasciocutaneous flap. There was no paresthesia related to the sacrifice of the sural nerve.

Discussion:

The heel is an essential weight-bearing area of the foot and prone to frequent traumatic insults. In addition, it has a tight skin envelope and relatively poor blood supply compared to the proximal parts of the body. Reconstruction of ankle and heel defects remains a challenging domain for the plastic surgeon.

Random pattern flaps have a high incidence of failure in this area. The cross leg flaps require prolonged immobilization. The positional constraints are uncomfortable for the patient and result in post operative joint stiffness and are therefore unsuitable for patients above 40 years of age.

The Medial plantar island flap is a sensate flap with durable weight bearing function. The major drawback is that it cannot be used for ankle defects.

The Lateral Calcaneal artery skin flap is a local

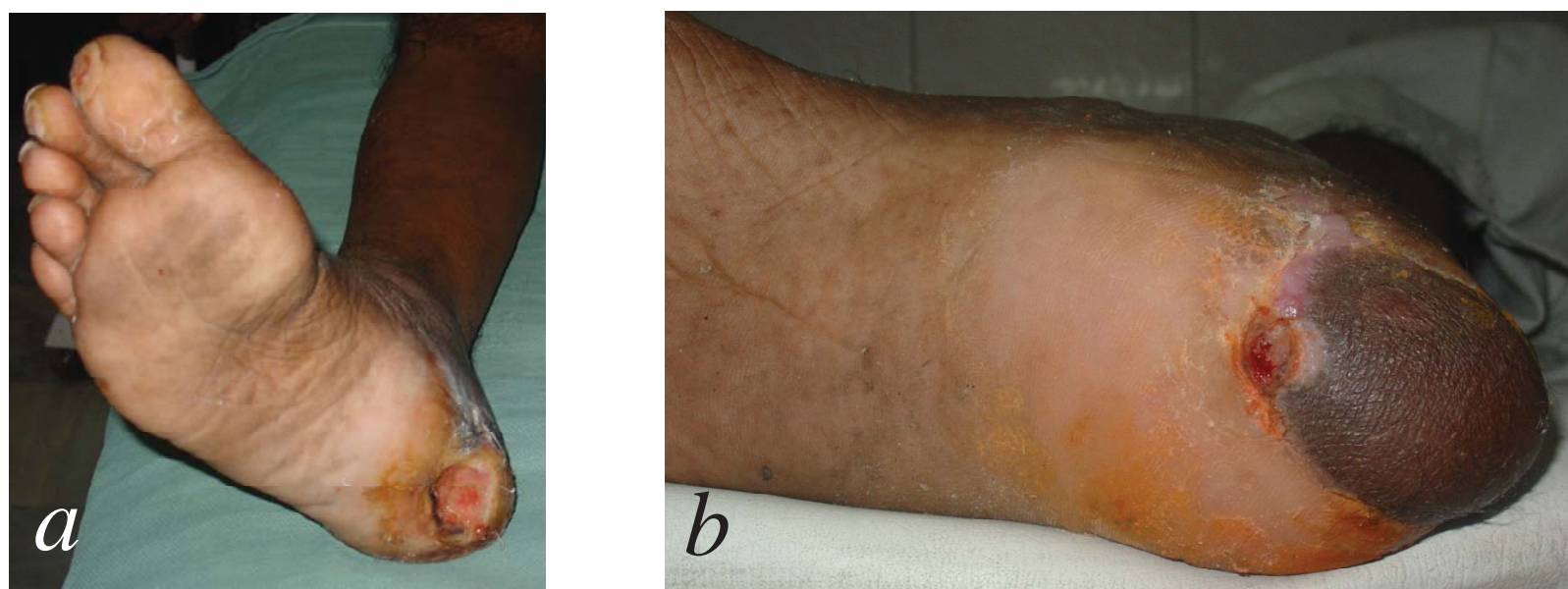


Figure 2: (a) Trophic ulcer heel pre op view, (b) Discharging sinus four months after surgery



Figure 3: (a) Preoperative view of a large post Traumatic ulcer with several Previous attempts, (b) Intraoperative view of a large RSA flap

neurovascular flap also useful but its use is limited to small sized defects only.

The Medial and Lateral Malleolar flaps (fasciocutaneous flaps) have a limited use owing to their small dimension.

Reversed island flaps such as Peroneal, Anterior Tibial and Posterior Tibial artery flaps may be used but their main disadvantage is sacrifice of major limb artery.

Free flaps demand a skillful microsurgical team, expensive equipment and a long operative time, in addition to being very bulky. Certain patients may not be ideal candidates for such a prolonged surgery.

The reliable vascularity and increased “safe” dimensions of the flap make it the best option for coverage of large heel, ankle and lower 1/3rd extremity defects, which are difficult to treat by any other flap. Unlike other flaps in the leg,



Figure 4: Ten months postoperative with major loss of flap

the reverse flow fasciocutaneous flap does not involve sacrificing major limb arteries. It can be used in limbs with arterial injury, provided Peroneal artery is intact and patent. The drawbacks are minor and include donor site scarring which is especially unacceptable in females, anesthesia along the lateral border of the foot due to division of the sural nerve and an insensate flap. Nonetheless, its advantages still outweigh the disadvantages.

Here, we would like to mention other local options described in the medical literature to improve flap survival in “high risk” patients and in patients with medical co-morbidities:

- Use of flap delay is questionable^{24,25,26,27}.
- Supercharging the flap by anastomosing the proximal divided end of the saphenous vein with any other vein in the recipient bed²⁸.
- Incorporating a midline “Gastrocnemius muscle cuff” around the Sural flap pedicle improves flap vascularity²⁹.
- Use of sterile medicinal leeches to reduce flap congestion^{30,31,32}.
- Pre-operative use of color Doppler ultrasound to locate the perforators^{33,34}, and
- Intra-operative use of hand-held dopplers.

Despite the measures described above, complete flap necrosis still occurs and is unpredictable probably due to anomalous blood supply in these cases. However, the exact cause remains unclear.

Akhtar Shaheen and Hameed A. used the technique of distally based Sural Artery flap to cover soft tissue defects in the lower third leg, heel, malleoli and hindfoot. Of the 84 patients described, in the seven years' study, the dimension of the flap ranged from 5-15 cms in length and 4-12 cms in width. Post operatively 66 flaps survived completely, marginal flap necrosis was observed in 6 patients and 4 patients developed infection. Complete flap necrosis occurred in 8 patients. All patients had a satisfactory functional outcome³.

Conclusion:

The distally-based reverse Sural Artery flap is the best available option for coverage of soft tissue defects in the distal 1/3rd of the leg and proximal foot. The main advantages of the rSA flap are that it can be done in a single stage, is a reliable alternative to free tissue transfer and carries minimal donor site morbidity. In addition, it has a reliable and constant blood supply with a broad range of rotation and provides a less bulky coverage compared to free muscle flaps. Flap dissection is technically less demanding, less time consuming and spares major vessels of the lower limb. Modifications such as flap delay and microsurgical venous supercharging should be considered in patients with peripheral vascular disease to improve flap viability. The pedicle should be as short and as wide as is necessary to repair the defect and should preferably be exteriorized to improve venous drainage of the flap. Adequate debridement of the recipient site still remains the single most important factor for ensuring flap success and this should be strictly adhered to. To conclude, if properly performed, the reverse Sural Artery flap has rich dividends and few complications!

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CORRIGENDUM

Anwar T, Salekeen MS, Khan F, Nausheen S. Comparison of outcomes among pregnant women with hepatitis C versus without hepatitis C. *Pak J Surg.* 2010; 26(4):304-307.

The second author, Mohammad Serajus Salekeen is associated with Dow University of Health Sciences, Civil Hospital, Karachi and not with Aga Khan University Hospital, Karachi.

The editors regret the error.