

## Distally Based Sural Flap in Children: Experience in Our Department

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### Abstract

### Original Research Article

The reverse sural artery flap (RSAF) was first described approximately four decades ago in 1983 by Donski and Fogdestam [1] and has since been used frequently for reconstruction of soft tissue defects in the distal part of the leg. Coverage of soft-tissue defects of the ankle and foot is often challenging. The distally based sural fascio-cutaneous flap is useful for reconstructing the lower leg, ankle, heel, and foot but has rarely been evaluated in paediatric patients. The objectives of this study were to assess the reliability of this flap in children, to get a global experience with the sural flap in our department of plastic and reconstructive pediatric surgery, and to describe the complications. **Material and methods:** A distally based sural fascio-cutaneous flap was used to cover soft-tissue defects of the ankle and foot in 5 paediatric patients between 2018 and 2021. The median age of patient at surgery was 6 years old. The most frequent mechanism of soft tissue defect was trauma caused by vehicular accident (open fractures) crush injuries, lacerated wound. **Results:** One of the 5 flaps was a cross leg sural flap, 4 recovered well without necrosis, only one developed partial necrosis requiring excision and skin grafting. The other complications were an early postoperative complications: partial or total necrosis of the flap late complications including impaired touch sensation over the flap and donorsite. **Discussion:** The distally based sural fascio-cutaneous flap is a method of choice for covering soft-tissue defects of the ankle and foot in paediatric patients. This reliable flap spares the major blood vessels and has a good blood supply. When there is exposure of a vital structure, distal sural flap is the best indication for coverage in a traumatic soft-tissue defect. The use of a distally based sural fascio cutaneous flap is not free from delayed complications most of them at the donor site.

**Keywords:** Sural Flap in Children, Surgery, microvascular surgery.

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## INTRODUCTION

Repair of soft-tissue defects remains a difficult challenge despite advances in microvascular surgery. The distally based sural fascio-cutaneous flap (DBSFCF) is used to cover soft-tissue defects of the ankle and foot. After the study done by Masquelet *et al.*, (an experimental work on skin island flap supplied by the vascular axis of the superficial nerves) the practitioners started to use the neurofasciocutaneous flap frequently to cover soft tissue defect [2]. It provides a good arc of rotation, constant vascularity, and easy and quick elevation with acceptable donor-site morbidity [2, 3]. It has many advantages but it is also associated with complications such as congestion due to poor venous drainage, partial or total necrosis, unsightly donor-site

scars, and sensory disorders [3, 4]. Acute traumatic soft-tissue defects are the main indication [2-5].

In our study we reviewed 5 cases of soft tissue defects in whom distal sural flap was an indication for covering in leg ankle and foot. Our aim in this study is to get our own experience of the sural flap in children and to define the indication of distal sural flap in children whom needs coverage soft tissue and determinate the complication of the flap in the donor site.

## PATIENTS AND METHODS

From 2018 to 2021, 5 distally based neurofasciocutaneous reverse sural flaps have been used as a two-step procedure for reconstruction of soft-tissue defects of the lower leg and foot in five paediatric

patients. Of these 5 paediatrics patients, 2 were girls and 3 were boys with an age range of 5 to 11 years old. The patients were followed from day one to 3 months. The defects were caused by debridement of the lateral border and dorsal foot after a vehicular crush, open fractures of the distal lower leg.

### Operative Technique

A fascio-cutaneous flap with a pedicle preserving its blood and nerve supply was raised like it's described by Ayyappan *et al.* The patient was in the prone position. The size of the defect was measured before we drawn on the posterior face of the leg the skin paddle flap and its trajectory. The pivot point is usually located 4 to 5 cm proximal to the tip of the lateral malleolus.

We include the sural nerve and the lesser saphenous vein after ligation. After complete elevation, the flap was fixed again at the donor site using running sutures after the receiver site was prepared by extensively debriding the scarred tissue then irrigating abundantly.

A split-thickness skin graft was placed over the donor site and pedicle for 21 days. We fashioned an awindowed dressing to detect a post-operative venous congestion.

For one patient the defect involved the lower one third of the leg so we used the distally based, posterior tibial artery perforator cross-leg flap. External fixation with pins was used to position the legs in appropriate position as it increases the ease of postoperative care.

### RESULTS

Four flaps survived completely and healed by primary intention. In only one flaps (the cross-leg flap), superficial necrosis developed in proximal parts of the flaps which was treated by debridement and grafting.

### Cases

1. A seven years old boy was victim of a vehicular accident which caused avulsion injury with exposing the dorsal part of the ankle associating exposure of Achille's tendon. A conventional sural flap was done. The flap survived, and the flap weaning was achieved after 21 days (Fig 1).



Fig 1: A. a seven years old boy foot after traumatic accident. B. Same patient as in figure 1.A intraoperative picture showing elevated flap and the target defect. C. Result of surgery after one month. D. Results after 5 month of follow-up of the same patient as in figure 1.A

2. A six years old boy was victim of crush accident in the foot with a defect of soft tissue of the heel exposing the talus. After debridement we decided to perform a sural flap to cover the bone. There no complications at the follow up (Fig 2).



Figure 2.A: a six years old boy victim of a crush accident with a soft tissue defect exposing the heel. 2B. picture of the same patient as picture 2.A. showing intraoperative elevation of sural flap. 2.C.results of surgery after one month. 2.D. picture of 3 month of follow up final result

3. An eleven years old girl was victim of a traffic accident (crushed by a car) which causes soft tissue defect of the medial part of the ankle and the medial face of the forefoot. A sural flap was done to cover the ankle and Extensor digitorum brevis muscle flap has

been used to cover the defect of the distal forefoot. The flap was elevated on the distal dorsalis pedis artery with a retrograde flow. There wasn't any complication at follow up (Fig 3).



**Fig: 3.A** An eleven years old girl with soft tissue defect of the medial part of the ankle and the medial face for forefoot after traffic accident. **3.B.** Picture of the same patient in 3A. with the elevation of the sural flap and the extensor digitorum brevis muscle flap. **3.C** Results of the same patient as picture 3A. after 4 months of follow up

4. Ten years old boy was victim of trauma exposing the dorsal part of ankle with a soft tissue defect. At first place a skin graft was performed which doesn't survived. We decided to perform a distal sural flap to cover the defect (Fig 4).



**Figure 4.A.** Ten years old boy was victim of trauma exposing the dorsal part of ankle. **4.B.** Picture of the same patient in 4.A. with intraoperative sural flap elevation. **4.C** Results after 3 weeks of surgery. **4.D.** Final result 4 months surgery

5. Our last patient is a 5 years old girl who was victim of a traffic accident with open fracture of the distal extremity of tibia and a large soft tissue the defect at the medial and dorsal face of the leg. In this case the

conventionnel distal sural flap wasn't a good indication we decide to perform a cross leg sural flap. Superficial necrosis developed in proximal parts of the flap which was treated by debridement and grafting (Fig 5).



**Figure 5.A.** 5 years old girl who was victim of a traffic accident with open fracture of the distal extremity of tibia and a large soft tissue the defect at the medial and dorsal face of the leg. **5B.** intraoperative picture of the same patient with a cross leg sural flap. **5C.** Same patient at the end of surgery. **5D.** Partial necrosis of the flap. **5.E.** Final result 4 month after surgery

Finally, all flaps provided stable defect coverage and good contour. No patient needed further flaps for defect reconstruction. Donor sites healed uneventfully in all patients.

## DISCUSSION

The DBSFCF was first described by Donski and Fogdestam in 1983 [1] and gained acceptance in the 1990s based on a detailed anatomic and clinical study [2]. Since then, several case-series studies have been published, but most of them focussed only on adults. Few studies in paediatric patients are available [7, 8].

In the systemic analysis of the literature that included 218 publications with 5145 RFAFs, only 8 publications concern the paediatric cases aged under 16 years which contains 149 flaps. All flaps were described as distal pedicled sural artery flaps. The most common complication was venous congestion 75.3%, followed by a rate of 63% of epidermal losses and tip necrosis of the flap in 55.9% of the cases, which were treated either conservative or operative with split skin grafting [9].

In our study all the patient where children with median age 6 years old. The main cause of soft tissue defect was trauma as shown in the literature and the most common complication was venous congestion with partial necrosis.

Although the popularity of this flap never reached the extent of that of free perforator flaps, it still serves as a reliable alternative. This has been demonstrated by the increased rate of publication on the technique in recent years. The number of authors reporting data has risen up to 20 reports a year. During this time, several new modifications of the flap were inaugurated in order to boost the efficiency and reliability of the flap. An overall survival rate of 95% and a rate of complications of 14% were reported in all the analyzed cases. Some modifications were able to improve flap viability but not at a statistically significant extent. Venous supercharging and the adipofascial variant of the RSAF provided the best results.

The operative procedure of reverse sural artery flap had been well described in the previous literature. The patient was placed in the lateral decubitus position with the injured leg upward. Pivot point was designed at 4 cm above the tip of lateral malleolus in the patients without preoperative locating perforators or at site of the marked preoperatively perforator near the defect. Length of the adipofascial pedicle was 2 cm longer than the distance between the pivot point and the point where the adipofascial pedicle entered the defect, and width of the adipofascial pedicle was marked with dotted line. A 1.5-cm to 2.0-cm-wide tongue-like skin strip overlying the adipofascial pedicle was designed all along the pedicle. Skin island was approximately 1 cm

larger than template of the defect in periphery. We began with incision of skin along posterior boundary of the skin strip, the skin along with thin (about 1 mm of thickness) fat was then sharply dissected to posterior border of the adipofascial pedicle. Then, the posterior border of adipofascial pedicle and 2-cm to 3-cm-long skin along the posterior border's downward extension line were incised through the deep fascia, to identify the perforator around the pivot point. The lesser saphenous vein and lateral sural nerve should also be contained in the flap. After division of the skin bridge between the pivot point and the defect, the flap was transposed to the defect via the incised passage. The donor site was either closed by direct suture or covered with free skin graft [10].

In our study in children, we use the same operative technique that shown in the literature. In one patient we used the cross-leg sural flap.

Survival flaps are defined as flaps with complete survival, distal de-epithelialization, or wound dehiscence. Partial necrosis flaps are defined as flaps with necrosis of dermis, or in conjunction with subcutaneous tissue and deep fascia in distal part of the flap. Complete-necrosis flaps are considered as entire loss of the skin island. Necrosis is the most common cause for total flap failure.

Some interesting systematically reviews showed that trauma is the most common indication for soft tissue reconstruction with the RSAF in the lower leg. They also did not correlate the indication like trauma or open fracture but comorbidities and age with the outcome of the flaps. In fact, it is also the most common cause for total flap failure.

## CONCLUSION

This flap is a technique of choice for covering soft-tissue defects over the ankle, dorsal foot, and heel in paediatric orthopaedic surgery. The optimal indication is an acute post-traumatic soft-tissue defect resulting in exposure of a vital structure. Some interesting systematical reviews showed that trauma is the most common indication for soft tissue reconstruction with the RSAF in the lower leg. One of the most feared and most frequent complications is venous congestion. In fact, it is also the most common cause for total flap failure.

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