ORIGINAL ARTICLE

# USE OF A SPECIAL SPLINT IN REVERSE SURAL ARTERY FLAP TO REDUCE VENOUS CONGESTION AND FLAP NECROSIS

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**Background**: Distally based sural fascio-cutaneous flap is a commonly performed plastic surgery procedure for the coverage of distal third of leg, ankle and foot defects. However congestion is the main complication of this flap which results into partial or complete loss of the flap. We devised a special splint to reduce this complication and retrospectively reviewed its effect on this complication between two groups. **Methods**: This retrospective study was carried out at Northwest General hospital between 1995 and 2012. Group-A included 30 patients who were managed without the splint between 1995 and 2005 and group-B comprised of 35 patients were treated with the splint between 2006 and 2012. Complications like venous congestion, epidermolysis, and partial and complete flap failure were documented. Data were analyzed by SPSS.16.5 software. Chi-square test was used for data analysis. *p*-value less than 0.05 was considered as the level of significance. **Results**: Total 65 patients were operated. Age of the patients ranged from 7 to 60 years. Road traffic accident and spoke wheel injury was the main cause of soft tissue loss in our patients. In group-A 12 patients suffered from venous congestion. Out of 12, three patients had epidermolysis while partial flap necrosis occurred in 9 patients. Only 3 patients had venous congestion in group-B. Two patients suffered from epidermolysis and one had partial flap necrosis. None of patient suffered from complete flap loss in both groups. **Conclusion**: Reverse sural artery flap continues to be a versatile flap for distal lower extremity reconstruction. By using a special splint to reduce pressure on the pedicle site as a modification, flap complication rate can be decreased significantly.

**Keywords**: Sural flap, distal lower extremity, venous congestion

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## INTRODUCTION

Distal lower extremity soft tissue defects are quite common and present a difficult task for the reconstructive surgeon. Free tissue transfers have become a standard criterion in dealing with most of this defects.[1] But being at the top of reconstructive ladder this facility may not be available everywhere as in our setup. Hence sural flap continues to be the good viable option in reconstructing such defects. Various modifications have been proposed every now and then to improve the survival rate of this versatile flap. But these modifications more or less transform a simple procedure into a complex one.[2]

Numerous studies have proven that it's not the compromised blood supply but the venous congestion that is the cause of partial or complete flap necrosis.[3] We describe our humble experience of using a special splint to reduce venous congestion and partial flap necrosis. In our experience this simple yet very effective technique along with general principles of flap care significantly improved our flap survival rate. The purpose of this study was to retrospectively analyze differences in complication between two group of patients one with and other without special splint.

## MATERIAL AND METHODS

It was a retrospective analysis of sural flap complications before using a special splint and after use of special splint. Sural flap was done in 65 patients by the senior author over a period of 18 years. Cases were done in Aman hospital and North West General Hospital Peshawar Pakistan. Patients with soft tissue defect in the region of lower leg, heel and foot were included in study. Patients with more than 2 co-morbidities were excluded from study. Diabetes, Hypertension, Atherosclerosis, peripheral arterial insufficiency, and venous insufficiency were considered major co morbidities. Similarly patients with trauma in zone of peroneal artery perforators were also excluded from study. Patients were divided in two groups. Group-A patients were those operated by senior author from 1995 to 2005. Special splint was not used in this group of patients. Thirty patients were operated during this time. Group B patients were those operated by senior author from 2006 to 2012.Special splint was used in this group of patients. 35 patients were operated during this time. Venous congestion, epidermolysis, partial flap loss and total flap loss were considered as major complications. Data were analysed by SPSS.16.5 software. Chi- square test was used for data analysis. *p*-value less than 0.05 was considered as the level of significance.

## RESULTS

Total 65 patients were operated by the senior author from 1995 to 2012. Age of the patients ranged from 7 to 60 years. Road traffic accident and spoke wheel injury was the main cause of soft tissue loss in our patients. In group-A 12 patients suffered from venous congestion. Out of 12, three patients had epidermolysis while partial flap necrosis occurred in 9 patients.

Only 3 patients had venous congestion in group-B. Two patients suffered from epidermolysis and one had partial flap necrosis. None of patient suffered from complete flap loss in both groups. Results are shown in table-1

We cover the pedicle and flap donor and recipient areas with bactigrass. We then hold either a kidney tray or a Ringer 1000 ml bottle over pedicle area and apply cotton around kidney tray and donor and recipient site. We apply below knee scotch cast and wrap it around kidney tray. We cover the scotch cast with crepe bandage. When cast is dry after molding we remove kidney tray. This creates a splint in which there is gap over pedicle area. There is no pressure over pedicle at any moment.

**Table-1: Frequency of various complications in both groups**

| Complications | Group-A (n=30) | Group-B (n=35) | *p* |
|---|---|---|---|
| Venous congestion | 12 | 3 | |
| Partial flap necrosis | 9 | 1 | 0.000 |
| Epidermolysis | 3 | 2 | |

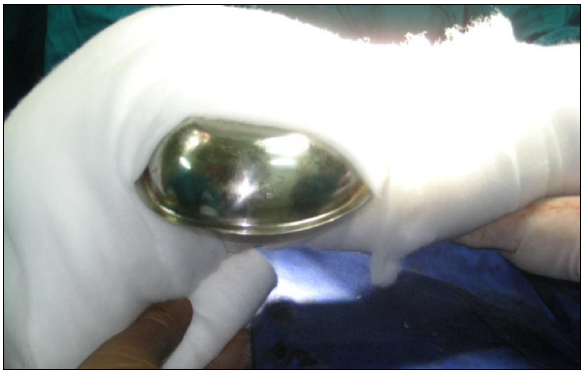

**Figure-1: Special splint by placing Kidney tray on pedicle site to avoid compression**

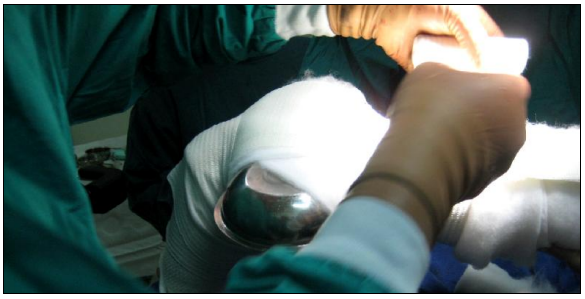

**Figure-2: Technique of dressing and splint by the senior author shown**

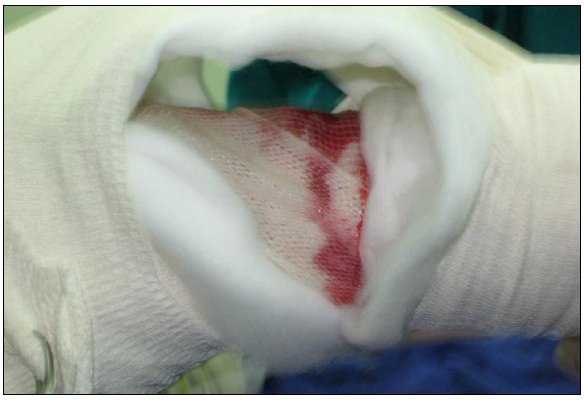

**Figure-3: Patient can remain prone or supine and critical area is free from pressure to lessen venous congestion**

## DISCUSSION

Soft tissue reconstruction of the distal lower extremity presents a difficult task for the reconstructive surgeon. Skin grafts are simple solution but cannot be used on exposed tendons, bones and hardware. Local flaps may not be feasible because of limited flap mobilization and arc of rotation.[4] Free tissue transfers provide reliable and excellent soft tissue coverage but there are disadvantages to free tissue transfer as well.[5] Prolonged operative time and need for microsurgical expertise are obvious limitations .In addition in this part of the world costly infrastructure cannot be provided at every hospital. Hence sural fascio-cutaneous and adipo-fascial flap keeps its special place in our setup. In fact there has been a renewed interest in local flaps because of pedicled perforator flaps.[6]

The reverse sural artery flap was first described by Donski and Fogdestam and later popularized by Masquelet *et al*.[7] The anterograde blood supply to sural angiosome comes from median, medial and lateral superficial sural arteries. However this flap is based on retrograde blood supply from distal sources. Classically described blood supply of this flap comes from fascio-cutaneous perforators of peroneal artery. But this flap also gets blood supply from perforators of posterior tibial artery. Additionally neuro-cutaneous perforators from small arteries accompanying sural nerve and Veno-cutaneous perforators from small arteries accompanying short saphenous vein supply sural flap.[8]

Venous drainage of sural flap is through short saphenous vein. This flap is easy to harvest in quick time without any microsurgical skills. It does not sacrifice any major vessel and can be used even in cases of occluded anterior and posterior tibial arteries.[9] By taking a cuff of gastrocnemius

and including proximal sub facial course of sural nerve in flap, osteomyelitis cases have been treated.[10] Surgical technique of flap harvest, width of pedicle, pivot point from lateral malleolus all have been well described in literature. We used sural fascio-cutaneous and adipo-fascial flap in 65 patients requiring soft tissue coverage of distal lower extremity.

Donor site was closed primarily in adipo-fascial flap and we used SSG in fascio-cutaneous flap. We kept the width of pedicle about 4 cm and used the pivot point 5cm above lateral malleolus. Patients of both genders were operated. Age of the patients ranged from 7 years to 60 years. Etiology of soft tissue defect consisted of trauma (30), spoke wheel injury (13), electrical burn (7), osteomyelitis (6), unstable scar (3) and non-healing diabetic ulcers (6). Trauma was the leading cause of soft tissue defect in distal lower extremity in this analysis which is compatible with another study done in this part of the world by mammon *et al*.[11] Patients underwent fascio-cutaneous and adipo-fascial version of sural flap. Various modifications have been described to improve blood flow of flap such as sural flap delay or delayed sural flap.[12] But we believe that venous congestion plays the main role in flap necrosis which is supported by numerous other studies as well. So we looked for the reasons of venous congestion and tried to solve them.

We persisted with general principles of flap care like limb elevation, warm temperature and good fluid intake. It is suggested that there should be no tunneling of flap pedicle to avoid compression which is likely to be increased in postoperative period due to oedema.[13] We exteriorized the pedicle if there was even minor doubt of pedicle compression at the time of flap harvest. But these methods did not improve our flap survival rate by and large. We realized in the early period of flap harvest that how careful and meticulous we are in avoiding pressure over pedicle postoperatively, we can't prevent it all the time. This led the senior author to devise a splint that is capacious at pedicle area and avoids pressure over pedicle at every moment. We started using this splint in later part of surgical practice.

Some other modifications have been suggested to improve venous outflow. As arterial pressure in distally based flaps is low there is usually venous hypertension due to continuous venous inflow if distally short saphenous vein is patent. This can lead to venous thrombosis. It is suggested to anastomose the proximal end of the vein to great saphenous vein in an end to side fashion to increase venous outflow.[14] Similarly leeches and intermittent drainage of proximal stump of short saphenous vein are suggested to reduce congestion and salvage the flap.[15] Dissection of sural nerve from artery is also one modification[16], all aiming towards improved flap survival. In our opinion these technique transform a simple flap to a complex one reducing the glamour of sural flap.

When we analyzed the results of two groups *p*-value of 0.000 was achieved which is statistically very significant.

Regarding drawback of this analysis, it is a short sample size to draw a definite conclusion. It is retrospective study as well. When sural adipo-fascial flap version is used venous congestion is difficult to assess and increased lymp-oedema might have drained through skin graft. This leads to less congestion and might had contributed to improved survival rate in this study.

## CONCLUSION

Reverse sural artery flap continues to be a versatile flap for distal lower extremity reconstruction. By using a special splint as a modification, flap complication rate can be decreased significantly.

## AUTHOR'S CONTRIBUTION

TM: Composing and compiling various components of the article. RA: Collecting data, analysis and interpretation of results. O: Idea of splint and the performance of surgical procedure

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