



Sural Flap Application in Three Cases with Foot and Tarsal Soft Tissue Defect and Review of Literature

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ÖZET

Ayak ve ayak bileği yumuşak doku defektli üç olguda sural flep uygulaması ve literatürün gözden geçirilmesi

Ayak ve ayak bileği yaralanmalarında subkutan dokunun ince olmasından dolayı tendon ve kemikler sıklıkla açıkta kalmaktadır. Bu defektlerin kapatılması için çeşitli metotlar tarif edilmiştir. Bu çalışmada travma sonrası ayak ve ayak bileğinde gelişen cilt ve cilt altı yumuşak doku kayıplarına bağlı açıkta kalan vital dokuların örtümünde ters akımlı nörokutan sural flep uyguladığımız üç hastanın dört ekstremitesinin tedavi sonuçlarını literatür eşliğinde değerlendirdik. Ters akımlı nörokutan sural flep kolay, etkinliği yüksek, donör saha morbiditesi ve komplikasyon oranları düşük olduğu için özellikle ayak bileği ve topuk bölgelerinde vital dokuların örtümünde tercih edilebilecek bir yöntemdir.

Anahtar kelimeler: Cerrahi flepler, topuk, ayak bileği, kırıklar, açık

ABSTRACT

Sural flap application in three cases with foot and tarsal soft tissue defect and review of literature

Tendons and bones often remain uncovered due to thin subcutaneous tissues in foot and tarsal injuries. Several methods have been described to close these defects. In this study, we assessed the treatment results of the four extremities of the three patients to which we applied reverse-flow neurocutaneous sural flap in covering the vital tissues which remain uncovered based on post traumatic foot and tarsal cutaneous and subcutaneous soft tissue losses with literature. Reverse-flow neurocutaneous sural flap is a preferred method in covering vital tissues particularly in tarsal and heel areas because it is easy, highly effective with low donor site morbidity and complication rates.

Key words: Surgical flaps, heel, ankle, fractures, open

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INTRODUCTION

Tendons and bones often remain uncovered based on post traumatic or chronic ulcers due to thin subcutaneous tissues in foot and tarsal injuries. The repair of the defects in this area is inconvenient. A great number of local, regional and free flaps were used in the repair of these defects. However, conditions in which the

vascularity of the region is defected based on trauma, peripheral vascular diseases or diabetes mellitus makes the use of these grafts difficulty. Therefore, reverse-flow sural artery flap which is defined as fasciocutaneous is a safe and an easily applicable method for the repair of tarsal, load area of the foot and heel circumference soft tissue defects (1-3).

Classical sural flap consists of cutaneous, subcutaneous tissue and fascia. It successfully meets the pedicle of small saphena vein and sural nerve reverse-flow sural flap which is accompanying arteries. Masquelet, for the first time in 1998, defined distal pedicle reverse-flow sural artery flap by exploiting the relationship between the median superficial artery and the lowermost perforator branch of peroneal artery (4). Then, in 1994,

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Hasegawa et al. stated that this technique was reliable, fast and easy, and Yilmaz et al. modified the technique four years later (2,5).

In this study, we assessed the treatment results of the four extremities of three patients to which we applied reverse-flow neurocutaneous sural flap in covering the vital tissues which remain uncovered based on post traumatic foot and tarsal cutaneous and subcutaneous soft tissue losses with literature.

CASE REPORTS

CASE 1: In a thirty-six year-old male case, Achilles tendon rupture which developed as a result of the right Achilles tendon rupture while walking was repaired. In the follow-ups, approximately 6x3.5 cm cutaneous and subcutaneous necrosis developed instead of incision in the second week. The necrotic tissues in the cutaneous, subcutaneous in the posterior of the tarsal of the patient and Achilles tendon repair area were debrided and the Achilles tendon was repaired again. In the same session, the Achilles tendon was covered with 7.5x4 cm reverse-flow neurocutaneous sural flap and partially thick cutaneous graft. The area on which the flap turns on itself was covered with partially thick cutaneous graft; the donor site and other areas were primarily sutured. The plaster of the patients was left opened as window in the place of flap, and made not to pressurize the flap pedicle and the flap. In the second week, the sutures were removed. The adaptation of the graft to the surrounding tissue was completed in six weeks in the case. Along with the recovery of the Achilles tendon of the case, the splint was removed and he was allowed to step with full load in the third month.

CASE 2: A thirty-three year-old male patient was brought to emergency service as a result of a traffic accident. There were Lisfrank fractured dislocation on the right foot and injury of approximately 14x8 cm diameter going towards the bone on the medial malleolar starting from approximately 3 cm beyond the medial malleolar and going towards the medial part of the rear and front foot accompanying cutaneous, subcutaneous tissue loss in other parts in the case (Figure 1a). Surgical treatment was applied on the fractures and dislocations of the patient, the necrotic soft tissues were debrided. And then, in the second session, the defect areas in the soft tissue were covered with 9x4.5 cm diameter neurocutaneous sural artery flap and partially thick cutaneous graft. After preparing the flap, it was brought to the defect area in the tarsal and foot medial by passing through the subcutaneous tunnel. The place on which the flap turns on itself and the donor site was covered with partially thick cutaneous graft. The plaster of the patient was left opened as a window instead of flap, and made not to pressurize the flap pedicle and the flap. The sutures were removed in the second week. The splint was removed in the sixth week. The adaptation of the graft to the surrounding tissue was completed nearly in the sixth week and the union of the existing fractures occurred (Figure 1b). The patient was allowed to step with full load.

CASE 3: A twenty-six year-old male patient was brought to emergency service as a result of falling down from height. The patient had L4 vertebra and pelvic fractures as well as segmental 3B open fractures in both calcaneuses. Surgical treatment was applied on the

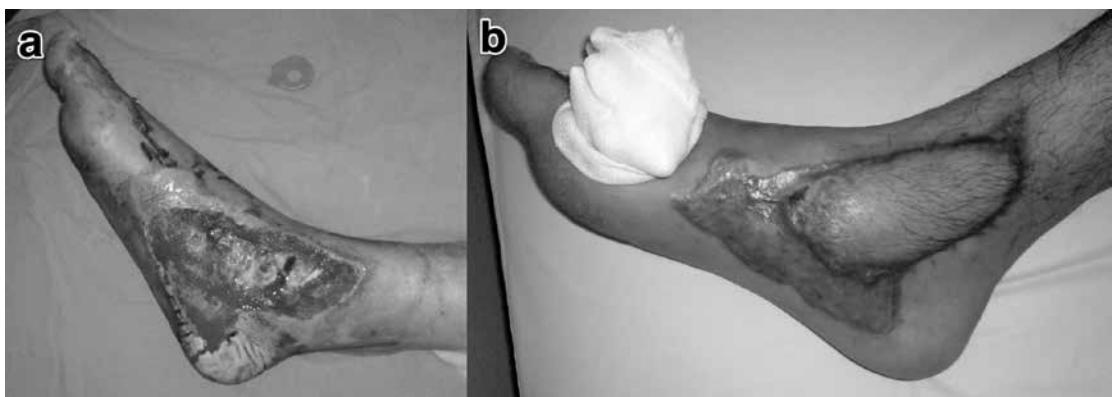


Figure 1: Image of the second case, preoperatively (a), after greft adaptation (b).

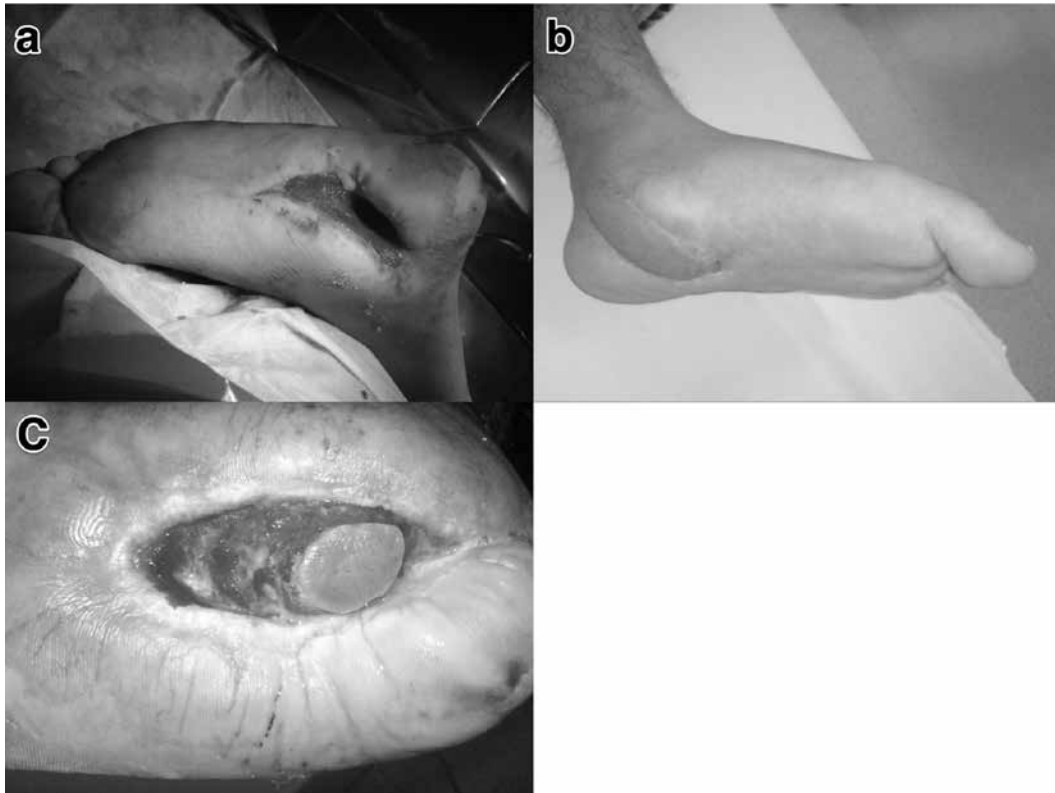


Figure 2: Image of third case's left calcaneal defect after serial debridements (a). First year image after graft adaptation (b). Superficial epidermolysis of the right side flap due to venous congestion (c).

lumbar vertebra fracture and both calcaneuses of the case. Osteomyelitis developed in both calcaneuses and necrotic wound developed in the medial part of the heel post-operatively. Intravenous antibiotherapy was started according to the result of the culture, which was taken from both heels of the patient. In addition, the infectious bones in bilateral calcaneus and the infectious scar tissues were debrided. Following the serial debridement, cutaneous, subcutaneous tissue and bone defect occurred on the medial of the heel nearly 7x4 cm on the right, 7x3 cm on the left, nearly up to 3 cm in depth in both sides (Figure 2). The defective areas with calcaneuses' osteomyelitis in both feet were covered with reverse-flow neurocutaneous sural artery flap 7x4 cm on the right, 7x3 cm diameter on the left. Plaster splint was made in a way not to pressurize instead of flap. Also in the two extremities of the case, sural artery flap was prepared and brought to the defect area and re-sutured to the place it was taken. One week later, the flap pedicle in both sides were passed through the subcutaneous tunnel prepared in the tarsal and carried to the defect area. The area on which the flap pedicle

turns on itself and the upper part of the donor site were covered with partially thick cutaneous graft. While the graft adaptation was completed in six weeks without any problems in the left heel of the patient, superficial epidermolysis based on venous congestion developed on the graft placed on the right heel and the adaptation was completed in the 14th week (Figure 2). Upon the union of the fractures of the patient and the completion of the graft adaptation, he was allowed to step on one side on the sixth week and the other on the 14th week with full load. The discharge due to calcaneuses' osteomyelitis ended with the suitable antibiotherapy and graft adaptation.

The cases were assessed subjectively in terms of fracture recovery in the third, sixth and twelfth months regarding infection findings, donor site morbidity, recovery in the defect site, the adaptation of the flap to its surroundings as well as the pain and touch sense of the flap. None of the three cases had donor site morbidity in the first year follow-ups and no subjective difference was seen in the pain and touch sense between the surrounding tissue and graft area. The first two cases

turned to their former daily activities without the need for shoe modification. And the third case could not turn to his former daily activities because of the accompanying fractures but he could perform his daily activities without pain by shoe modification.

DISCUSSION

Foot and tarsal circumference soft tissue defects are the most frequently seen annoying problem in orthopaedic surgery. Traditionally, local, regional flaps are used in covering these defects but the sizes and arc rotations of these flaps are quite limited (6-7). Cross leg flap is a reliable method in such cases but its prevention of the mobility of the patients is its main disadvantage (8). Reverse-flow anterior tibial artery flap and posterior tibial artery flap can be used but these flaps require the sacrifice of the major arteries of the subextremity. Furthermore, free flaps can also be used but they have disadvantages such as requiring microsurgery experience, long surgical time and higher complication rates when compared to other flaps (9). The lateral supramalleolar, saphena neurocutaneous and medial plantar artery flaps which are defined as fasciocutaneous are used in the defects on the tarsal, foot and the heel. Besides, the results of neurocutaneous sural artery flap are seen to be more successful in literature (1,10,11). Neurocutaneous sural artery flap is a practical flap like other neurocutaneous flaps because it has a sense in the areas of the heel, which carry weight, and often, no difference is seen between it and the steady side while walking (12). Furthermore, its use is gradually widespread particularly in the last ten years because it is a reliable and easily applicable method (1-3,13-15).

Advantages such as the good rotation arc due to the long pedicle of the fasciocutaneous sural artery flap, the shorter and easier surgical procedure when compared to free flap, the non-deterioration of the circulation of the major leg arteries during taking and constant continuance of the blood flow of the flap, achievement of primer covering of the donor area, giving successful results in big defects, the usability even in little children and applicability to patients with external fixators were specified in literature (1-3,12-14). Another advantage is that it can be applied bilateral in the same session. Successful results were obtained in the cases to whom neurocutaneous sural flap was applied bilateral in

literature (1,14). And we consider it a highly practical method for use in cases with both sides tarsal, foot and heel injury. The main disadvantages of this flap are venous congestion, temporary hyperesthesia in the foot lateral side, and the scar which is left in the posterior calf area (1-3,12,13). This is particularly important in young female patients. However, there is usually an acceptable appearance in the donor site and receiver site. Usually, no painful neuroma is seen because the end of the nerve cut is routinely buried in the deep muscle layer. The temporary hyperesthesia in the area, which the sural nerve feeds usually, reveals in three months in average (5). In literature neurocutaneous sural flaps with sizes up to 15x12 and 17x16 cm were applied and these flaps recovered without complications (2,13). In their studies, Hollier et al. healed nearly 6x10 cm wound which covers the tarsal and the heel in a way to leave open the Achilles tendon which developed due to lawnmower in a three-year old child by covering fasciocutaneous sural flap (14). As a result, they stated that this flap can be safely used in children as well.

Hasegawa et al. mentioned that flap necrosis can be avoided by taking sural flap with deep fascia (5). Some researchers mentioned that there was anastomosis between the superficial sural artery and the perforator arteries in the lateral malleolar area. So, they mentioned that the injury in the perforator veins can be prevented by the ending of the distal dissection of the sural flap pedicle 5 cm beyond the lateral malleolar (2,14,16). Furthermore, they also showed that the injury of these arteries could be potentially avoided if the perforator branches of the peroneal artery are determined preoperatively by Doppler (2,3,14). The pedicle width of the reverse-flow sural flap should be between 2-4 cm (2,3). We considered the flap with a pedicle width of 3 cm with the deep fascia and ended the pedicle dissection 5 cm beyond the lateral malleolar in our application. Furthermore, the pedicle should also contain sural nerve and small saphena (2,3). In addition leg elevation should continue for three days and pressure application should be avoided from the middle of posterior cruris to the heel. Ahmed et al. defined the plaster modification of paris boot for this (3). Delay procedure can also be used in order to increase the success of the graft (3,13,17,30,31). And we applied delay procedure as bilateral in the same sessions in one of our cases.

We passed the graft pedicle through subcutaneous

tunnel in our sural flap application in the three extremities of the two cases. In all of our applications, we did not cover the cutaneous on the place where the pedicle is turned on itself and covered this area with partially thick cutaneous graft. However, venous congestion developed in the flap which was applied to the defect on the right side in the second case and no necrosis developed in the graft post three-day leech treatment but opening in the graft edges and epidermolysis was seen in some part. Nevertheless, he recovered without problem in the follow-ups (Figure 2). Ahmed et al. mentioned that leech treatment can be used in the venous congestion of the sural flap and applied it for the first time and achieved successful result (3). To avoid the venous congestion of the flap, the flap will not be passed through the tunnel and covered with cutaneous flap if the opened subcutaneous is stretch or ruins the circulation of the flap. Venous congestion can also occur due to the subcutaneous compression of the flap pedicle on the place, which it is turned. To prevent such conditions, some writers have suggested passing the fasciovascular pedicle through the open tunnel and covering it with cutaneous graft while some of them suggested covering the pedicle on the tarsal with the cutaneous protrusion which is left in the flap (2,3).

Quite deep and large wounds occur as all bone and badly scarring soft tissues appear in the presence of osteomyelitis. Abductor hallucis, abductor digiti minimi, flexor and extensor digitorum brevis flaps can be used in the foot. However, they have a limited area of use because of the smallness of the foot muscles and shortness of the pedicle length (18). Furthermore, the obligation of covering the surface of the muscle flap with cutaneous graft also creates disadvantage. Particularly, the purpose in the treatment of calcaneus osteomyelitis is not only the eradication of the infection but also enabling the patient's heel to carry the load. Colen mentioned that the presence of osteomyelitis created relative contradiction for fasciocutaneous sural flap and suggested that muscle flap should be primarily considered in such cases (19). On the contrary Yıldırım et al. reported quite successful results in the calcaneus osteomyelitis

cases who they treated by neurocutaneous flap (12). All of the nine cases, except for one, recovered without problem, and reached preoperative ambulatory condition and there was no need for custom-made shoes and orthosis. And, no re-infection was seen except for one case. Furthermore, Touman et al. determined that sural flap could be safely used even in the osteomyelitis in one quarter of the leg, tarsal and foot, post traumatic tissue loss and chronic ulcer cases (1). They also mentioned that it could be successfully used in emergency cases too. The ulcers, which develop due to diabetes mellitus and peripheral vascular diseases, which have gradually increased, recently give successful results with neurocutaneous sural flap (1,2,12,15,20). In our second case, there was osteomyelitis, which developed post open fracture in both calcaneuses, and the purulent discharge stopped along with the graft adaptation post fasciocutaneous sural flap, which we applied on the defects in both sides under appropriate antibiotherapy following the serial debridements. No recurrence was seen in the patient. Free flap applications are risky in covering the defects in trauma based injuries or due to major embolisms. Reverse-flow sural flap application seems to be safer in covering these kinds of defects (1-3,12). We considered using sural flap safer because tissue loss due to trauma developed in all our three cases.

As a result, we applied reverse-flow neurocutaneous sural artery flap on the four extremities of the three cases with soft tissue defect on the tarsal, foot and the heel. There were no donor site morbidity in any of the three cases and no subjective difference was seen in the pain and touch sense between the surrounding tissue and the graft area. First two cases turned to their former daily activity without the need for shoe modification. The third case could not turn to the former daily activity because of the accompanying fractures but could perform his daily activities without pain by shoe modification. Fasciocutaneous sural flap is a preferred method in covering vital tissues particularly in tarsal and heel areas because it is easy, highly effective with low donor site morbidity and complication rates.

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