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Original Research Article

Reverse Sural Flap for Regeneration of the Soft Tissues in the Ankle and Heel

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Abstract:

Introduction: It has never been easy to restore large soft tissue lesions in the ankle and foot. There has been varying success using reverse sural flaps and free flaps for this issue. Without microvascular repair, the reverse peroneal artery flap is an alternative that can be used reliably. Anterior and posterior tibial arteries form deep and reliable connections with the peroneal artery around the talus and ankle joint. When the short saphenous vein and the reverse sural artery were included into the flap, arterial input and venous drainage improved.

Materials and Method: Over the course of two years, ten patients with significant heel deformities underwent repair with a reverse peroneal artery flap (pedicled). Final inset given after initial surgery has healed after 18–21 days. These patients were 45 years old on average.

Results: All ten flaps displayed full survival, with no signs of even minor necrosis. Two patients reported minor donor site issues that were treated conservatively and resolved.

Conclusions: For the purpose of covering significant soft tissue deformities of the heel and sole, RPAF is a very dependable flap. Without vascular microsurgery and without endangering the major vessels in the foot region, large abnormalities can be repaired. If there is prior knowledge of flapping perforators and a free fibula, RPAF is simple to do reliably.

Keywords: Sural Flap, Periosteal Artery Flap, Reconstruction Of The Heel, And Foot.

Introduction

Due to the expose of the joints, tendons, and bones in the area of the foot that has complex soft tissue abnormalities, reconstructive solutions are challenging. Numerous reconstructive methods, such as local skin flaps, free flaps, pedicled muscle flaps, and fascial or fasciocutaneous flaps, have been suggested to treat soft tissue deficiencies in various areas.[1,2]

Taylor and Daniel were the first to identify the possibility using the musculocutaneous branches of the medial sural artery as the foundation for a free flap on the medial calf integument after doing cadaver research [3]. For lower extremity soft tissue loss, notably around the knee, Ponten [1] offered the fasciocutaneous sural flap as a reconstructive choice in 1981. Two years later, Donski and Fogdestram [4] introduced the sural region's distally-based fasciocutaneous flap, and Montegut and Allen viewed the Gastrocnemius myocutaneous flap replacement with the sural artery perforator flap [5]. Free flaps are crucial for saving limbs, although a greater understanding of regional flap designs and their application has occasionally led to simpler and more affordable substitutes in order to shield the lower extremity's injured soft tissues.[5] Regional foot flaps have a limited range of motion and a limited amount of usable soft tissue. Based on the surrounding the ankle are the peroneal artery perforators, and their connections to the subarachnoid sural artery, A distally based fasciocutaneous flap was described by Donski and Fogdestam [4].

Over the past few decades, a variety of sural flap alterations have been observed, as well as the appearance of numerous, frequently perplexing denominations. The sural flap has been called the delayed sural flap [9], the reverse sural artery flap [7.8], and other names. supercharged reverse flap [10], sural fascio musculocutaneous flap [11], cross-leg Distally based sural neurocutaneous flap [14], distally based sural neurocutaneous flap [12,13], and distally base sural neurocutaneous flap [15], and distally based sural fascio musculocutaneous flap, nerve-sparing distally based sural fasciocutaneous flap [16], proximally based sural neuro-lesser saphenous Ven cutaneous compound flap [17], etc.

Vein congestion won't be an issue because of the strong two significant comitants, a short saphenous vein, and a fasciocutaneous pedicle. [18] The design of the flap on the reverse peroneal artery, its dissection, and the outcomes in our 10 instances are all thoroughly described in the current publication.

Materials and Methods

In Department of Plastic surgery, Patna Medical College and Hospital, Patna, 10 patients overall with soft tissue abnormalities reconstruction via RPAF transfer was performed over the heel and distal sole in two years. From the patients' medical records, information such as history, age, sex, aetiology, defect dimensions, flap cover cause, complications, and hospitalisation were recorded. Prior to surgery, any history of past surgery or injury to the limb, the reason for the deformity, its aetiology, and its location, and peripheral pulses were evaluated. When at least one of the major vessels (ATA/PTA) is palpable at ankle level, this flap was intended.

Peroneal perforators don't need to be located before surgery. Every procedure was completed while under spinal anaesthesia. After elevating the lower limb for four to five minutes, all procedures were performed while using a tourniquet.

Under one permitted tourniquet time (about 1.5 hours), the defect was prepared and the flap was elevated. The first four procedures were performed with the knee bent, but we later discovered that the prone position is considerably superior for donor site grafting, flap elevation, and defect preparation. The following six procedures were thus performed in the lying flat.

The flap's pivot point was 5 cm above the lateral malleolus in its design and a small base between the tendoachilles and side malleolus. A region of 5 cm above the side malleolus is preserved unaltered to prevent injury to the critical connecting vessels. Depending on the circumstance, the flap may be safely extended to the top of the leg, up to the knee's line, and laterally up to the midline on both sides. On the corresponding flap that is latitudinally positioned (fibular side), an incision was made that went straight down deep to the fascia. At this point, It was possible to observe the perforators from the peroneal artery entering the skin. The middle portion of the leg sees a fair amount of consistency in these.

The flap was designed with a the tendoachilles and a tiny base between them serve as the pivot point, which is located 5 cm above the side malleolus. A region of 5 cm above the side malleolus is preserved unaltered to prevent injury to the critical connecting vessels. Depending on the situation, the flap may be safely extended to the upper part of the leg, up to the line of the knee joint, and laterally up to the midline on either side. On the designated lateral side of the flap (fibular side), an incision was made that went straight down deep to the fascia. At this point, It was possible to see the perforators from the peroneal artery penetrating the skin. The middle portion of the leg sees a fair amount of consistency in these.

Bipolar was used to coagulate or ligate the branches of the artery that were heading out. If the peroneal artery is entrenched in the muscle, a portion of the flexor hallucis longus may occasionally be removed with a flap. Over tendoachilles, a good fascial layer is still present. Tourniquet withdrawn, flap blood supply assessed, and total hemostasis obtained at this point. Then, flap stitched to the flaw and skin from the donor site is subsequently grafted. Skin is also grafted into the flap's pedicle and bare area. Dissection of this flap is made a little easier by previous expertise with free fibula and perforator flaps.

On the dorsal side of the leg, we employed a slab of plaster of Paris with moderate plantar the ankle joint flexes to allow the flap to come into a stance that is relaxed. Extra padding was placed over the pedicle and the patient was positioned on the bed to the side in order to prevent pedicle compression. Additionally, two pillows were used to elevate the patient in order to increase venous outflow and lessen flap edoema. In 2 cases, the flap was entirely repositioned during a single step of surgery. A second stage of surgery was performed 18 days after the first procedure under local anaesthetic (the last inset) was performed on 7 additional pedicled flaps. In one patient, the lowest 4 cm of the fibula became exposed from a deep infection and was removed under spinal anaesthesia.

Results

10 patients were present, and their average age was of 46 years (34–61 years), including 6 men and 4 women. Foot cutaneous verrucous cancer (3 instances), carcinoma of the squamous cell (2 cases), and tissue loss following trauma (5 cases) are just a few examples of the soft tissue defects that were covered. Sizes of the flaps ranged from 21 by 10 to 28 by 14 cm. These flaps were entirely able to live. None of these patients experienced venous congestion, marginal necrosis, or partial flap loss. After 4 weeks following surgery, all patients were ambulant and the graft take was generally positive.

With an average age of 45 years (35–60 years), the 10 patients were divided into 6 men and 4 women. Soft tissue defects with diverse aetiologies were reviewed, including squamous cell carcinoma (2 instances), verrucous carcinoma of the foot (3 cases), post-traumatic tissue loss (5 cases), and verrucous carcinoma of the foot (3 cases).

The flap's size varies from 21 by 10 to 28 by 14 cm. These flaps were all successfully endured. None of these patients experienced marginal necrosis, venous congestion, or partial flap loss. All patients

were ambulatory 4 weeks after surgery, and the graft take was typically satisfactory. There were minimal problems in 3 patients at the donor site in the lower tendoachilles (graft loss) region. On the 18th postoperative day, the left flap was reversed following the final inset to address these problems. In one patient, a severe infection subsided, expos ing a 4 cm portion of the lower fibula. On the 18th day, 5 cm of bone were removed with left flap coverage after the wound was debrided. In 4 weeks, all donor sites were fully healed. In none of the patients was regrafting necessary. Patient was discharged 7 to 10 days after initial surgery and was then seen 18 days later for the final inset.

Table 1: The reverse peroneal artery flap's aetiology, defect size, flap dimensions, and problems are all discussed.

No.	Age/Gender	Etiology	Defect location	Flap dimensions (cm)	Complications
1.	38/m	Trauma	Tendoachillis in the heel	24×11	Graft failure in part at the lower donor site
2.	45/f	Trauma	Heel avulsion	24×11	Graft failure in part at the lower donor site
3.	49/f	Trauma	Area of the middle malleolus	21×10	None
4.	45/m	Verrucous carcinoma of heel	Heel	23×10	None
5.	48/m	Verrucous carcinoma	Heel region	22×10	During the last inset, Fibia of 5 cm was removed and covered with the left flap.
6.	42/m	Trauma	Heel and midfoot sole avulsion	28×14	Patchy graft loss that was dressed over and recovered in 20 days.
7.	43/f	Trauma	Area of the middle malleolus	25×10	None
8.	37/f	Heel-specific squamous cell carcinoma	Heel area	25×12	None
9.	60/m	Heel-specific squamous cell carcinoma	heel portion that protrudes into the sole	26×11	Graft loss in part at the lower donor site
10.	42/m	Verrucous carcinoma	Heel region	23×10	None

On an OPD basis, dressings were advised for these cases twice a week. Table 1 summarises the aetiology, flap size, and problems in detail. The typical follow-up time was a year. For six months, patients were instructed to wear crepe bandages. None of the patients mentioned any issues with bearing weight. No patient had a recurrence of the tumour. All patients' functional and aesthetic outcomes were favourable. All patients expressed satisfaction with the results.

Discussion

Across the ankle and foot, there are large soft tissue lesions that can be successfully repaired frequently result in limb preservation.[5]Those patients who have soft tissue of a medium size abnormalities utilising neurofasciocutaneous or fasciocutaneous flaps from the leg may help treat of the leg, ankle, or foot. as adaptable and effective reparative alternatives. Their issues have been the fragile venous drainage and their restricted rotational arc of large and small adipofascial pedicles, which prevented them from reaching the distal deficits.

Considering the fact that free flaps can provide sufficient tissue for restoration, not all patients are

fit for free tissue transfer because of pre-existing comorbidities and cost concerns. [19-21]To produce a more distal and stable cover, The opposite flow peroneal artery and the reverse sural system are incorporated in this flap design. Authors that have successfully performed reverse sural flaps are against taking flaps from the distal portion from the leg. [19-21]This neurofasciocutaneous flap gets perfused through the lower and middle peroneal perforators and has an axial pattern of circulation in the bottom 2/3 of the leg. The role of the flap mentioned above this as this flap's expansion in a haphazard pattern.[19-21] According to our experience, these flaps can reliably accommodate up to 3/4 of the leg.

In an attempt to stabilise anterior third of the skin, Ayyapan and Chaddha11 added all the connective tissue located in the space between heads of the gastrocnemius (acting as a "mesentry" with perforators of the adipose tissue). The study recorded 27% complication rates, and this only slightly improved the results. Peroneal artery perforators typically supply the lateral and posterior leg by entering the skin through the intermuscular

barrier in the back. Continual perforators are located from the fibular head, 7–21 cm.[9]

In this study, the perforators were not identified before surgery; nonetheless, it might be safer for novices so as to. From our observations, the majority of these penetration devices were septocutaneous direct perforators. Musculoskeletal course is sporadic, brief, and passes through the flexor hallucis longus. As a result, the perforator to the peroneal vessel is quickly dissected. The periosteum covering after the chosen perforator has been dissected to the peroneal arteries, the fibula is reflected close to it. [10]

Further dissection and complete major pedicle visualisation are made possible by this. For a comfortable reach, when necessary, the peroneal vessels are connected proximally and reflected subsequently. The arterial peroneal andthe approach described results in enhanced venus drainage via venae comitantes and arterial supercharging of the flap based on the supramalleolar perforators (regular reverse sural flap) by including its perforator in the (axial system) pedicle. As a result, there is a marked increase in the perfusion pressure in the flap taken from the upper leg third. When these advantages are taken advantage of, the flap from the upper leg obtains all the benefits of an axial pattern flow. [10]

This allows for more dissection and full main pedicle visibility. According to what is required for a comfortable reach, the peroneal arteries are ligated proximally and reflected distally. Through the venae comitantes, the disclosed method enhances venus drainage, and the flap based on the supramalleolar perforators (standard reverse sural flap) receives arterial supercharging. The (axial system) pedicle incorporates the peroneal artery and its perforator. The flap obtained from the upper leg third experiences a noticeably increased perfusion pressure as a result. When these benefits are utilised, the flap from the upper leg receives all the advantages of an axial pattern flow.[10]

As long as the anterior or posterior tibial artery are both patent, using the peroneal artery is not problematic. In contrast, we suggest RPAF for foot and ankle reconstruction, preferably when the ankle region is unharmed. When the wrist and hand are hurt, the standard method of reconstruction is a reverse radial artery forearm flap. Most of the blood flow to the ankle and foot comes from the anterior tibial artery and posterior tibial artery, making the peroneal artery the least important source of blood transport.[11,12]

Although there is very little risk to the foot, the successful rebuilding of the cover represents a tremendous achievement in an otherwise difficult area. Even for free tissue transfer in the distal extremities, the majority of surgeons prefer end-to-end anastomosis, which results in the eventual loss of one of the main veins supplying the ankle and foot region (privileged discussion with numerous authors). We did not see any ischemia-related problems that might have resulted from RPAF harvest in the leg.The bigger amount of soft tissue transferred, the better distal reach, the increased reliability, and the ease of rotation compared to any other regional flap, including the sural flap, allowed us to salvage these limbs without the need for microvascular surgery. [11]

Although the secondary operation of the final inset has a minor drawback, the tendoachilis region and foot seem more attractive as a result than they would have under a single sitting technique and atherosclerosis is least likely to occur in the peroneal artery.[11]This flap has a number of benefits compared to other distally oriented fasciocutaneous flaps, including (i) dependable flap dimensions that can be extended up to the 3/4th of the leg (ii) pedicle length that can be planned liberally to minimise kinking, and (iii) longer pedicles that enable the flap to reach more distal locations over the sole. [11]

This reworked flap may be appropriate for patients with Large soft tissue defects include (i) those over the heel, distally sole, and dorsum of the foot; (ii) more distal defects where the standard reverse sural flaps may not reach; (iii) patients with large raw areas around the ankle and foot where the standard reverse flap may not be enough; and (iv) salvaging in the event that a free flap fails. The procedures, all of which were completed under spinal anaesthetic, took an average of 2.5 hours. [11]

We realised and found that the prone position is significantly better for donor site grafting, flap in setting, defect preparation, and flap dissection after the first four instances were carried out in the supine position. Patients easily accepted the straightforward post-operative posture. Following the original operation, a second procedure was performed under local anaesthesia 18 days later. This flap has helped in all of the cases that have been discussed avoid surgery on the microvasculature. [11]

Conclusion

In our opinion, it was safe and dependable to extend 3/4 of the leg is covered with reverse sural flaps (RPAF). These encouraging outcomes enable us to improve our methods and give dependable coverage in the distal foot deformities. Greater planning flexibility and tension-free flap reach to the recipient defect are made possible by the flap's upper extension. The only other choice in the majority of these situations was free flap. For the restoration of greater heel and distal sole deformities in these situations, RPAF has been employed with excellent success.

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