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Original Research Paper

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SUPERDRAINAGE IN REVERSE ISLAND SURAL FLAP: INDEED AN OPTION TO INCREASE THE PREDICTABILITY OF THE FLAP

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ABSTRACT Soft tissue defects in the lower third of the leg and foot presents a considerable problem to reconstructive surgeons. A variety of flaps were used in the attempt to achieve excellence in form and function. Reverse Island sural flap has become the work horse for these defects. However, it often suffers from venous congestion. In order to reduce the rate of congestion and increase viability, venous superdrainage of the proximal cut end of the small saphenous vein with any draining vein of the foot can be considered.

AIMS: To study and compare super-drained reverse island sural flaps with reverse island sural flaps in particular reference to technical details and flap viability.

METHODOLOGY: Patients requiring lower limb reconstruction due to various aetiologies were being chosen randomly in 2 groups – study and control, evaluated and operated with the resurfacing being done by reverse island sural flaps either super-drained or not over three years in a tertiary hospital. The results were compared and analyzed using standard statistical methods. The study was a prospective, institutional and analytical one.

RESULTS: Among the 30 patients in study (14 cases with superdrainage) and control (16 cases without superdrainage) groups, 1 patient and 4 patients respectively in the study and control groups suffered partial flap loss due to congestion. The spectrum of aetiologies was trauma in majority of the cases and the posterior heel region was the major recipient sites.

CONCLUSION: Venous superdrainage improves the viability rate of reverse island flaps and can be safely considered in large sized flaps.

KEYWORDS : superdrainage, sural flaps

CONTEXT:

Soft tissue defects in the lower third of the leg and foot presents a considerable problem to reconstructive surgeons because of poor circulation and paucity of local tissue for reconstruction. A variety of flaps were used in the attempt to achieve excellence in form and function. The distally based neurovascular sural flap has become the work horse for these defects. The sural flap's arterial inflow is robust and constant such that arterial insufficiency is rarely encountered[1]. However, the retrograde venous outflow is obstructed by the valves of both the small saphenous vein located superficially and the deep venae comitantes system; thus, venous congestion is a frequently encountered complication resulting in partial or total flap loss.[2]

The distally based sural artery flap has 2 venous drainage systems, namely, the small saphenous vein and the vena comitantes accompanying the sural nerve. These 2 systems are connected by oscillating avalvular veins.[3] Blood draining the flap via the short saphenous vein has to flow in a retrograde direction, whereas that in the vena comitantes accompanying vasa nervorum of the sural nerve flows antegradely towards the distal leg perforators.[4-5] The small saphenous vein collects venous blood from its tributaries serving the entire flap but has no outflow; hence, blood has to be rechanneled into the deep venous system via oscillating avalvular veins to the vena comitantes accompanying the sural nerve that eventually drain into the peroneal perforator veins. This delicate network channels blood from the superficial to the deep venous systems. According to Taylor et al[3] these oscillating avalvular veins multiply and hypertrophy in response to increased flow, as is the situation after flap elevation. Hence, intermittent phlebotomy is a form of delay which allows new venous channels to develop.[6]

Nonmicrosurgical techniques entail bleeding the flap intermittently. These include the use of medicinal leeches, dermal bleeding, and phlebotomy.[7-8] We have used a venous super-drainage technique by anastomosing the proximal end of the small saphenous vein with a vein at the defect site (tributaries of great saphenous vein) and assess the flap reliability in this study.

PATIENTS AND METHODS:

We conducted this study in our institute. The duration was three years from January 2015 to December 2017. The study population comprised of the patients admitted to our department or referred from other departments in our hospital. We included all consecutive patients with soft tissue defects in lower leg and foot indicated for flap coverage and who consented for the surgery (convenience sampling method). The minimum size of the flap included in our study was 6cm in length and 5 cm in breadth as relatively larger flaps suffer from venous congestion.

The patients were divided randomly over two groups – study group A of 14 patients (with super-drainage procedure) and control group B of 16 patients (reverse island sural flaps without super-drainage procedures). The study was a prospective, institutional, analytical and comparative between 2 groups. Institutional ethical clearance was taken.

Operative technique:

Patients were operated under regional anaesthesia (spinal and / or epidural anaesthesia) and under tourniquet control. The posterior midline of leg was marked. Distal peroneal perforators were marked by hand held doppler. With the patients in prone position, flap markings were performed by planning in reverse. Flaps had a triangular tail with its tip pointing to the pivot point to help the closure of pedicle without requirement of skin graft.

The elevation of the flap commenced proximally, identifying the sural nerve, short saphenous vein, and the median sural artery, which were included within the flap. An additional 5 cm of the small saphenous vein was mobilized as a venous pedicle, which was exteriorized and temporarily occluded with a microvascular clamp and divided for an adequate length to allow for possible vascular anastomosis. The deep fascia was then incised medially and laterally and deeper dissection started from medial to lateral over the medial head of gastrocnemius and from lateral to medial over the lateral head of gastrocnemius to reach the furrow between the two heads where the pedicle could be traced there, protected and kept attached to the flap with a fine mesentery-like structure(Fig 1a, 1b)

Fig1a: Flap harvested with 5cm of proximal small saphenous vein
Fig 1b: Superdrainage being executed after flap inset

A strip of fascia with a width of 3 cm containing the sural nerve and the small saphenous vein was included in the pedicle. Dissection continued toward the pivot point. The flap was raised and transferred to cover the defect. The tunnel between the pedicle and the defect was laid open before insetting the flap. Then, an end-to-end anastomosis was performed between the free end of the small saphenous vein and any superficial vein with a good calibre match located in the defect site to allow for a natural anterograde venous outflow. Finally, the donor site was covered by a skin graft.

We monitored the flap in the post-operative period to look for ischemia or venous congestion. We followed up the patients after discharge in the out patients department at least for 3 months.

RESULTS:

We studied a total of 30 patients. 17 patients were males and 13 were females with their ages ranged between 15-69 years (average age was 40.9 years). The flaps were used to reconstruct complex distal leg, ankle and foot defects. The spectrum of aetiologies was trauma in majority of the cases and the posterior heel region was the major recipient sites. In traumatic defects, delayed reconstruction, following repeated debridement, was planned after an average period of 11 days (range 5-26 days) in 20 patients. The choice between delayed or immediate coverage depended on the local condition of the wound, exposure of vital structures and the general condition of the patient. We did super drainage of sural flap in 14 patients, primarily of small saphenous vein with adjacent superficial vein, mainly to the tibial side. 16 patients had no super drainage. The mean flap size was 103.32 square cm (12.3 x 8.4). The average operating time for all the patients was 206 min while for patients without superdrainage was 174.38 min as opposed to 242.14 min in superdrainage procedures. 1 patient and 4 patients in the study and control groups respectively suffered partial flap loss due to congestion. (Table 1).

Table 1: Data of patients included in the study

S. No.	age (years)	gender	type of wound aetiology;	site of wound	Flap dimensions (in cm)	drainage done (1); no drainage (0)	duration of operative procedure (in min)	Duration of hospital stay (days)	Complication
1	38	M	post inflammatory non-healing ulcer	antero-lateral aspect of right ankle	12 X 10	1	255	10	No
2	28	M	post-traumatic ulcer	mid third lower third junction of right antero-medial leg	8 X 6	0	150	7	No
3	15	F	post-traumatic ulcer	lower third medial aspect of right leg	12 X 6	0	120	10	No
4	34	F	post-traumatic ulcer	lower third medial aspect of right leg	12 X 7	0	200	8	Partial necrosis
5	32	M	SCC	lower third medial aspect of right leg	12 X 10	1	280	10	N0
6	55	M	post-traumatic ulcer	right posterior heel	18 X 10	1	255	10	N0
7	67	F	SCC	left posterior heel	10 X 7	0	170	9	N0
8	20	M	post-traumatic ulcer	left sided mid third medial tibial ulcer	12 X 8	0	180	12	N0
9	45	F	SCC	mid third lower third junction of right antero-medial leg	12 X 6	0	190	11	N0
10	42	M	post-traumatic ulcer	antero-medial aspect of left lower third leg	12 X 10	1	240	10	N0
11	50	M	post-traumatic ulcer	left posterior heel	12 X 10	1	220	10	N0
12	35	F	post-traumatic ulcer	right posterior heel	12 X 10	1	210	10	N0
13	37	F	diabetic ulcer	medial planter aspect of left foot	10 X 8	0	165	12	N0
14	28	M	post-traumatic ulcer	entire middle third leg antero medial aspect	18 X 12	0	185	16	Marginal necrosis
15	47	F	SCC	right posterior heel	9 X 6	0	165	11	N0
16	48	M	diabetic ulcer	medial plantar aspect of right foot extending to plantar heel	16 X 10	1	255	16	Partial necrosis

17	42	F	post-traumatic ulcer	left posterior heel	12 X 8	1	225	13	N0
18	45	F	post-traumatic ulcer	left posterior heel	12 X 8	1	240	7	N0
19	30	M	post-traumatic ulcer	right posterior heel	12 X 8	1	240	7	N0
20	62	M	post-traumatic ulcer	left posterior heel	20 X 12	0	150	10	Marginal necrosis
21	51	F	post-traumatic ulcer	lower third medial aspect of left leg	9 X 8	0	200	12	Partial necrosis
22	28	M	post-traumatic ulcer	left planter heel extending to mid plantar foot	12 X 8	1	280	10	N0
23	32	M	SCC	middle third of anterior right leg	16 X 12	0	150	10	N0
24	49	F	post-traumatic ulcer	middle third of anterior right leg	14 X 8	0	165	12	N0
25	28	M	post-traumatic ulcer	right posterior heel	12 X 8	1	240	7	N0
26	50	F	diabetic ulcer	right posterior heel	6 X 5	0	205	10	N0
27	25	M	post-traumatic ulcer	left posterior heel	12 X 8	1	240	10	N0
28	50	M	post-traumatic ulcer	right posterior heel	12 X 8	1	210	7	N0
29	45	M	diabetic ulcer	right posterior heel	12 X 9	0	200	10	Marginal necrosis
30	69	F	post-traumatic ulcer	lower third medial aspect of right leg	10 X 6	0	195	11	Marginal necrosis

DISCUSSION:

The reverse island sural flap is a valuable reconstructive option for the coverage of soft-tissue defects of varying aetiologies at the level of the hindfoot, the ankle, and the lower leg. Its advantages are simplicity of design, easy and rapid dissection, short operation time, preservation of major arteries of the leg, minimal morbidity at the donor site, and the ability to complete the reconstruction in a single operation. The flap's arterial inflow is robust and constant such that arterial insufficiency is rarely encountered. even in flaps with larger than average dimensions[1]. One of the primary disadvantages of this flap is its susceptibility to venous congestion, which was demonstrated to be around 4.5% following the literature review and occurring in up to 21.4% of cases.[9] Large flaps have been classically associated with a greater incidence of venous congestion leading to necrosis despite adequate arterial perfusion.[10]

Various technical modifications have been proposed to prevent venous congestion including delay techniques, exteriorization of the pedicle, modification of the pivot point etc[11]. Super-drainage of the flap takes advantage of the natural venous outflow course of the small saphenous vein and dramatically reduces or eliminates venous congestion and allows for the design of larger than average flaps while ensuring reproducible outcomes.

Therefore, the anastomosis of the small saphenous vein with a vein at the recipient site not only improves the flap's reliability but also allows for harvesting larger flaps. This was achieved through a reliable venous outflow with our microsurgical venous anastomosis. In construction of these flaps, reverse venous flow is changed into antegrade flow.

The average size of the flaps in our series was 12.3 cm in length and 8.4 cm in width, with a mean surface area of 103.32 cm^2 compared with 55.08 cm^2 in the literature ($P < .001$) Furthermore, in our case series, there was only one complication from venous congestion leading to partial necrosis in the flap, significantly lower than that reported in the literature ($P < .05$). This was because there was thrombosis in venous anastomosis performed. Therefore, the anastomosis of the small saphenous vein with a vein at the recipient site not only improves the flap's reliability but also allows for harvesting larger flaps. This was achieved through a reliable venous outflow with our microsurgical venous anastomosis.

CONCLUSION:

To conclude, super drainage in reverse island sural flap reduces the incidence of venous congestion by reversing the flow, thereby increasing flap reliability and allowing for larger flap sizes to be raised safely. The routine usage of this technique is recommended in flaps larger than 6×5 cm, especially if the flap shows signs of initial venous congestion, which puts it at an increased risk of necrosis.

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