

Reconstruction of the Middle Third of the Leg by Distally Based Hemigastrocnemius Muscle Flap

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ABSTRACT

Background: One of the most challenging areas in plastic and reconstructive surgery is closure of soft tissue defects of the lower extremity. Inferiorly based hemigastrocnemius muscle flap can be useful for reconstruction of the middle third of the leg. The vascular basis of this flap is the vessels across the distal half of the raphe between the muscle heads. The aim of this study is evaluation of coverage of middle third defects of the leg by using the inferiorly based hemigastrocnemius muscle flap.

Patients and Methods: This study performed in the Plastic, Reconstructive and Burn Unit, Menoufiya University Hospital during the period from March 2002 to April 2004 has included 19 patients 13 males (68%) and 6 females (32%) presented with post-traumatic middle leg defects with exposed tibia. Their ages ranged from 10 to 58 years (mean 34). All defects were reconstructed by the inferiorly based hemigastrocnemius muscle flap. Follow-up period ranged from 6 months to 2 years.

Results: Partial flap loss occurred in 2 patients (10.5%). One flap (5.2%) was lost in the early postoperative period because of venous congestion related to inadequate tunneling of the flap. There was no postoperative hematoma or infection. As regard donor site morbidity, no functional deformity, but wound dehiscence occurred in one patient (5.2%) healed by local wound care and secondary sutures. Because of the thinness of the flap, no defatting procedure had to be performed and the subjective aesthetic result, according to the patients, was satisfactory. No recurrence of ulceration was noticed during follow-up.

Conclusion: The inferiorly based hemigastrocnemius muscle flap based on the vascular bundles between the two heads can be useful for reconstruction of the middle third of the leg. It is a simple technique allowing rapid, durable and reliable coverage of these defects without sacrificing a nerve or a major vessel to the foot. No donor site morbidity as functional deformity, with primary closure of donor site.

INTRODUCTION

One of the most challenging areas in plastic and reconstructive surgery is closure of soft tissue defects of the middle third leg. Traumatic wounds, burns, or tibial fractures in the lower leg frequently expose the bone because of the thinness and small quantity of local tissue available for reconstruction. The poor vascularization and subsequent poor healing encountered in this region often lead to

prolonged exposure of bone or tendons, resulting in infection or necrosis [1].

Methods for coverage have evolved from simple relaxing-calf incision, local random flaps and cross-leg pedicle flaps to local muscle flaps, fasciocutaneous flaps and microvascular free flaps. The choice of flap in lower extremity reconstruction is determined by the location of the defect, the size of the defect, donor site morbidity, and the status of the recipient vessel. Many techniques are available for leg reconstruction but each technique has its inherent limitations and costs. These techniques include the neurocutaneous sural flap, the distally based lesser saphenous venofasciocutaneous flap, the anterior tibialis flap, distally based sural fasciocutaneous cross-leg flap, the medial adiposofascial flap, the soleus flap and the free flaps.

The inferiorly based hemigastrocnemius muscle flap can be useful for reconstruction of the middle third of the leg. The arterial communication between the gastrocnemius muscle heads has been reported in the literature [2]. However, little has been mentioned in further detail. Although Bashir reported 3 or 4 vessels between the gastrocnemius muscle heads [5], Tsetsonis et al., revealed a mean number of 5.8 [3]. The majority of these arterial communication is arranged in bundles, although isolated, single ones are not infrequent. The bundles consisted of arterioles and, concomitant venules as well. Regarding arterial cross supply, it is clearly evident that each head can be vascularized solely from the contralateral one, mostly through these bundles. However, even if only part of the bundles is preserved intact vasculature is not affected.

Not only does arterial cross-supply between the heads exist, but maintenance of arterial vasculature from one head to the other can be expected as well. Furthermore, even if some of these vessels are blocked, the vasculature is still maintained [3]. Mathes and Nahai, after having made a rough mention to the anastomotic vessels, proposed the

use of an inferiorly based flap [4]. The main clinical application that could be suggested is an inferiorly based hemigastrocnemius muscle flap for defects of the middle third of the leg. The vascular basis of this flap is the vessels across the distal half of the raphe between the muscle heads. Indications are restricted to defects of the middle third of the tibia. The first reported inferiorly based flap was supplied from the lower bundle alone [5]. Although Bashir reported three successful cases, the reliability of the pedicle of such a flap needs to be further investigated [6]. This may be a reliable alternative for lower leg defects, especially when other flaps are not available i.e., when local fascial flaps cannot be used and free flaps are not indicated [7].

The aim of this study is evaluation of coverage of middle third defects of the leg by using the inferiorly based hemigastrocnemius muscle flap.

PATIENTS AND METHODS

This study performed in the Plastic, Reconstructive and Burn Unit, Menoufiya University Hospital has included 19 patients 13 males (68%) and 6 females (32%) during the period from 2002 until 2004. All patients were presented with post-traumatic mid third leg defects with exposed tibia. Their ages ranged from 10 to 58 years (mean: 34). The inferiorly based hemigastrocnemius muscle flap was used in all patients. Follow-up ranged from 6 months to 2 years.

Surgical technique:

All nonviable and poorly vascularized tissue should be aggressively débrided. An incision is made along the upper part of the calf carried down to the deep fascia. Then the muscle is dissected and separated from the underlying soleus and other

muscles. The neurovascular pedicle from the popliteal artery and vein and the tibial nerve is carefully dissected and divided. Then the muscle origin from the femoral condyle and capsule of the knee joint is detached. The two bellies are separated from each other and the vascular bundles between them are divided and ligated except the lower bundles which supply the muscle flap. Then tunnel of the skin bridge between the flap and the ulcer is made. Then the flap is passed through this tunnel to be insetted in the recipient site after making sure that there is no tension on the pedicle. Suction drain is inserted at the donor site for 3 days. Then the hemigastrocnemius muscle flap is covered with a thin split thickness skin graft. Results were recorded and discussed.

RESULTS

This study has included 19 patients 13 males (70.6%) and 6 females (29.4%) presented with post-traumatic mid third leg defects with exposed tibia. All defects were reconstructed by an inferiorly based hemigastrocnemius muscle flap. Follow-up period ranged from 6 months to 2 years. Partial flap loss occurred in 2 patients (10.5%). One flap (5.2%) was lost in the early postoperative period because of venous congestion related to inadequate tunneling of the flap. There was no postoperative hematoma or infection. As regard donor site morbidity, no functional deformity, but wound dehiscence occurred in one patient (5.2%) healed by local wound care and secondary sutures. Because of the thinness of the flap, no defatting procedure had to be performed and the subjective aesthetic result, according to the patients, was satisfactory. No recurrence of ulceration was noticed during follow-up. Representative clinical cases are shown in Figs. (A,1-10 & B,1-6).

Table (1): Patients data and complications.

Patient	Sex & age	Side	Partial loss	Complete loss	Function morbidity	Infection	Haematoma	Dehiscence
1	Male-10 ys	LT.	NO	NO	NO	NO	NO	NO
2	Male-18	LT.	NO	NO	NO	NO	NO	NO
3	Female-16	LT.	NO	NO	NO	NO	NO	NO
4	Male-58	RT.	YES	NO	NO	NO	NO	NO
5	Male-46	LT.	NO	NO	NO	NO	NO	NO
6	Male-36	RT.	NO	NO	NO	NO	NO	NO
7	Female-54	RT.	NO	NO	NO	NO	NO	YES
8	Male-35	LT.	NO	NO	NO	NO	NO	NO
9	Male-30	LT.	NO	NO	NO	NO	NO	NO
10	Female-24	RT.	YES	NO	NO	NO	NO	NO
11	Female-21	LT.	NO	NO	NO	NO	NO	NO
12	Male-52	LT.	NO	YES	NO	NO	NO	NO
13	Male-25	RT.	NO	NO	NO	NO	NO	NO
14	Female-23	RT.	NO	NO	NO	NO	NO	NO
15	Male-49	RT.	NO	NO	NO	NO	NO	NO
16	Male-19	LT.	NO	NO	NO	NO	NO	NO
17	Female-29	LT.	NO	NO	NO	NO	NO	NO
18	Male-38	RT.	NO	NO	NO	NO	NO	NO
19	Male-28	LT.	NO	NO	NO	NO	NO	NO



Fig. (A,1): Post-traumatic leg ulcer.



Fig. (A,2): Sural nerve and the two heads.



Fig. (A,3): Detachment of muscle origin.

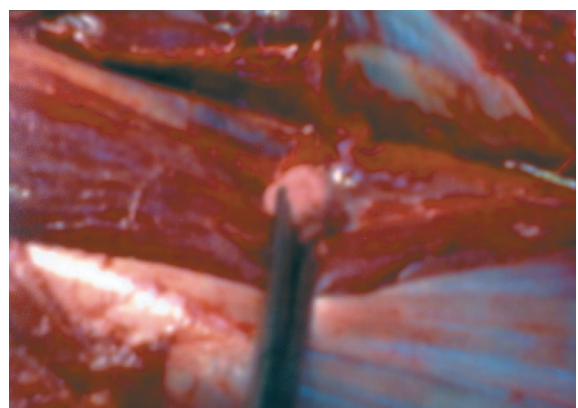


Fig. (A,4): Bundles between the two heads.



Fig. (A,5): Harvesting of the flap.



Fig. (A,6): Passing the flap through tunnel.



Fig. (A,7): Insetting of the flap.



Fig. (A,8): Skin graft on the flap.



Fig. (A,9): Three months postoperative.



Fig. (A,10): One year postoperative.



Fig. (B,1): Post-traumatic leg ulcer.



Fig. (B,2): Insetting of the flap.



Fig. (B,3): Covering of the muscle by graft.



Fig. (B,4): One month postoperative.



Fig. (B,5): Two months postoperative.



Fig. (B,6): One year postoperative.

DISCUSSION

Finding an appropriate soft-tissue grafting material without functional deformity and donor site morbidity to reconstruct lower extremity defects can be a difficult task because of the lack of intervening muscle between the skeletal elements and the skin, and the limited mobility of the overlying skin [8].

Although microsurgical procedures provide excellent results in the head and neck region, the success rate is usually lower in the lower limbs, especially in infected cases [9]. Although the free flap covers the defect successfully in a one-stage operation, it requires a long operative time; experienced, skillful technique; and patent vascular status of the recipient site. Free flap transfer to the lower limb in chronic post-traumatic conditions is known to have a higher complication rate with flap loss in up to 10% of cases, mainly due to the recipient vessel [10]. The dissection of these vessels often leads to refractory spasm, due to the so-called post-traumatic vessel disease (PTVD) [11].

Despite recent advances in microsurgical techniques, leading to major improvements in the quality of lower limb reconstruction, coverage of lower leg defects by locoregional flaps remains indicated in selected cases. A local random-pattern skin flap has an indistinct perfusion pattern and is limited in size. The disadvantages of muscle flaps is that it may lead to functional deformity and donor site morbidity [12]. Defects of the middle third of the tibia can be covered with the soleus flap [13]. But the defect will be covered by the least vascularized part of the flap, the volume of the flap is often too small to fill the defect, and there is often an unacceptable donor-site scar.

Fascial and fasciocutaneous flaps can provide an excellent alternative for coverage of defects, even when bone has to be covered [1]. The medial adiposofascial flap based on the vascular network supplied by the saphenous artery and the posterior tibial artery perforators can be harvested on the anteromedial aspect of the leg and can be mobilized to cover defects located between the patella and the heel [14]. But it causes a relative hyposthesia at the donor site.

The cross-leg flap has the disadvantage of long-term immobilization and several operative stages [15].

Because of the importance of vascular "economy" in lower limb reconstruction, perforator pedicled flaps provide an excellent solution, because

all these flaps spare the major vessels of the limb [16]. Reconstruction with neurocutaneous flaps is a versatile alternative to the use of local or distant muscle flaps [17].

The neurocutaneous sural flap is well described for reliable coverage of the lower leg defects without sacrificing a major vessel to the foot, but the major donor deficit of this flap is the loss of sensibility along the lateral aspect of the foot and leaves ugly donor-site scars because of the need for skin grafting [18]. The risk factors, which can potentially impair successful defect coverage using the reversed sural flap and thus contribute to flap complications include concomitant diseases, particularly diabetes mellitus; peripheral arterial disease or venous insufficiency, which increase the risk of flap necrosis five-fold to six-fold; and patient age of over 40 years, because of an increased rate of comorbidity, underlying osteomyelitis, and the use of a tight subcutaneous tunnel [19].

Advantages of distally based sural fasciocutaneous cross-leg flap over the standard cross-leg flap are clearly demonstrated, stressing the extremely comfortable leg positioning and the simplicity of the immobilization made possible by the distal pedicle location [15]. The distally based lesser saphenous venofasciocutaneous flap mobilized from the posterior aspect of the upper leg, used as an island pedicle skin flap, also can be used [20]. The anterior tibialis flap procedure is a useful option for providing soft tissue to cover open tibial injuries in the middle and distal thirds of the tibia. It is limited by the transition of the muscle to the tendon in the distal third of the tibia [21]. The gastrocnemius musculoadipofascial flap based on the fascial plexus and cutaneous perforators of gastrocnemius muscle can be used for soft-tissue reconstruction of wider and longer areas used by the classic gastrocnemius muscle flap [22].

In this study, we have treated 19 cases presented with post-traumatic defect on the middle third of the tibia using an inferiorly based hemigastrocnemius muscle flap. Follow-up period ranged from 6 months to 2 years. Partial flap loss occurred in 2 patients (10.5%). One flap (5.2%) was lost in the early postoperative period because of venous congestion related to inadequate tunneling of the flap. There was no postoperative hematoma or infection. As regard donor site morbidity, no functional deformity, but wound dehiscence occurred in one patient (5.2%) healed by local wound care and secondary sutures. Because of the thinness of the flap, no defatting procedure had to be performed and the subjective aesthetic result, according to

the patients, was satisfactory. No recurrence of ulceration was noticed during follow-up.

Conclusion:

The inferiorly based hemigastrocnemius muscle flap based on the vascular bundles between the two heads can be useful for reconstruction of the middle third of the leg. It is a simple technique allowing rapid, durable and reliable coverage of these defects without sacrificing a nerve or a major vessel to the foot. No donor site morbidity as functional deformity, with primary closure of donor site.

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