Reversed Hemisoleus Flap for Traumatic Wound Coverage in the Distal Third of the Leg

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Abstract

Background: Reconstruction of soft tissue defects of the distal third leg are common challenging therapeutic problems with significant long-term morbidity. Treatment options include cross leg flaps, local flaps (as muscle flaps and fasciocutaneous flaps) and the free vascularized flaps.

Aim of Study: The aim of this study is to evaluate the clinical outcome of reversed hemisoleus muscle flap in coverage of traumatic soft tissue defects in the distal third of the leg.

Patients and Methods: In this prospective study, we present 21 patients with traumatic soft tissue defects in the distal third leg with exposure of bone, tendons and neurovascular structures, managed by reversed medial hemisoleus muscle flap. Clinical and radiological data were analyzed.

Results: The outcome of the flap surgery was evaluated after at least 6 months follow-up on the basis of flap survival, graft intake, functional gain and donor site morbidity [1]. Clinical results were graded as excellent, good, fair as follows: 13 showed excellent results (61.9%), 7 showed good survival (33.3%) and 1 flap was graded as fair (4.8%) with no poor results. The excellent and good results were considered as satisfactory results, while the unsatisfactory included the fair and the poor results. Accordingly, satisfactory results were found in 20 patients (95.2%), and the unsatisfactory results were found in 1 patient (4.8%) with reliable soft-tissue coverage and complete wound healing in all patients.

Conclusion: This study shows that reversed medial hemisoleus muscle flap is a reliable reconstructive option for traumatic soft tissue defects on the medial side of the distal tibia in selected cases.

Key Words: Distal 1/3 tibia – Soleus – Muscle flap.

Introduction

ONE of the most challenging and common areas in reconstruction facing orthopaedic surgeons is the closure of soft tissue defects in the lower extremity. By far the most common etiology for

defects requiring reconstruction is trauma. The most common site for reconstruction of the leg is the distal leg. This area has limited soft tissue for protection of vital structures, tightness, and limited mobility of the skin with by poor circulation. Thus chronic infection following Achilles tendon rupture or trauma surgery often occur leading to exposed bone, tendons, vessels or nerves. Impaired vascular flow also inhibits the healing of small defects which may ultimately result in extensive defects which require free flap coverage [1,2].

Regarding trauma being the most common cause, severe injuries of the lower extremities such as Gustillo type III-B injuries of the distal third leg caused by road traffic accidents, outdoor falls & sports happen more often than before. They have high incidence of infection & non-union. They are usually accompanied by extensive soft tissue damage & leg defects ranging from small to large ones, severe comminuted fractures or bone defects & even vascular injuries adding another difficulty to the limb reconstruction [4,5].

Regarding soft-tissue defects, the optimal timing of the operation, the most suitable type of tissue, and the consideration between a local or free approach still remains under discussion. However, the use of free tissue transfer for soft-tissue coverage of the distal third leg has been the method of choice for this reconstruction. Other options available for reconstruction of such defects. Usually including local muscle flap, fasciocutaneous flap and cross-leg flap [7,8].

The decreasing trend of the usage of microvascular flaps in the acute lower limb trauma is also due to fairly high incidence of failure and the cost of the treatment with significant donor site morbidity. The injured limbs in failed free flap surgeries

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are even more difficult to salvage. These factors justify the usage for free flaps only when the local or regional flaps are not feasible either because of the size or extensive local tissue trauma [9].

The soleus muscle is frequently used as a local muscle flap for the reconstruction of defects of the middle third of the leg, based on its major pedicle. However, the viable use of the hemisoleus muscle in a reverse manner, based on its secondary distal pedicles, has been described by several authors for the reconstruction of defects of the lower third of the leg as an alternative to the microsurgical flaps [10-12].

The aim of this study is to evaluate the results of reversed hemisoleus muscle flap in coverage of traumatic soft tissue defects in the distal third of the leg.

Patients and Methods

A- *Patients:*

This study is prospective study included 21 patients (18 males, 3 females and their ages range from 15 years to 65 years with an average of 33) with traumatic soft tissue defects in the medial side of the distal third leg were treated with reversed medial hemisoleus muscle flap in the Orthopedics and Traumatology Department of Tanta University Hospital between October 2017 and October 2018. The location of the soft-tissue defect was on the right side in 11 patients and on the left side in 10 patients.

Clinical examination:

General examination: Blood pressure, pulse, temperature, respiration and other body systems. Associated injuries was documented.

Local examination: Full local examination including soft tissue evaluation and neurovascular assessment. The extent, dimensions of the defects and exposure of bone or tendons. Photographs were taken. Routine hand held Doppler ultrasound examination Fig. (1) was done in all cases to confirm the patency of distal perforators prior to surgery. Plain X-ray (AP and Lateral views) to rule out associated fractures.
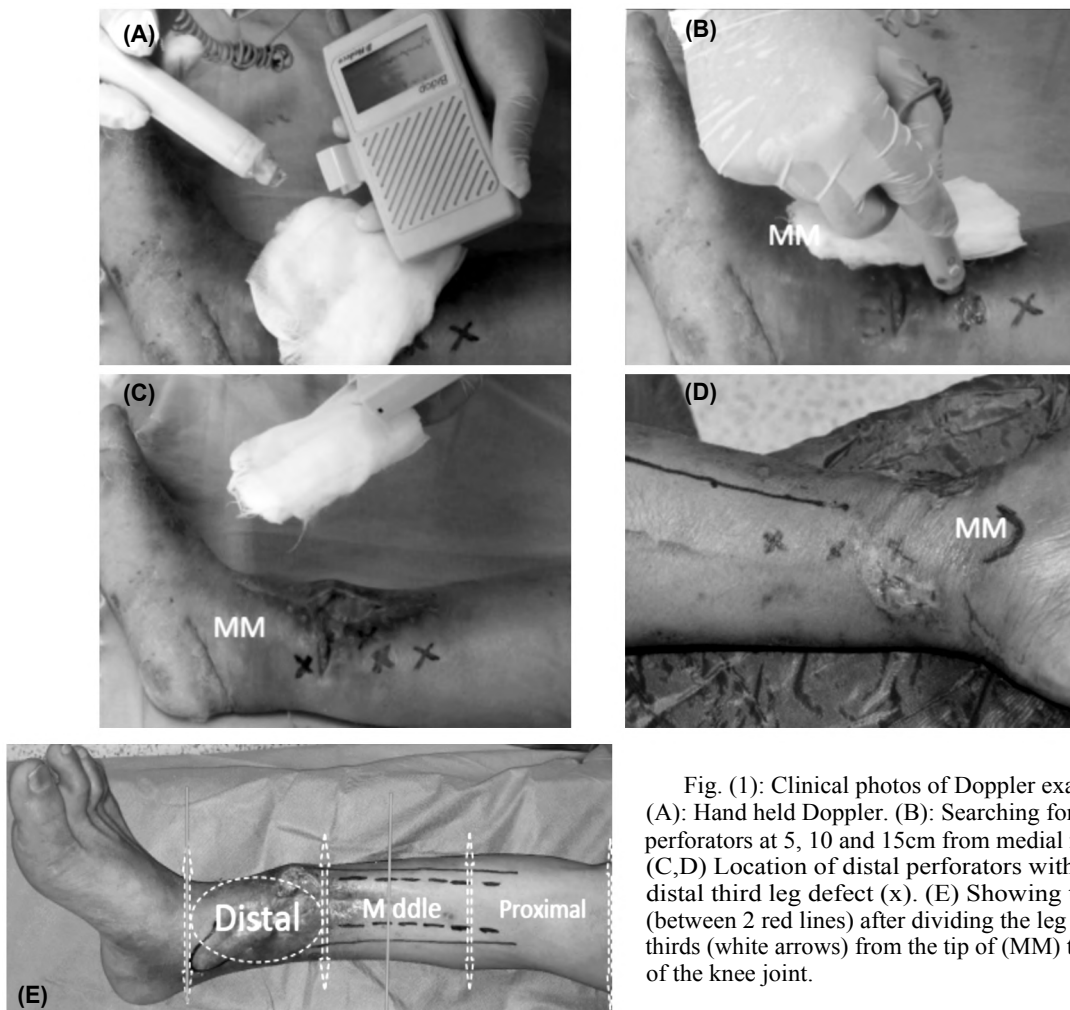

Fig. (1): Clinical photos of Doppler examination. (A): Hand held Doppler. (B): Searching for the distal perforators at 5, 10 and 15cm from medial malleolus. (C,D) Location of distal perforators with a medial distal third leg defect (x). (E) Showing the defect (between 2 red lines) after dividing the leg into equal thirds (white arrows) from the tip of (MM) to the level of the knee joint.

Computed Tomography Angiogram (CTA) was performed before surgery in 6 of our patients (4 diabetics and 2 heavy smokers) who had questionable distal perforators on hand held Doppler examination to assess the permeability of the popliteal vessels, its branches and the major distal perforators from the Posterior Tibial Artery (PTA) to the distal portion of the medial soleus muscle.

The inclusion criteria were patient with distal third leg defects <80cm^2 that cannot be closed directly without tension provided patency of one or more of distal perforators located approximately at 5, 10 and 15cm proximal to Medial Malleolus (MM) confirmed by hand held Doppler examination and/or Computed Tomography Angiogram (CTA) prior definitive soft tissue coverage.

While, the main exclusion criteria were patients with extensive tissue loss (>80cm^2) or wounds at the pedicles site. Previous gastrocnemius or soleus resection in trauma or after tumor removal. Vascular injuries as (Gustilo Anderson type 3C open fracture tibia).

B- *Methods:*

Stabilization of the patients was done, tetanus prophylaxis, and broad-spectrum antibiotics were given in 19 cases who were presented immediately after trauma to our ER Department. Aggressive debridement of non viable tissue was done. Above knee back slap was applied in 19 patients (5 intact tibia and 14 tibial fractures) after the initial debridement. Preliminary external fixation in 1 patient for 3 weeks was done (unstable open fracture Gustilo IIIB with bone defect to avoid further soft tissue injury by the fracture fragments) before definitive skeletal stabilization and flap coverage. Debridement was repeated when tissue viability was uncertain every 48hrs.

When the wound bed was clean, the flap was designed and performed as soon as possible, within the first 10 days following initial injury. The distally based hemisoleus flap was the primary management option for 15 patients (71.4%) within 10 days. However, NPWT was applied for 2-3 weeks pre-operatively for wound care in 6 patients when the flap was performed after 10 days. Timing of definitive soft tissue coverage ranged from [1st] day of trauma to 6 months after the initial trauma with a mean of 16 days.

Spinal anesthesia was used in 16 patients, general anesthesia in 4 patients and spinal epidural was used only in one patient. In case of associated fractures, stabilization of the bone was performed [1st] in supine position, then flap harvest position was chosen depending on the location of the defect either supine or semi-prone position.

A longitudinal skin incision was made under a tourniquet control about 2cm medial to the posteromedial subcutaneous palpable border of the tibia and parallel to it. The length of the incision started proximally from the junction between the proximal & middle one thirds of the leg, and stopped distally 10cm above the medial malleolus.

Caution was taken to identify and retract the greater saphenous vein as well as the saphenous nerve. Once these two structures were identified, dissection was carried down to the investing fascia of the superficial posterior compartment overlying the gastrocnemius muscle.

The soleus muscle was identified proximally deep to the gastrocnemius muscle. Blunt dissection was used to easily separate the more superficial medial gastrocnemius muscle belly from the medial soleus muscle belly, the plantaris runs in the plane between the two muscles. The plane between the two muscles is relatively avascular with the exception of some small perforators which were ligated.

By performing sharp dissection, the medial soleus was separated from its anterior tibial attachments. The muscle was then separated anteriorly from the Flexor Digitorum Longus (FDL). During this dissection, the posterior tibial neurovascular pedicle became visible and was protected between the soleus and (FDL).

The medial hemisoleus muscle flap transected just lateral to median raphe incorporating the raphe, leaving the lateral hemisoleus muscle in situ to preserve motor function.

During distal dissection, as many distal perforators as possible should be preserved while allowing an adequate arc of the flap turnover to cover the exposed tibia or hardware. The proximal part of the medial soleus was transected at the level of the proximal and middle thirds of the muscle.

The tourniquet was deflated and perfect hemostasis was done. Muscle flap viability was checked and non-viable fibers were debrided down to bleeding muscle fibers.

Multiple transverse incisions through the epimysium were done to increase the muscle surface area.

The medial hemisoleus muscle was turned over or transposed into the defect without vessel kinking and inset with absorbable 3-0 vicryl half buried mattress sutures to the periphery of the defect to be overlapped by the undersurface of the normal skin. Muscle tunneling was avoided as this could jeopardize the vascularity of the flap. Direct donor site closure was done using 3-0 vicryl for subcutaneous and 3-0 proline or staples for the skin closure.

Delayed skin grafting was done in all cases to confirm flap survival before skin grafting. Vaseline impregnated gauze dressing with local antibiotic ointment were used to cover the muscle flap. A well-padded posterior plaster splint was applied with care to prevent any compression of the pedicle or the flap.

Average operative time of the cases from incision to skin closure ranged between 55 and 93 minutes for medial hemisoleus muscle harvesting, transposition and fixation to the defect with a mean of 73.6 minutes, and ranged from 15 to 23 minutes for delayed Split Thickness Skin Grafting (STSG) after 5-7 days with a mean of 18.8 minutes. On follow-up visits, which was on 2, 4, 6, 8, and 10 weeks then every other month after the discharge. All patients were followed for at least 6 months post-operatively.

Case presentation:

A 45 years old diabetic and smoker man sustained Gustilo type III B open fracture of the left distal both bones leg caused by a train fall Fig. (2A). He initially underwent debridement of the open tibial fracture wound. After further debridement, a 10 X 7cm tibial wound in the distal third of his leg, with an exposed tibial fracture site NPWT was applied for 3 weeks till optimizing his glycemic control preoperatively (<200mg/dl).

Hand held Doppler examination and CTA confirmed the patency of the distal PTA perforators. The patient was operated 22 days following the initial injury by open reduction through the pre-existing wound after extension and definitive internal fixation using plate and screws with iliac crest bone graft. The wound was covered with reversed medial hemisoleus muscle flap.

The muscle flap was skin grafted one week afterward following immediate debridement of a small distal necrotic portion) and advancement of the flap. The soft tissue and the fracture healed eventually Fig. (2B) with full mobilization and return to the pre-injury level of activity.
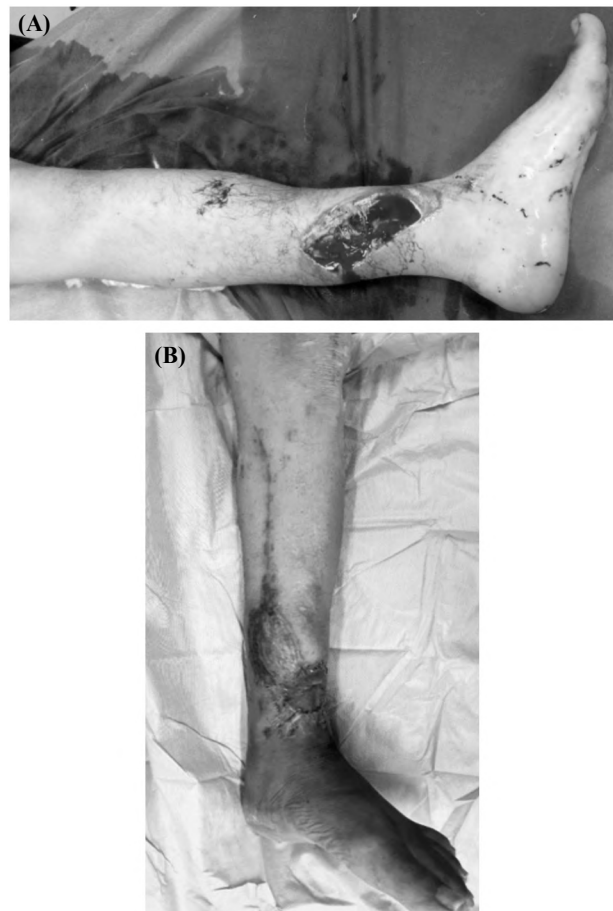

Fig. (2): (A): Showing the traumatized lower extremity on admission with the soft tissue defect over the distal third leg. (B): Complete wound healing with return to pre-injury level of activity.

Results

The outcome of the flap surgery was evaluated according to our modifications of Ahmad I et al., [28] , 1 on the basis of flap survival and graft intake. A grading of excellent depicts no flap loss and survival of the skin grafted over the flap surface, good depicts where there is some loss of skin grafted over the flap or marginal loss of the flap <20% (distal tip necrosis), fair depicts where there is partial flap loss (>20% <50%) and poor depicts where complete loss of the flap or necrosis of more than 50% of the flap.

Of the 21 flaps and at the time of delayed skin grafting (5-7 days after the flap coverage) that was done in all cases to confirm the flap survival before grafting, 15 flaps (71.4%) were fully viable (Table 1), 5 flaps (23.8%) showed insignificant distal tip necrosis (defined as <20% necrosis at the distal part of the flap 5 days after transposition) where debridement and advancement were done before skin grafting with complete healing of the wounds in the follow-up visits.

Table (1): Grading of muscle flap survival and final outcome.

Flap viability	Complete viability	Distal tip necrosis	Partial loss	Total loss	Total cases
No. of patients	15	5	1	0	21
%	71.4	23.8	4.8	0	100
Outcome	Excellent	Good	Fair	Poor	
	Satisfactory		Unsatisfactory		

We witnessed partial flap loss (30% necrosis of the flap) in 1 flap (4.8%) managed with debridement, NPWT and later a skin graft was applied after a course of dressing changes again with complete wound coverage. No cases of total flap necrosis. 13 showed excellent results, 7 showed good survival and 1 flap was graded as fair with no poor results. Twenty cases showed satisfactory outcome with 1 unsatisfactory regarding flap viability Fig. (3) and (Table 2).

Follow-up period ranged from 6 to 9 months with a mean of 6.6 months. The patients were followed-up until the flap provided reliable soft-tissue coverage and complete wound healing in all patients.
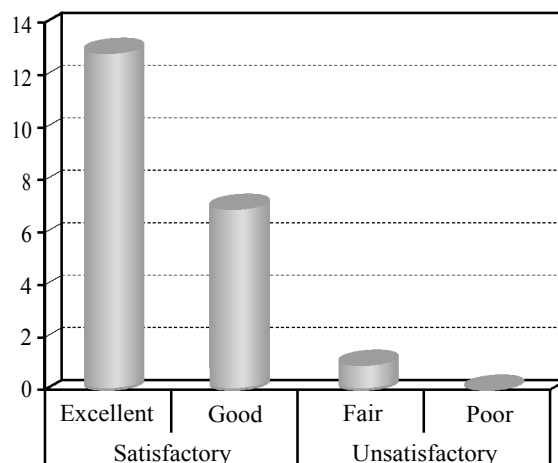

Fig. (3): Satisfactory and unsatisfactory results.

Table (2): Satisfactory and unsatisfactory results.

Satisfactory						Unsatisfactory						Total	
Excellent		Good		Total		Fair		Poor		Total			
No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
13	61.9	7	33.3	20	95.2	1	4.8	0	0	1	4.8	21	100

Table (3): Final results.

Age (ys)/sex	Smoking	Medical Hx	Days before surger	Site of defect	Siz of defect (cm)	Fx & method of Fix	Copmlications	Secondary intevention	Flap outcome	Bony outcome
22/M	NO	NO	1	Junction	9 X 5	Fx/ILNT	NO	Non	Excellent	Healed
36/M	S	NO	8	Dista 1/3	10 X 5	Fx/ILNT	Partial graft loss	Appropriate deressing	Good	Healed
32/M	NO	HTN	1	Dista 1/3	6 X 3	Tension band MM	NO	Non	Excellent	Healed
55/F	NO	NO	5	Junction	8 X 6	Fx/ILNT	NO	Non	Excellent	Healed
29/M	S	NO	4	Dista 1/3	9 X 7	Fx/ILNT	Distal tip necrosis	Debrid. & advancement	Good	Healed
15/M	NO	NO	8	Dista 1/3	6 X 4	NO	NO	Non	Excellent	–
65/F	NO	DM	16	Dista 1/3	10 X 7	Fx/Nancy	Distal tip necrosis	Debrid. & advancement	Good	Healed
33/M	NO	NO	3	Junction	10 X 6	Fx/ILNT	NO	Non	Excellent	Healed
49/M	S	DM	18	Dista 1/3	13 X 6	Fx/ILNT	Partial flap loss	Debrid., NPWT & STSG	Fair	Healed
25/M	NO	NO	6	Junction	10 X 5	Fx/ILNT	NO	Non	Excellent	Healed
18/M	S	NO	5	Dista 1/3	8 X 5	NO	NO	Non	Excellent	–
45/M	S	DM	22	Dista 1/3	10 X 7	ExFix/ORIF + BG	Distal tip necrosis	Debrid. & advancement	Dood	Healed
35/M	NO	NO	4	Junction	7 X 5	NO	NO	Non	Excellent	–
28/M	NO	HTN	7	Junction	8 X 7	Fx/ILNT	NO	Non	Excellent	Healed
21/F	NO	NO	9	Junction	11 X 5	Fx/ILNT	NO	Non	Excellent	Healed
47/M	S	DM	12	Dista 1/3	11 X 6	Fx/ILNT	Distal tip necrosis	Debrid. & advancement	Good	Healed
19/M	NO	NO	5	Junction	9 X 5	NO	NO	Non	Excellent	–
29/M	NO	NO	1	Dista 1/3	9 X 6	Fx/ILNT	NO	Non	Excellent	Healed
23/M	S	NO	13	Dista 1/3	8 X 6	NO	Partial graft loss	Appropriate deressing	Good	–
31/M	NO	NO	8	Junction	9 X 4	Fx/ILNT	NO	Non	Excellent	Healed
40/M	S	NO	180	Junction	9 X 6	ILNT + BG	Distal tip necrosis	Debrid. & advancement	Good	Healed

Discussion

The detailed anatomical knowledge of soleus vascularity assists the application of the hemisoleus muscle as a flap in a rational and predictable reversed manner to cover the soft tissue defects of the distal leg that was designed and suggested by Tobin [13] in 1985.

Over the past 20 years, Pu [14,15] has refined techniques in flap dissection and successfully used this flap for soft-tissue reconstruction with good to excellent outcome and minimal morbidity.

The purpose of our study was to report our results in treatment of traumatic soft tissue defects in the distal third leg with the reversed medial

hemisoleus muscle flap, with emphasis on understanding blood supply to the flap and refinements in flap dissection. The indications and limitations of the flap along with management of flap complications such as distal flap necrosis are also discussed.

The mean age in our study was 33 years old (15 to 65) conforming with the mean age incidence reported in literature by Rabbani et al., [16] with a mean of 30 (12 to 65), Fayman et al., [17] with a mean of 32 (22 to 57), with the mean age of 32 (14 to 65), Pu [14] with a mean age of 35 (12-52), Kauffman et al., [12] with a mean of 38 (18 to 61). However, others reported higher mean age as Sayed [18]with a mean of 46 (28 to 72),Schierle et al., [8] with a mean of 59 (34 to 78), Houdek et al., [19]with a mean of 67 (46 to 81).

Our study showed male predominance involving 18 males and 3 females which reflects that males have higher level of activity and more susceptibility to trauma and this scenario was found to be predominant in literature. However, Houdek et al., [19] reported equal gender distribution in his study.

In this study, 16 defects were associated with tibial fractures, while the remaining 5 defects had no bony fractures, 4 with exposed intact tibia after degloving injuries and 1 defect with exposed Achilles tendon after dehisced repair site. Based on previously mentioned evaluation method, 20 flaps healed satisfactorily (13 excellent and 7 good) with no further intervention and 1 flap with fair outcome that required minimal 2$^{\text{y}}$ procedure for complete healing. Eventually, all flaps healed with a good functional outcome, complete closure of the exposed structures, no dehiscence of the reconstructed area, no infection, complete fractures healing, a progressive return to ambulation at routine follow-up visits with good planter and dorsi-flexion power, and no recurrence of the wound after 6.6 (range 6 to 9) months.

Regarding the flap survival, we experienced 23.8% distal tip necrosis (5 of our 21 patients), which was insignificant and treated with debridement and flap advancement in the same setting of delayed skin grafting. 1 case of partial flap necrosis (30% necrosis of the flap) that required debridement and later on a STSG. No total flap loss was observed in our study.

Our results were nearly similar to Pu [14] who reported 25% distal flap necrosis (in 2 patients) after reversed medial hemisoleus muscle flap for reconstruction ofan open tibial wound ranging 9-

$60cm^2$ in the lower third of the leg in a series included 10 patients.

In a study by Rabbani et al., [16] with defects sizes $<50cm^2$, Primary healing was achieved in 33 cases (86.8%). There was partial necrosis of flap without dehiscence in 3 cases (8.1%) and partial necrosis with dehiscence in 1 case (2.7%). All three cases of partial necrosis without dehiscence healed by secondary intension satisfactorily. There was no total loss of the flap in the study. All patients, ultimately, achieved wound coverage with good cosmesis due to lesser bulk of the muscle. Patients with history of poly trauma, high velocity injuries and diabetes mellitus were excluded.

Our results were inferior to those encountered in a series by Schierle et al., [8] , the outcomes of 17 patients undergoing distally based medial hemisoleus flaps were successful in using this flap for soft tissue coverage measuring $<50cm^2$ in the distal leg in 16 patients with the only complication involving a small area of distal tip necrosis present in 1 patient (6%).

Houdek et al., [19] achieved successful coverage in 9 of 10 patients withreversed medial hemisoleus flaps for coverage of distal third leg wounds with soft tissue defect ranging 8-45cm^2, with distal tip necrosis occurring in 1 patient (10%).

Our relatively higher incidence of distal tip of flap necrosis than Schierle et al., [8] and Houdek et al., [19] could be attributed to higher risk factors in the 5 cases of distal tip necrosis, 4 of them being smokers, 3 of them being diabetics and all of them with defects $>60cm^2$ (up to 78 cm^2) and our greater number of cases (21 cases). Besides, the previous studies didn't comment on smoking and DM as major risk factors in flap survival. Schierle et al., [8] described the benefits of adhering to principles of angiosomes when designing a muscle flap. By capturing one full angiosome in their flap design, the patients in the study had successful outcomes with a healed wound.

Regarding graft intake, 2 flaps in our study (9.5%), also being smokers, showed partial graft loss (<50% graft loss) which healed satisfactorily by dressing. Our results was higher than Houdek et al., [19] who did immediate skin grafting in the same flap inset and experienced graft loss in 4 flaps (19%) requiring repeated skin grafting. Pu [14] and Schierle et al., [8] experienced 1 case of partial skin graft loss (6%) treated with regrafting.

Regarding the site of the defects, all the defects managed in our series were located on the medial

side of the distal third of the leg. This reflects that the medial defects are more common than the lateral ones in agreement with the literature, owing to the limited soft tissue for protection and coverage of vital structures including bone, tendons, and neurovascular structure, tightness, and limited mobility of the skin over the tibia with poor circulation [20-24].

Though Karbalaeikhani et al., [25] could not prove the ability of the reverse hemisoleus flap to cover soft tissue defects in the distal third of the leg, he believed that free flaps must not be viewed as the first choice. Free-flap coverage has many disadvantages and is not possible at times, so many surgeons still prefer local flaps, and in case of their failure the free flap will be a good choice [26,27].

To compare our findings with those in literature regarding the effect of time lag on successful outcome of medial hemisoleus flap, Houdek et al., [19] reported the mean time between the initial injury and the flap coverage was 35 days (range 2-248) with no mention of its influence on the outcome. Other studies of medial hemisoleus flap didn't report the period of time from initial trauma till flap coverage.

In a study done by Ahmad I et al., [28] on 42 patients with defects at lower third of leg, covered by distally based posterior tibial artery perforator flap. All the flaps survived and were taken up well except for 1 patient (2.4%) who experienced complete flap loss. Minor complications were noted in four other patients (9.5%). 1 patient developed superficial epidermolysis, 1 developed post-operative venous congestion, which subsided within 3 days by conservative means, and in 2 patients, partial loss of the skin graft occurred at the donor site. The patient who developed complete flap loss required a cross-leg flap.

We found that our results were comparable with the previous study as a local flap with no need for microvascular anastomosis, but again with no complete flap failure. An advantage of using fasciocutaneous perforator flaps over our muscle flap is that the lost tissue is replaced with like, using only the elements that are required for wound coverage, namely, the skin and subcutaneous tissue. This allows for precision in contour and color match. However, compared with fasicocutaneous flaps, the hemisoleus as a muscle flap provides a better supply for improved fracture healing when orthopedic trauma is present, treatment of infection and an obliteration effect because of their bulky tissue [8,27,29].

Conclusion:

Reversed medial hemisoleus muscle flap represents a good alternative to the free flaps in the setting of traumatic injuries, Gustilo IIIB open tibial fracture and wound dehiscence in the distal third leg when other local reconstructive procedures are not possible. The favorable results reported in the literature, as well as the results of our work for lower limb reconstruction, are encouraging and showed good functional gain following this technique.

Conflicts of interest:

No conflicts of interest declared.

Authors' contributions:

All authors had equal role in design, work, statistical analysis and manuscript writing. All authors have approved the final article work.

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إعادة بناء الأنسجة الرخوة المفقودة
نتيجة للصدمات الثلث السفلى من الساق

إعادة بناء الأنسجة الرخوة المفقودة نتيجة للصدمات الثلث السفلى من الساق مع إنكشاف العظام والأوتار والأعصاب والأوعية الدموية والشرائح والمسامير المثبتة للكسور هى من المشاكل العلاجية الصعبة مع الإعتلال الكبير على المدى الطويل، وذلك بسبب الوضع السطحى للجزء الأمامى الأنسى من عظمة القصبة تحت الجلد مباشرة وقلة الغطاء من الأنسجة الرخوة. ومن الملاحظ إزدياد حدوث الإصابات الشديدة فى الأطراف السفلية مثل إصابات غوستيلو من النوع الثالث (ب) فى الثلث السفلى للساق والتى يصاحبها أضرار واسعة مثل فقدان الجلد، التفتت فى العظام، أو فقدان أجزاء منها أو إصابة الأوعية الدموية والأعصاب التى تضيف صعوبات لإعادة بناء الطرف.

أعتبر نقل الأنسجة الحرة الميكروسكوبية الحل العلاجى المتعارف عليه لعيوب الأنسجة الرخوة فى الثلث السفلى من الساق، ومع ذلك تتوفر بعض السدائل المحيطة ذات الإمداد الدموى القريب مع الحد من إعتلال الجزء المانح للسديلة والعجز الوظيفى المحدود مقارنة بنقل الأنسجة الحرة. يتم تغذية الثلث البعيد من العضلة السولية (النعلية) عن طريق شرايين دقيقة متفرعة من الشريان القصبى الخلفى. بناء على هذه الشرايين الدقيقة ذات القطر المناسب، يمكن إستخدام العضلة السولية بطريقة عكسية لتغطية فقدان الأنسجة الرخوة فى الثلث السفلى من الساق.