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Latissimus dorsi muscle free flap for management of large complex wound

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Abstract

Background and objective: Dealing with a large complex wound is very challenging, and latissimus dorsi flap through history has been used as its very variable and flexible in the form of pedicle or free flap in the coverage of those large complex wounds as its large, well perfused, and flexible in configuration. The study aimed to evaluate the versatility of use and viability of latissimus dorsi free flap for coverage of large complex wounds in different parts of the body.

Methods: A retrospective study was conducted from 2012 to 2019 in Erbil Rizgary teaching hospital, Rozhawa emergency hospital, and PAR private hospital, Kurdistan region, Iraq on 22 cases, (20) male (90.9%), and (2) female (9.1%), all with a large complex wound in different sites of the body that latissimus dorsi free flap in the form of myocutaneous mainly and only one with muscle free flap.

Results: The complex large wounds ranged from (22*15 cm – 35*20 cm) indifferent sites of the body, (18) from the lower limb,(3) from the forearm and (1) from the scalp, from those 22 cases, we had 17 cases that survived totally(77.2%), and 5 failure cases (22.7%) those were from leg who associated with tibial bone fracture gestilo type 111B and C and large soft tissue defect with or without vascular injury, and in regard to flaps out of 22 cases 5 of them presented with total necrosis (55.6%), one case with partial necrosis (11.1%), and 3 cases with partial skin graft loss (33.33%), that managed conservatively, in all cases donor site closed primarily with few morbidities as happened in 5 cases (22.7%) like bleeding in 3 cases (60.0%) and stoppage needed operation theater, one case (20.0%) with seroma, and one with minor wound dehiscent (20.0%), that both managed conservatively.

Conclusion: The latissimus dorsi myocutaneous free flap is the reliable, flexible and highly recommended for large soft tissue defect reconstruction in different sites of the body especially those associated with extensive bone damage.

Keywords: Latissimus dorsi free flap; Soft tissue lost; Osteomyelitis; Reconstruction.

Introduction

Even an expert reconstructive microsurgeon dealing with complex large wound put them in a conflict in deciding the way of management, as there will be tissue loss and exposure of underneath vital structures like vessels, nerves, muscle, tendons, and bone, and there are many ways that can be used in treating those extensive soft tissue defects by raising single or variable flaps with different integration and composition.[1,2] although, the microsurgical techniques carry a greater result but they are very challenging procedures in regard to technique and donor site morbidity.[1] Throughout history in 1906 the latissimus dorsi myocutaneous flap been mentioned by Tanzini,[1] and the fact that the latissimus dorsi muscle flap is large, well perfused and flexible that can

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be used as pedicle or free flap for large soft tissue defects throughout the body,[1,3-5] also for restoration of the function especially in the upper and lower extremity, without significant effect to the donor site.[3]
The study aimed to evaluate the versatility of use and viability of the latissimus dorsi free flap for reconstruction of a large complex wound, and to our knowledge, this research has not been done in Kurdistan region government.

Methods

The design of the study was a retrospective study conducted from 2012 to 2019 Rizgary teaching hospital, Rozhawa emergency hospital, and PAR private hospital in Erbil, Kurdistan region, Iraq, twenty-two patients underwent surgery. Their mean age (SD) was 23.8 (15.5) years, the median was 23.5 years, and the age range was 4-67 years. It is evident in Table 1 that the largest proportion (36.4%) of the patients were in the age category of 30-39 years, and seven patients (31.8%) were in the age category of 10-19 years. The table shows also that the majority of the patients (90.9%) were males (Table 1), and that all of them were complaining of large soft tissue defects and or exposure of vital structures that all of them preoperatively assessed and prepared regarding the site, size, arterial injury and investigation in need, and exclusion of all small to medium-sized complicated and non-complicated wound done as they can be managed by other options.

Surgical procedures:

Before any procedures the detailed information provided to all patients and informed consent obtained from them.
The procedure proceeded under general anesthesia, with one team of plastic surgeons and orthopedic surgeons for those cases associated with fracture, although, the bone fixation may be held in previous operations.
The operation started by marking and designing the donor site and before harvesting the flap the recipient site debridement is done with the preparation of the vessels that the flap pedicle to be anastomosed with and those are anterior tibial artery and vein in 14 cases, posterior tibial artery and vein in 3 cases and the radial artery and its concomitant vein prepared in the 3 cases of the upper limb and in the case of the scalp the superficial temporal artery and vein been prepared.
Then the flap was raised as the myocutaneous flap in all except one as the muscle flap, all based on the thoracodorsal artery and vein.
Then flap is transferred to the recipient site and vessels are anastomosed as end-to-end anastomosis, only in three cases with

Table 1 Age and gender of the studied sample

	No.	(%)
Age (years)		
< 9	3	(13.6)
10-19	7	(31.8)
20-29	2	(9.1)
30-39	8	(36.4)
≥ 40	2	(9.1)
Mean (SD)	**23.8**	**(15.5)**
Gender		
Female	2	(9.1)
Male	20	(90.9)
Total	22	(100.0)

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end-to-side anastomosis.

Then the skin closed and in most of them, the thick split skin graft was used immediately or after few days to cover the muscle then dressing was done and leaving a window for the follow-up.

The donor site of all the cases was sutured primarily and the drain left in for 1 to 2 weeks.

Post-operative care:

After operation, the patients were transferred to the high dependable units, and kept on optimal blood pressure and close follow-up of the flap, and room temperature optimized, patient was put in full rest without ambulation of operated part with slight elevation. All the patients received antiplatelet tab (Aspirin) and anticoagulant (low molecular weight heparin or unfractionated heparin) in the form of infusion or subcutaneously given in addition to antibiotics and painkillers.

They were discharged from the hospital around (7-10) days post-operatively on well -equipped instructions, medications, and follow-up visits that started from the first week up to three months to three years.

Statistical analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS, version 25). Fisher's exact test was used (instead of the Chi square test) when the expected frequency (value) was less than 5 of more than 20% of the cells of the table. A *P* value of ≤ 0.05 was considered as statistically significant.

Results

In a total of 22 cases that included in our study, the leg was affected in more than half (54.5%) of the patients, then comes the forearm (13.6%), the foot (13.6%), the foot and ankle (13.6%), and the scalp (4.5%). The injured area (bare area) constituted 40-59% of the affected part in 50% of the patients. The cause was road traffic accident in 80.8% of the patients. Twelve patients had a fractured bone, mainly the tibia (50%). The recipient vessel was the ATA in 68.2% of the cases. Regarding the type of the flap, it was myo-cutaneous in the majority (95.5%) of the cases (Table 2).

Five donors (22.7%) developed complications at the donation site, mainly bleeding (60% of the complications), while 9 (40.9%) recipients developed complications, mainly total necrosis (56.6%). Regarding the flap outcome, it was successful in the majority (77.3%) of cases, as presented in Table 3.

It is evident in Table 4 that there was no significant association between the outcome (success/failure) with age (*P* = 0.933), gender (*P* = 1.000), and site (*P* = 0.538), but it is worth to mention that all the failure occurred in the leg, and the failure rate was 41.7% in the leg.

No significant associations were detected with flap surface area (*P* = 0.518), cause (*P* = 1.000), and type of flap (*P* = 1.000) as presented in Table 4.

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Table 2 Injury and operation details

	No.	(%)
Site		
Forearm	3	(13.6)
Leg	12	(54.5)
Foot	3	(13.6)
Scalp	1	(4.5)
Foot and ankle	3	(13.6)
Surface area of the flap*		
40-59 %	11	(50.0)
60-79 %	7	(31.8)
≥ 80 %	4	(18.2)
Cause		
Road traffic accident	18	(81.8)
Osteomyelitis	2	(9.1)
Explosion	2	(9.1)
Fractured bone (n = 12)		
Radius	2	(16.7)
Tibia	6	(50.0)
Tarsal and metatarsal	2	(16.7)
Tibia and femur	1	(8.3)
Parietal bone	1	(8.3)
Recipient vessel		
Radial artery	3	(13.6)
PTA	3	(13.6)
ATA	15	(68.2)
STA	1	(4.5)
Type of flap		
Myo-cutaneous	21	(95.5)
Muscle flap	1	(4.5)
Total	22	(100.0)

*Percentage of the affected part.

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Table 3 Flaps' complications and outcome

	No.	(%)
Donors' site complications		
Yes	5	(22.7)
No	17	(77.3)
Types of donors' complications (n = 5)		
Bleeding	3	(60.0)
Seroma	1	(20.0)
Wound dehiscence	1	(20.0)
Recipients' complications		
Yes	9	(40.9)
No	13	(59.1)
Types of recipients' complications (n = 9)		
Total necrosis	5	(55.6)
Partial necrosis	1	(11.1)
Partial skin graft loss	3	(33.3)
Flap outcome		
Success	17	(77.3)
Failure	5	(22.7)
Total	22	(100.0)

Table 4 Factors associated with the flap outcome.

	N	Success No. (%)	Failure No. (%)	*P value*
Age				
< 9	3	3 (100.0)	0 (0.0)	
10-19	7	5 (71.4)	2 (28.6)	
20-29	2	2 (100.0)	0 (0.0)	
30-39	8	6 (75.0)	2 (25.0)	
≥ 40	2	1 (50.0)	1 (50.0)	0.933*
Gender				
Female	2	2 (100.0)	0 (0.0)	
Male	20	15 (75.0)	5 (25.0)	1.000*
Site				
Forearm	3	3 (100.0)	0 (0.0)	
Leg	12	7 (58.3)	5 (41.7)	
Foot	3	3 (100.0)	0 (0.0)	
Scalp	1	1 (100.0)	0 (0.0)	
Foot and ankle	3	3 (100.0)	0 (0.0)	0.538*
Flap surface area				
40-59 %	11	9 (81.8)	2 (18.2)	
60-79 %	7	6 (85.7)	1 (14.3)	
≥ 80 %	4	2 (50.0)	2 (50.0)	0.518*
Cause				
RTA	18	13 (72.2)	5 (27.8)	
Osteomyelitis	2	2 (100.0)	0 (0.0)	
Explosion	2	2 (100.0)	0 (0.0)	1.000*
Type of flap				
Myo-cutaneous	21	16 (76.2)	5 (23.8)	
Muscle flap	1	1 (100.0)	0 (0.0)	1.000*
Total	22	17 (77.3)	5 (22.7)	

*By Fisher's exact test

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Case no.3

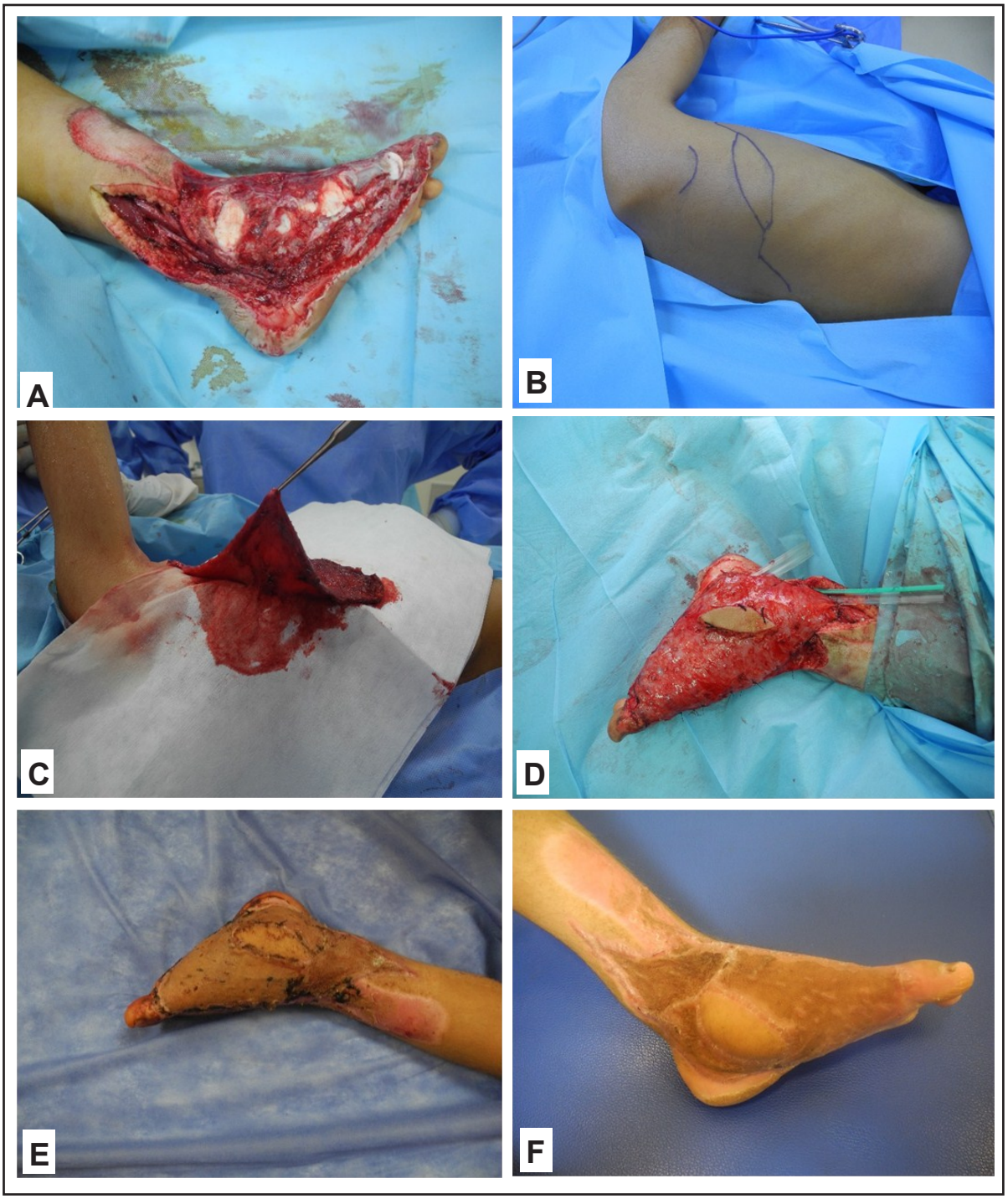

Figure 1 A 4 years old boy victim of road traffic accident with extensive wound (17*22) cm at the dorsum of foot and ankle. **A**, A defect in the medial and dorsal aspect of left foot with exposed tarsal and metatarsal bones. **B,** Marking for latissimus dorsi free flap with skin paddle. **C**, the flap harvested but pedicle not divided. **D**, Inset of the flap to the defect. **E** and **F,** Result after three weeks and three months from follow up.

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Case no.19

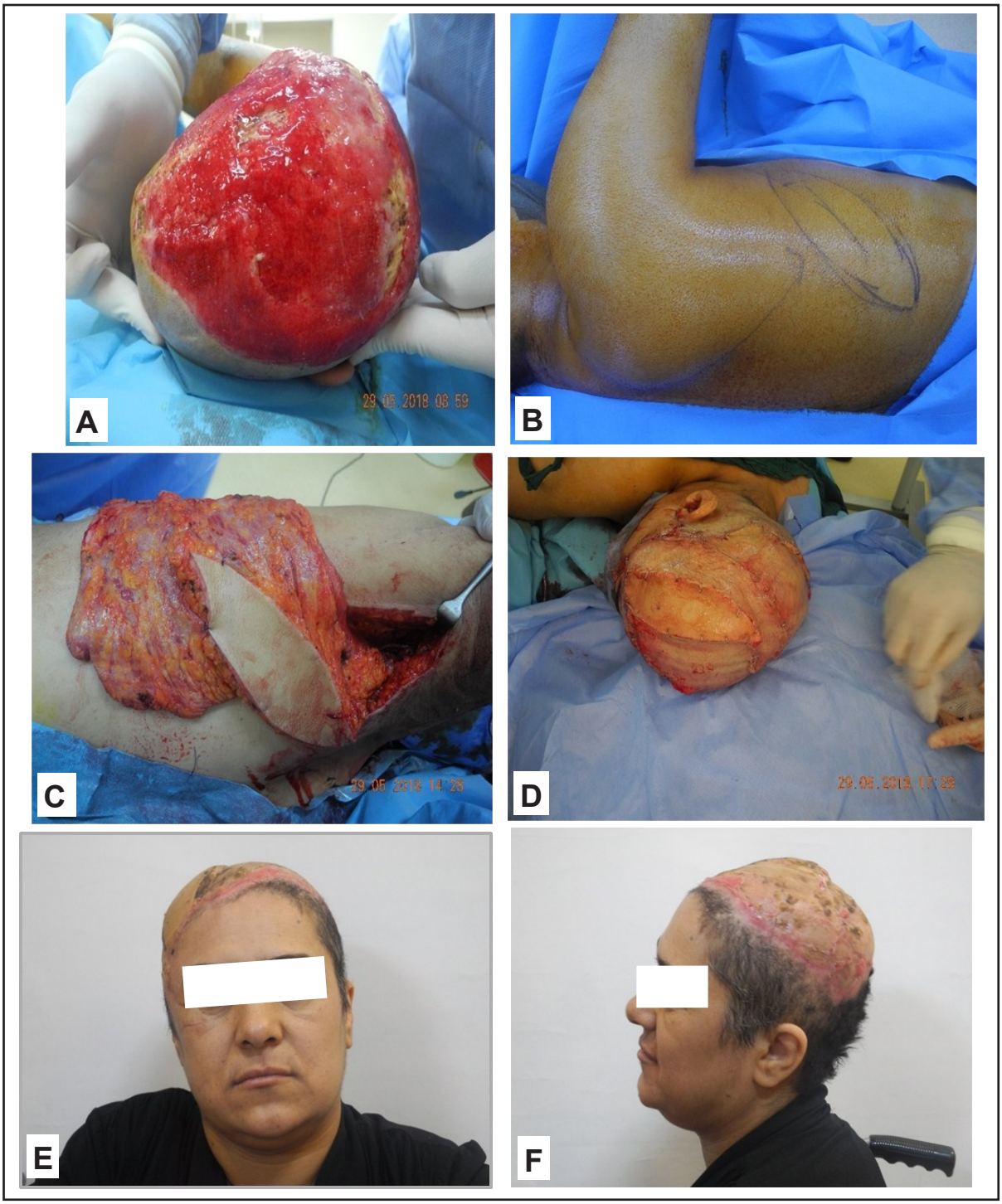

Figure 2 A 39 years old lady with history of scalp avulsion in a road traffic accident that about more than half of her scalp was lost (35*20) cm and bone were exposed plus loss of bone of about (5*5) cm and dura were exposed. **A,** Defect on the scalp that showing exposure of the bone and dura in-between granulation tissue. **B,** Marking for free latissimus dorsi flap with skin paddle. **C,** Harvested flap before pedicle division. **D,** Inset of flap with immediately skin grafting. **E** & **F,** follow up result of the patient after two months.

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Case no.6

Figure 3 A 35 years old male again victim of RTA with extensive injury to his right forearm and dorsal hand about (35*20) that led to big defect with all extensor muscle loss **A,** large defect in the dorsum of right forearm with exposed muscle and tendons. **B,** Marking for free latissimus dorsi flap with skin paddle. **C,** Latissimus dori flap before pedicle division. **D,** Inset of flap to the defect site. **E,** Follow up after three weeks from operation. **F,** Second operation for tendon transfer to the extensors of forearm. **G** and **H,** Follow up after three years showed hand and wrist regained complete extension.

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Case no.14

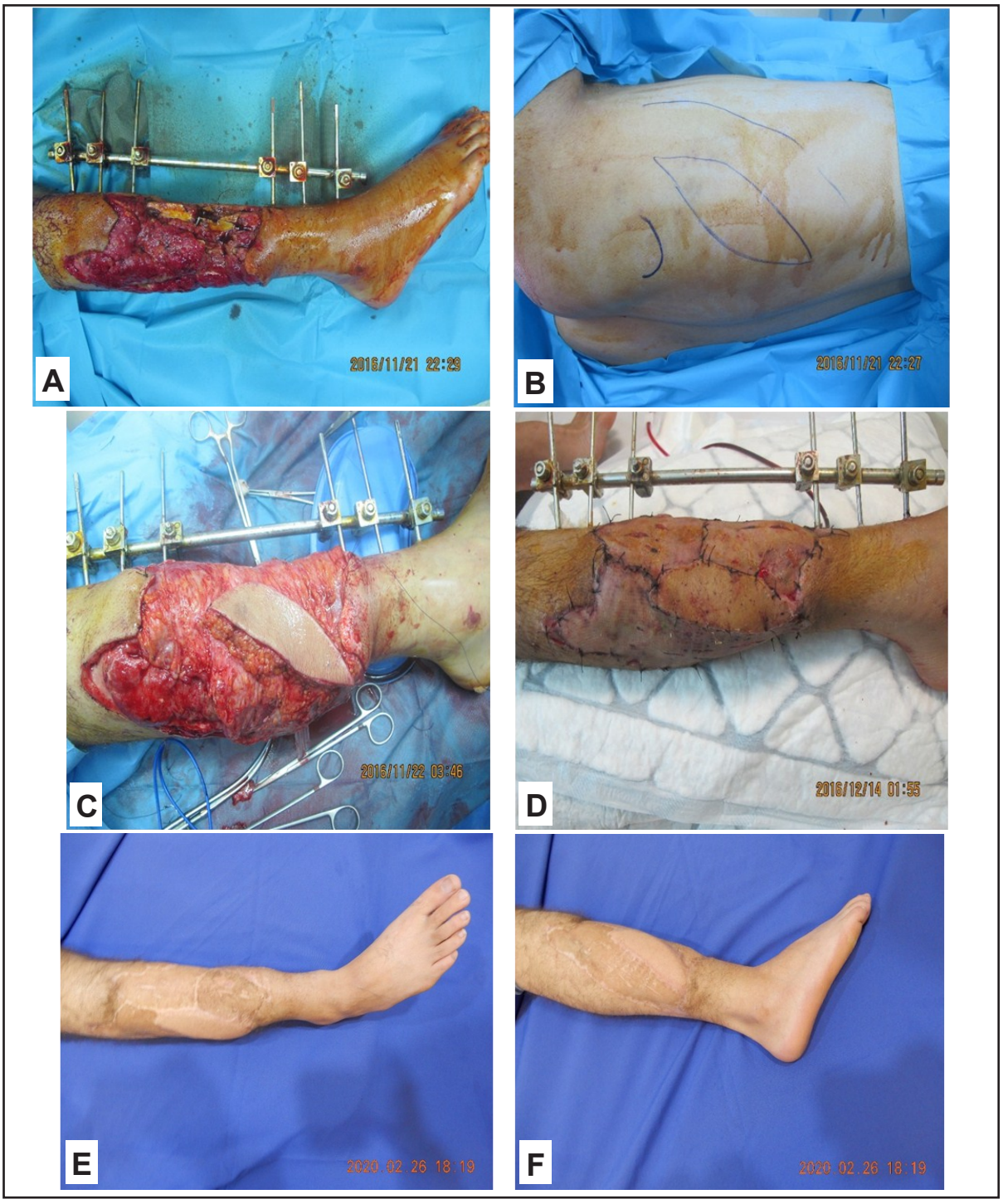

Figure 4 A 35 years old man victim of RTA with extensive soft tissue loss about (22*15) and fractured tibia and fibula at mid-anterolateral aspect of right leg that led to exposure of the bone **A,** Large defect on the mid-anterolateral aspect of leg with exposed muscles tendons and bones that fixed by external fixator. **B,** Marking of free latissimus dorsi flap with skin paddle. **C,** Inset of the flap to the defect. **D,** On third week follow up with flap and skin graft. **E and F,** The result after one-year post operation.

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Case no.14

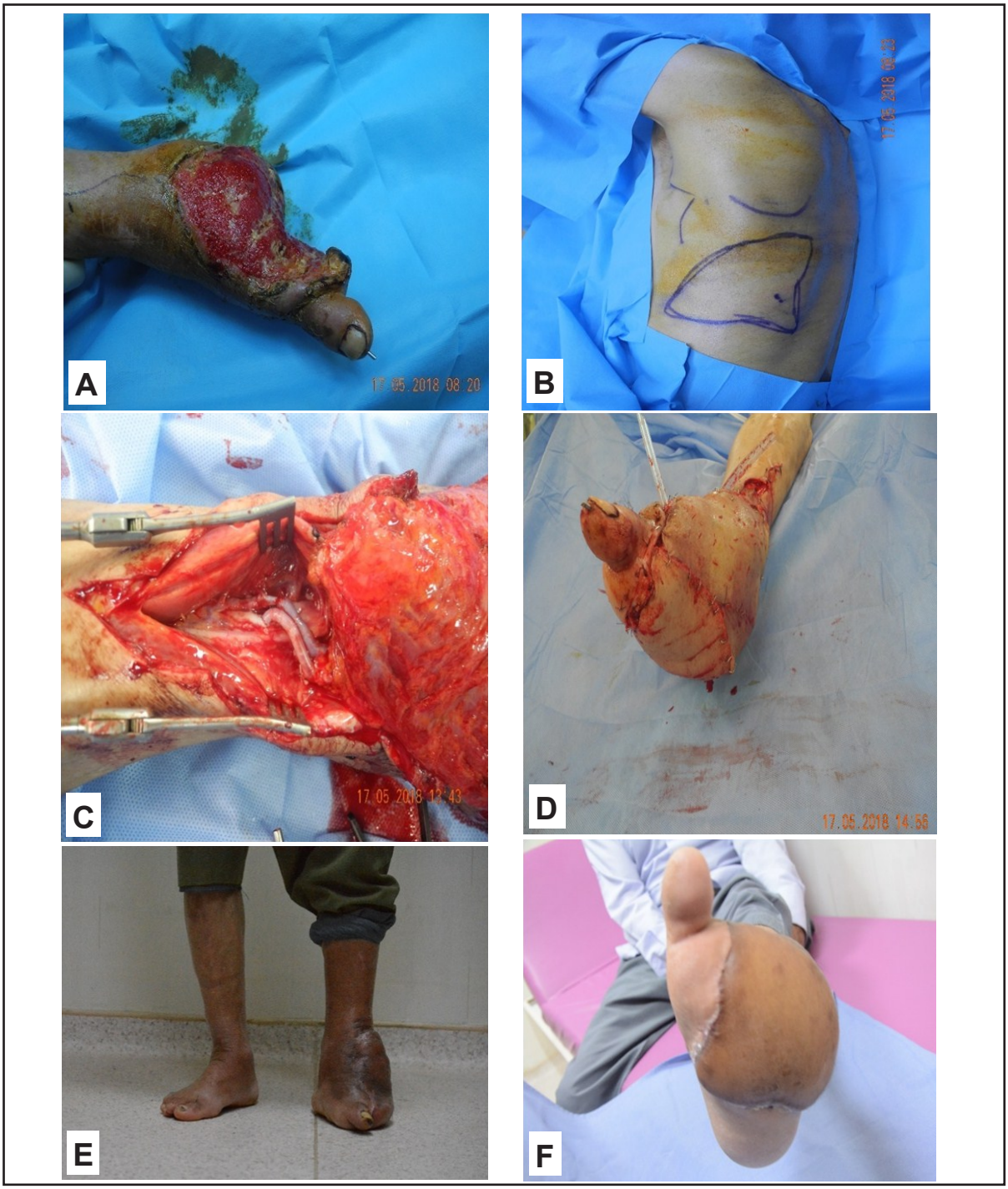

Figure 5 A 67 years old man victim of an explosion that led to partial amputation of his left forefoot. **A,** Partial amputation of left foot with remaining big toe, with exposed metatarsal bones. **B,** Marking plan for free latissimus dorsi held with skin paddle designed to cover the planter surface. **C,** Inset of flap with end to side anastomosis of thoracodorsal artery pedicle to the anterior tibial artery. **D,** Immediately skin graft to the rest of muscle and skin paddle put in planter surface. **E** and **F,** Follow-up result after one and half year post-operation.

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Discussion

Treating a large complex wound by itself is very challenging, making appropriate decision is very critical for the surgical outcome and those complex large wounds usually in need for bulky soft tissue coverage in the form of free or pedicle flaps. And it's very advantageous to involve the muscle in the flap in the form of muscle flap or myocutaneous flap from different sites of the body like (latissimus dorsi, rectus abdominis and serratus anterior, ……) and we've used the latissimus dorsi free flap that gives very large surface area with the least donor site morbidity the flap can be taken in different directions and designs that will make coverage much easier and as a fact that muscle is rich in vascularityn so that its better resistant to infections so that we mainly used myocutaneous flap in our study, thought recently declared that there is no significant different in final outcome of muscle flap and fasciocutaneous flap.[4,6,7]

In disagreement with a study held on animal declared that the muscle flap is better for defects associated with bone exposure because it containing bone morphogenic protein and this enhance bone healing, bone union and better strength so that carries better outcome,[8,9] that's why we preferred the muscle or myocutaneous free flap for the coverage of defects that associated with an exposed bone fracture.

In the inset of free flaps, the selection of appropriate recipient vessels is very critical in the outcome,[6,7] and according to the patients their site and size, we have used (anterior tibial artery, posterior tibial, radial, and superficial temporal artery).

And in regard to our study, we had a (22.7%) failure rate, and all those failure cases were from the leg that was associated with extensive injury with tibial fracture (Gestilo type 111B and C) that is more than just a soft tissue defect and associated more with intimal vessel injury plus two of our cases faced donor site bleeding and that led to decrease in blood pressure and vasospasm and thrombosis.

The free flap is used for lower leg defects than ever before, but there is a fact that the rate of necrosis and failure in the lower leg is higher than in any area of the body has been mentioned by (Melissices and Park), the success rate of free flaps were 96.8% in head and neck, 100% in the trunk, 98.8% in the upper extremities and 95.6% in the lower extremities reconstruction.[6]

In our study, the success rate in the upper limb, head, and neck was 100%, but in the lower limb less than about 72,23%. Still, for lower limb extensive defects we prefer the latissimus dorsi free flap as there is no better substitute for it.

And one of the advantages of the latissimus dorsi free flap is minimal donor site morbidities, that usually closed primarily only if it's too big, skin graft might be in need, aesthetically satisfactory, and seroma sometime happen in donor site as we had only one case, that is managed conservatively, and there are some techniques help to prevent formation like quilting sutures, fibrin glue application and triamcinolone injection,[10,11] we have used the quilting sutures for prevention, minor wound dehiscence is one of the complications and we had only one case and is managed conservatively, and donor site bleeding, we had three cases, the cause might be the slippage of the ligature as in one of the cases and the other two are non-adequate hemostasis at the site of the lumber perforators because sometimes the hypotension during surgery may miss lead u for the adequate hemostasis by coagulation then after recovery from anesthesia, rise in blood pressure and rebreeding from the secondary perforators specially the patients already received anticoagulant.

The limitation of the current study was a sample size, because of the lack of referral by other center or specialty, and the special requirements and needs (special tools, microscope and environment) for those microsurgical free tissue transfer as this cannot be afforded by all hospitals.

Our recommendation is to prioritize the microsurgical free tissue transfer for managing complex large wound as it give a superior outcome in comparison to all other options.

Conclusion

The latissimus dorsi myocutaneous free flap is reliable and flexible for large soft tissue reconstruction in all over the body and survival decline in lower limb compared to other sites of the body, especially those associated with extensive bone damage Gustilo type 111B and 111c, still is the best choice as there is no other better substitute for such defects in the lower limb, plus latissimus dorsi free flap carry little morbidity in regard to the donor site.

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Competing interests

The author declares that he has no competing interests.

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