

Fasciocutaneous Flaps in reconstruction of lower extremity: our experience

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Abstract

Objective: To assess the role of Fasciocutaneous flaps in coverage of exposed tibia, in terms of final outcome of procedure.

Methodology: This two years (January 2014 to December 2015) prospective and descriptive study was carried out at Plastic surgery and Burn Unit Lady Reading Hospital, Peshawar. 30 patients with exposed bone in the region of proximal two thirds of tibia were included in the study and treated with ipsilateral fasciocutaneous flaps. Post-operative assessment was done for 6 months using proforma and photographs. Results were analyzed with SPSS 23. Final outcome was assessed as Good (Full bone coverage), Useful (Bone coverage, but with complications) and Useless (Unable to achieve bone coverage).

Results: During two years study period, 30 patients with soft tissue defect in the region of proximal two thirds of tibia were included in study. To provide soft tissue coverage for exposed tibia, 32 ipsilateral fasciocutaneous flaps were performed. Patients were followed up to 6 months post operatively. Two patients (6.6%) had total failure of the procedure while 4 (13.3%) had complications.

Conclusion: Ipsilateral fasciocutaneous flap is a good option to provide soft tissue coverage to the exposed tibia in terms of its ease and lesser complications. In the centers where facilities and expertise for micro-vascular free tissue transfer is not available, this flap is a workhorse in lower limb reconstruction.

Keywords: Exposed tibia, proximal two third, fasciocutaneous flap, Ipsilateral fasciocutaneous flap

Introduction:

Severe blunt or penetrating lower extremity trauma frequently results in a soft-tissue defect that exposes vital neurovascular and musculoskeletal structures.^{1,2} Infection is a possible complication when there is a break in the skin barrier.³ It is for this reason that the effective provision of skin cover becomes a matter of urgency, though its provision has to be coordinated with the management of the other damaged structures, each of which carries its own imperative. The leg is a complex district with functions of weight bearing, support, stability, and motility. Relatively unprotected anatomy leads to tibia exposure after trauma which needs specialized type of soft tissue coverage to protect bone from osteomyelitis and non-union of fracture. Fracture man-

agement is to be done with external fixation or internal fixation and soft tissue reconstruction needs flap surgery. Crushing, avulsion, or high velocity injuries lead to complex defects. Comminuted open fractures of the tibial shaft, commonly associated with extensive soft tissue loss require expertise of plastic surgeon. The “gold standard” for coverage of severe lower extremity injuries is free tissue transfer. Free flaps are needed for many lower extremity reconstructions⁴ but the procedure needs microvascular equipments and expertise.⁵

A relatively new concept described initially by Ponten in 1981 has shown that the inclusion of the deep fascia with local skin flaps has enhanced their survivability. Whereas previously

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Table :Gender Distribution

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	9	30.0	30.0	30.0
Male	21	70.0	70.0	100.0
Total	30	100.0	100.0	

Table 1:Age groups

Age in years	No of patients	Percentage
Below 10 years	01	3.3 %
10 – 20	13	43.3 %
21 – 30	05	16.6 %
31 – 40	05	16.6 %
41 – 50	02	6.6 %
51 – 60	03	10 %
61 – 70	01	3.3 %

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	30	8.00	65.00	29.6000	16.4811
Valid N (list wise)	30				

Table 2: Causes of Injury

Cause of injury	Frequency	Percent	Valid Percent	Cumulative Percent
Bomb blast injury	2	6.7	6.7	6.7
Electric burn	1	3.3	3.3	10.0
Earthquake victim	5	16.7	16.7	26.7
Fire arm injury	8	26.7	26.7	53.3
Necrotizing fasciitis	1	3.3	3.3	56.7
Road traffic accident	13	43.3	43.3	100.0
Total	30	100.0	100.0	

Table 3:Duration of injury at the time of presentation

Time elapsed	No of patients	Percentage
1 day	1	3.3%
2 – 7 days	4	13.3%
8 –15 days	9	30%
16 – 30 days	9	30%
31 – 90 days	6	20%
91 – 180 days	0	0
One year	1	3.3%

	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	30	1.00	365.00	35.7667	65.6688
Valid N (list wise)	30				

a 1:1 length to width flap ratio in the lower extremity was considered precarious, now 3:1 or larger so-called super flaps can be designed with greater reliability. In selected cases, e.g., relatively uncontaminated, small, or moderate-sized

open wounds, the choice of a fasciocutaneous flap has allowed reconstruction of many lower leg defects which previously would have necessitated a free flap transfer.⁶ Constituent-wise, fasciocutaneous flaps are those, which include skin, subcutaneous tissue and the deep fascia and when design includes intermuscular septum it is called septo-cutaneous flap.⁷ The management of lower extremity trauma has evolved over the last two decades to the point, that many extremities that would have required amputation are routinely salvaged.⁸

Serial debridements are equally important as timing of soft tissue coverage, as optimum debridement and early soft tissue coverage improves the result. The ideal management of open tibial fractures cannot be tackled unless one categorizes the injury according to fracture type, degree of soft tissue loss and the velocity of injury. The average time to fracture healing can be reduced significantly by providing the soft tissue cover at an early stage. The local (ipsilateral) fasciocutaneous flaps may be of great importance in a compromised polytrauma patient as these flaps can be elevated and inset rapidly, perhaps more simply than even the alternative of limb amputation. Presence of internal or external fixators does not hinder the procedure. Fasciocutaneous flaps can even help in salvage of the exposed plates and fixators.⁹

This rationale for fasciocutaneous flap reconstruction of the lower extremities most frequently is justified when dealing with wounds of the upper two thirds of the leg. Fasciocutaneous flap has additional advantages over local muscle flaps or the more complex micro-surgical tissue transfers. The morbidity is significantly diminished, as the surgical plane of dissection is more superficial. The subfascial flap elevation is relatively bloodless, with little risk of haematoma and preservation of major arteries of the leg.¹⁰

No muscle function is expended hence the donor area morbidity is minimal. Since their dissection is simple and rapid, consideration of these flaps should be given a higher priority for coverage of leg defects.



Fig.1: Exposed tibia. Granulation tissue at the wound margins



Fig.2: Distally based fasciocutaneous flap is raised



Fig.3: 5th post-operative day. Flap fully covering the expose tibia and flap donor site covered with split thickness skin graft



Fig.4: Grade III b Gustilo fracture of tibia with periosteal stripping in an earthquake victim



Fig.5: Proximally based fasciocutaneous flap delayed to increase vascularity at the flap pedicle



Fig.6: Previously delayed flap is inset to cover exposed tibia. Flap donor area is covered with split thickness skin graft



Fig.7: A distally based fasciocutaneous flap

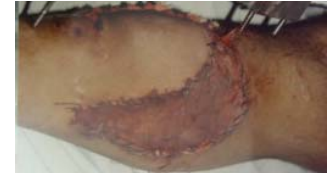


Fig.8: Flap fixed in its new position to cover exposed tibia. Flap donor area covered with split thickness skin graft



Fig.9:



Fig.10: Fasciocutaneous flap coverage for exposed tibia in a road traffic accident victim



Fig.11: Fasciocutaneous flap nicely covering tibia at 15th post-operative day



Fig.12: 5th post-operative day. Exposed tibia covered with fasciocutaneous flap. Surrounding wound and flap donor area covered with split thickness skin graft.



Fig.13: 14th post-operative day



Fig.14: Flap donor area covered with split thickness skin graft at 14th post-operative day



Fig.15: Split thickness skin graft area fully epithelialized. 14th post-operative day



Fig.16: 6 moths post-operative. Bone fully covered under flap, surrounding wound covered with split thickness skin graft.



Fig.17: Flap donor site after 6 months of surgery covered with well maintained soft supple split thickness skin graft.



Fig.18: Split thickness skin graft donor area after 6 moths of surgery



Fig.19: Complication. Flap dehiscence and retraction due to infection



Fig.20: Complication. Flap tip necrosis.



Fig.21: Complication. Venous congestion with superficial necrosis. Bleeding dark color blood on needle prick

Materials and methods:

The study was carried out at Plastic Surgery and Burn Unit, Lady Reading Hospital Peshawar. The study included patients presenting from 1st January 2014 to 31st December 2015. Patient age, sex, mode of injury, duration of injury, dimensions of exposed bone and status of surrounding soft tissues were assessed, pho-

tographed and documented in preform. Data analysis was done with the help of SPSS 23, pre-operative and post-operative photographs.

Inclusion Criteria:

All age groups and both genders were included in study. Cases with exposed bone in the region of proximal two thirds of Tibia were included in

Table 4: Causes of Injury (n=30)

	Frequency	Percent	Valid Percent	Cumulative Percent
Proximal one third	10	33.3	33.3	100.0
Middle one third	20	66.7	66.7	66.7
Total	30	100.0	100.0	

Table 5: wound condition at the time of presentation (n=30)

Condition	patients	Percentage
Fracture tibia	19	63.3 %
Degloving injury	11	36.7 %
Clean wound	25	83.3 %
Gross infection	05	16.7 %

Table 6: Length of tibia exposed (n=30)

Length of tibia exposed	No of patients	Percentage
3 to 5 cm	15	50 %
6 to 10 cm	11	36.7 %
11 to 15 cm	04	13.3 %

	N	Minimum	Maximum	Mean	Std. Deviation
Wound length in cm	30	3.00	13.00	6.3333	2.6042
Wound width in cm	30	2.00	5.00	3.5000	0.9002
Valid N (list wise)	30				

Table 7: Details of fasciocutaneous flaps used for soft tissue coverage

Flaps	Patients (n = 30)	Percentage
Single flap	28	93.3%
Two flaps	02	6.6 %
Based on posterior tibial artery axis	14	46.6 %
Based on peroneal artery axis	14	46.6 %
Based on anterior tibial artery axis	04	13.3%
Proximally based	25	83.3 %
Distally based	07	23.3 %

Table 8: Early complications (n=30)

Complications	Patients	Percentage
Heamatoma formation	0	0 %
Superficial skin necrosis	01	3.3%
Wound dehiscence	04	13.3%
Infection	03	10%
Inadequate coverage	0	0%
Flap tip necrosis	03	10%
Total flap necrosis	02	6.6%
Total loss of skin graft at flap donor site	0	0%

study regardless of the cause of injury

Exclusion Criteria:

Patients with extensive soft tissue loss and ex-

posed skeleton in the region lower one third of leg were excluded.

Results:

30 Patients with exposed bone in the region of proximal two third of Tibia, regardless of cause were included in the study. It was a prospective case series (descriptive) study, carried over duration of two years at Plastic Surgery and Burn Unit Lady Reading Hospital Peshawar. All the eligible subjects were included in the analysis. Procedure was performed by different senior and junior surgeons. Postoperative clinical assessment was done for 6 months and recorded in specified proforma. Pre and post-operative photographs were taken in all cases.

21 patents were male and 9 were female with male to female ratio of 7:3. Ages ranged from 8 to 70 years (mean age 29.6 years). Most common cause of injury was road traffic accident (13, 43.3%) and followed by Firearm injuries (8, 26.6%). Study included 5 earthquake victims (16.6%). Table 2. We received only 5 patients within 7 days, rest of the patients presented later than one week. One patent presented a year after injury. Most of the patients were referred from different orthopedics or surgical units of the province and had already received initial treatment for tibial fracture and general wound care (19, 63.3%). 32 Ipsilateral fasciocutaneous flaps were used, based on the perforators of posterior tibial artery, anterior tibial artery and peronial artery. 25 flaps were proximally based and 7 flaps were distally based (Table 7). We kept flap length to width ratio 2:1. In two patients double flap was used to cover larger defect, one proximally based and another distally based. Flaps provided good and stable cover to the tibia. There was total flap loss in two patients while in three patients we encountered flap tip necrosis. Four patients suffered from flap dehiscence due to infections (Table 8). Final bone coverage was achieved without any additional surgical procedure in all cases except the two, with total flap loss. No complication occurred in patients who presented earlier. The patients were followed up for six months. 4 Minor late complications were noted and were related to split thickness skin

Table 9: Late complications

Complications	No of Patients	Percentage
Ulceration of flap	0	0 %
Ulceration of flap donor site	4	13.3%
Distal oedema	1	3.3%
Functional loss related to flap	0	0%

Table 10: Final outcome (n=30)

	Frequency	Percent	Valid Percent	Cumulative Percent
Good	22	73.3	73.3	73.3
Useful	6	20.0	20.0	100.0
Poor	2	6.7	6.7	100.0
Total	30	100.0	100.0	

graft at the flap donor site. This included ulceration of graft at donor site. There was no functional loss.

Discussion:

Road traffic accidents and firearm injuries are common in our setup. According to WHO data, deaths from road traffic injuries account for around 25% of all deaths from injury.³⁴ During such mishaps lower limbs are more prone to trauma, and it may result in soft tissue loss to fracture of bones.³⁵ Avulsion and degloving injuries are common findings.¹

The anteromedial third of tibia is placed subcutaneously. This relatively unprotected anatomy leads to instances of bone exposure. Tibial fractures are the most common long bone open fractures of the body skeleton. With high rates of infection and frequent injury to neurovascular structures, they have a high incidence of complications and poor treatment outcome.³⁶

Males are more common victims of such injuries. In our study 70% of patients were male. Other studies also show that males predominantly suffer such injuries.^{34,37,38} The outdoor nature of their jobs makes the males more vulnerable to trauma. Road traffic accident is the major cause behind such type of injuries. In our study, the leading cause of injury was road traffic accident (43.3 %). (Table 2). In another study, causes of lower limb trauma in order of frequency were, motorcycle accidents (28% of patients), vehicle accidents (24%), domestic accidents (13%),

pedestrian accidents (12%), crushing injuries (8%), firearm accidents (2%), and miscellaneous causes such as work- and sports-related accidents (13%).¹⁵ While the road side accident remained the leading cause like other studies, fire arm injuries were the second most common cause in our case. This seems to be because of socio-cultural norms in this region.

An extensive soft tissue defect of the lower leg is great challenge for orthopedic and plastic surgeons and often prone to complications, including non-union and infection.³⁴

Management of open tibial fractures needs careful preoperative evaluation and surgical planning, adequate debridement of bone and soft tissue.³⁵ It is a multi-disciplinary team work involving orthopedic, vascular and plastic surgeons. Fracture management is to be done with external fixation or internal fixation and soft tissue reconstruction needs flap surgery. Management of extensive and complex defects is more challenging and often results in leg amputation and shortening. With the better understanding of anatomy and advent of micro vascular surgery several options are available for reconstruction of complex soft tissue defects including muscle flaps, fasciocutaneous flaps, perforator based flaps and free microvascular flaps. Although muscle flap is considered a superior option for the coverage of open tibia fractures in terms of rate and quality of fracture healing, the resultant donor area morbidity and suboptimal cosmetic outcome are limitations.^{32,39} While free flaps provide good soft tissue coverage they also have their own limitations. For instance free flaps cannot be used in patients with major lower limb injury with axial vessel damage and a history of previous trauma and thrombosis of vessels.³⁴

In the late 1980's with improved understanding of the vascularity of the soft tissue of the leg based on the perforators, Fasciocutaneous flaps based on these perforators with a non-conventional dimension of more than 3:1 ratio were designed.³² In this study we kept the dimensions of flap 2:1. As the positions of the perforators are almost always constant, Fasciocutaneous flaps

are reliable. Since these perforators are adequate to supply significant amounts of the proximal tissue, no delay is required. Thus, the hospital stay and morbidity is reduced. This short hospital stay and early return to work becomes even more important with the fact that most of the afflicted victims are young adults and often the only bread earners for the entire family.

The Mean age of affliction in our study was 29.6 years (8 years to 65 years). This is in accordance with the observation of other's studies.^{29,32,33} Timing of surgical intervention is crucial for optimal outcome with delay causing more risk of complications.⁷ We received only 5 patients (16.6 %) within first 7 days and found no complication in them during and after treatment. Wound coverage is classified as early (0-7days) or late (8-30days). During the study it was noted that in cases where early management was performed there were lesser and only minor complications. Unfortunately, in developing countries due to lack of healthcare facilities, poverty and ignorance, patients often reach the specialized units late after initial precious hours.³⁷ In 4 patients (13.3%) we encountered dehiscence of flap at distal ends secondary to infection which needed advancement and re suturing all of them presented after 30 days of injury. If the fractured bone is not covered earlier then it may result in to osteomyelitis and leads to nonunion requiring secondary procedures and long antibiotic treatment.

In our series, stable bone coverage was achieved in 93.3% of the cases while total flap loss was noted in 6.6%.

In a series of 67 fasciocutaneous flaps to lower extremity Hallock found an overall complication rate of 18.5%. Distally based flaps had an even higher complication rate i.e. 37.5% complication rate, though wound closure was ultimately achieved in 97% of patients.⁸ In our study we performed 32 ipsilateral fasciocutaneous flaps in 30 patients. Overall complication rate was 26.7%, out of them 20% suffered from minor complications and 6.6% had total failure of procedure. In 93.3% cases finally ultimate bone cov-

erage was achieved. Interestingly, we did not encounter any complication in our distally based flaps (7 in total). We think that reduced length to width ratio, which was kept 2:1, was the reason behind improved survival and decreased complication rate.

Fasciocutaneous flaps are reliable, easy to perform with less complication rate, provide a good soft tissue cover to the exposed tibia with preservation of muscle function and main vascular trunks.³⁸ The flap donor area has an esthetically poor appearance due to split thickness skin graft, but acceptable to most of the patients when compared with good functional results of the procedure. The indications may be markedly broadened especially in the centers with no access to microsurgery.³⁴

Wherever feasible the ipsilateral fasciocutaneous flaps are most justified procedure for moderate sized defects with exposed tibia.³²

Conclusion:

Local Fasciocutaneous flap to cover exposed upper tibia is a useful tool in the armamentarium of a reconstructive surgeon. It offers an easy solution to a difficult problem. Its merits include being single staged, simple and easy to learn. It provides stable, supple and durable coverage with shortened hospital stay. Minimal functional and cosmetic morbidity makes it a better choice while comparing with other available options like split skin graft and free microvascular flaps.

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Role and contribution of authors:

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Reading Hospital Peshawar, conception of the Idea, literature review, data collection and analysis

Dr Irfanullah FCPS (Plastic Surgery), Assistant Professor Plastic Surgery and Burn Unit, Lady Reading Hospital Peshawar, did data collection and analysis

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