

# Comparison of Outcome in Coverage of Open Fractures of Tibia With Pedicled Fasciocutaneous Flaps and Muscle Flaps With Overlying Graft in Patients Presenting to Plastic Surgery Department, Lahore General Hospital, Lahore

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## ABSTRACT

**Background:** Open fractures of tibia are high energy injuries which are normally treated by internal fixation, debridement and wound closure. These are often complicated by deep infection and pose a reconstructive challenge to orthopedic surgeons. Prognosis largely depends on initial bone displacement, soft-tissue injury, type of flap used and skills of the treating surgeon.

**Aim:** To compare of outcome in coverage of open fractures of tibia with pedicled fasciocutaneous flaps and muscle flaps with overlying graft.

**Methods:** This is a cross-sectional comparative study conducted at Lahore General Hospital, Lahore, Pakistan from January 2011 to January 2018. All the patients of Gustilo Anderson type IIIb, treated with flap repair by the author during this time period were included in this study. Proximal defects were covered with gastrocnemius muscle flap while middle and distal wounds of tibia were covered using soleus muscle flap.

**Results:** Middle 1/3 of the tibia is the most common fracture site (n=14, 60.9%), followed by proximal 1/3 (n=7, 30.4%) and distal 1/3 (n=2, 8.7%). Significant correlations (.773, *p*-value <0.001) exist between flap size and length of hospital stay when adjusted for age of the patients.

**Conclusion:** Pedicled fasciocutaneous flaps and muscle flaps with overlying graft are equally effective in the management of open tibial fractures.

**Keywords:** Open fractures of tibia, pedicled fasciocutaneous flaps, muscle flaps

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## INTRODUCTION

Open fractures of the tibia are high-energy injuries commonly caused by road traffic accidents or fall from height. The incidence of tibial fracture is very high with predominance in male gender<sup>1</sup>. Less severe fractures of the tibia can be treated by internal fixation, debridement and wound closure however, open tibial fracture (Gustilo Anderson type IIIb & IIIc) requires timely management and complex soft tissue coverage<sup>2</sup>. Soft-tissue loss and open bony lesions in this type of fracture often leads to deep infection which results in slow healing, mal-union or non-union of the bones and wound complications<sup>3</sup>. Such wounds pose a reconstructive challenge to orthopedic surgeons and often requires involvement of plastic surgeons to cover the defect<sup>4</sup>.

Strategies to manage open fractures are continuously improved based on the addition of new scientific knowledge. In the past, soft tissue coverage was not done immediately after fixation of bone due to fear of bone infection and wound complications<sup>5</sup>. With the advent of modern anti-biotics and development in the fields of reconstructive surgery and osteosynthesis, early repair of the wound is possible now a days. Bone stabilization is done by using internal or external fixations, dynamic compression plates, screws, reamed and undreamed intramedullary nailing and minimally invasive plate

osteosynthesis<sup>6,7,8</sup>. Temporary fixation of the bone with delayed soft tissue coverage is obsolete now in open tibial fractures. Now days, irrigation, aggressive debridement of the wound, debris and necrotic tissue, coupled with early flap repair has led to reduce infection rates<sup>9</sup>. Treatment strategies revolve around the principles of timing of initial surgical management, I/V or oral use of antibiotics, duration of antibiotic use, early or late repair of the wound and adjunctive therapies to assist the healing process<sup>10</sup>.

Researchers have reported that use of incorrect treatment approach in open tibial fracture may lead to delayed healing and other wound complications<sup>11</sup>. Although, Incidence of wound complications has significantly decreased with new treatment approaches but still there needs to be consensus by plastic surgeons regarding possible measures to be taken<sup>12</sup>. Timing as well as consideration of free versus local flap repair in open fractures is also debatable. The current study was undertaken to evaluate the outcome of fixation and coverage of open wounds (Gustilo type IIIb) using pedicled fasciocutaneous and free muscle flaps.

## METHODOLOGY

This was a cross-sectional comparative study held in Lahore General Hospital Lahore from January 2011 to January 2018. The approval of the study was taken from ethical and institutional review boards. All the patients of open tibial fracture Gustilo Anderson type IIIb, referred by

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orthopedic department requiring flap repair and treated by the author during this time period were included in the study. Patients having history of chronic illness, diabetes mellitus, previous surgery and skin loss due to non-traumatic causes were excluded from the study. Type of flap was selected based on location of wound and availability of flap. Inferiorly based fasciocutaneous flaps were used in upper, middle and lower third of the legs. Among muscle flaps with overlying graft, defects in proximal 1/3 of tibia were covered with gastrocnemius muscle flap while middle and distal 1/3 wounds were covered using soleus muscle flap.

Flap repair was done in plastic surgery department and patients were discharged from plastic surgery ward on 7<sup>th</sup> post-operative day. The patients were then followed up in orthopedics ward till their discharge from the hospital. After discharge from the hospital, patients were followed in outpatient department fortnightly to observe the progress of wound healing.

**RESULTS**

A total of 23 patients of isolated open tibial fracture were treated with flap repair. 21(91.3%) of them were male and only 2(8.7%) were females. The common cause of tibial fracture was road traffic accidents in 20(87%) patients

followed by fall from height 3(13%). Details of age, hospital stay and flap size in male and female patients is given in table 1.

The commonest fracture site was middle 1/3 of the tibia in 14 (60.9%) patients, followed by fracture of proximal 1/3 in 7(30.4%) and distal 1/3 in 2(8.7%) patients. Out of total 23 patients, pedicled fasciocutaneous flap was applied in 12(52.2%) patients while remaining 11(47.8%) were treated with muscle flaps. Details of the type of flap applied and site of wound is given in table 2.

We analyzed the outcome by observing the skin coverage considering as good- healing of the surgical wound without flap suffering, Fair- suffering of less than 1/3 of the flap and poor the loss greater than 1/3 of the flap. 20 (87%) of the patients were having good recovery. Two (8.7%) patients were having fair recovery while only 1(4.3%) patients, recovery were poor. In poor recovery patient, there was marginal loss of 1/3 of the flap due to infection. Debridement of the wound was done and the wound healed with second intention. No significant differences (*p*-value = 0.619) was observed in the outcome of both types of flaps in open fractures.

Significant correlations exist between flap size and length of hospital stay when adjusted for age of the patients. The details are given in table 4.

Table 1: Comparison of various parameters between male and female subjects

	Total(n=23)	Muscular flap (n=11)	Fasciocutaneous flap (n=12)	<i>p</i> -value
Age	41±17.97	37.36±17.72	44.33± 18.30	.365
Hospital stay (in weeks)	6.22± 0.90	5.91± 0.70	6.50±1.00	.119
Flap size (in cm)	9.26± 4.20	7.55±1.37	10.83± 5.23	.059

- A *p*-value of ≤ 0.05 is considered statistically significant
- Values are given in mean±S.D.
- Independent sample t-test was used to compare the groups

Table 2: Detail of the type of flap applied and wound site

Location of the defect	Transferred tissue	Number
Proximal 1/3	Gastrocnemius muscle	3
	Fasciocutaneous	4
Middle 1/3	Soleus muscle	7
	Fasciocutaneous	7
Lower 1/3	Soleus muscle	1
	Fasciocutaneous	1

Table 3:Chi-square analysis of various outcomes in muscular and fasciocutaneous flap coverage of open tibial fractures

Type of Flap		Outcome			Total
		Good	Fair	Poor	
Muscle flap	Observed Count	10	1	0	11
	Expected Count	9.6	1.0	.5	11
Fasciocutaneous flap	Observed Count	10	1	1	12
	Expected Count	10.4	1.0	.5	12
Total		20	2	1	23

- 4 cells have expected count less than 5. The minimum expected count is 0.48
- $\chi = 0.958$
- p*-value = 0.619

Table 4: Correlation between flap size and length of hospital stay adjusted for age

Flap Type	Correlation Coefficient	<i>p</i> -value
Combined Muscle and fasciocutaneous flaps	.773	<0.001
Muscle Flap with overlying graft	.728	.017
Pedicled fasciocutaneous flap	.775	.005

A *p*-value of ≤ 0.05 is considered statistically significant

## DISCUSSION

Open fracture of tibia are among the most common long bone fractures and have a bimodal age distribution. Common complications after treatment of open fractures include infection, mal-union and non-union<sup>13</sup>. Even with advances in the trauma management, open fractures still pose therapeutic challenge to the doctors<sup>14</sup>. Use of external or internal fixators for bone reunion, metallic instrumentation in infected wound, debridement in <6 hrs or >6 hrs and timing to start antibiotic therapy have been a debate for long<sup>15,16</sup>. Ideal timing for coverage of skin and soft tissue defects using flaps in such infected wounds have also been controversial in the past<sup>17,18</sup>. It is therefore, appropriate to state that timing for management of infected wound and grafting by plastic surgeons in open fractures is a critical determinant of outcome.

Management of open fractures requires thorough irrigation of the wound, debridement of dead & necrosed tissue and contaminants with use of intra-venous antibiotics to prevent infection and accelerate wound healing process (19). British Orthopedic Association and British Association of Plastic, Reconstructive and Aesthetic Surgeons has introduced guidelines to treat open traumatic injuries by early stabilization of the bone by internal or external fixation<sup>20</sup>.

In open fractures, adjoining muscles often get injured and are not suitable to cover wound site. In such cases, fasciocutaneous flaps are used being easily availability and near to the wound site. It is now reported that early management of fracture and reconstructive surgery improves flap survival and decreases the risk of infection and osteomyelitis (5). However, choice of flap-type is still a matter of discussion amongst reconstructive surgeons over the past three decades<sup>21</sup>. The purpose of the present study was to compare the outcome in coverage of open fractures of tibia with pedicled fasciocutaneous flaps and muscle flaps with overlying graft.

In the present study, open tibial fractures were covered with inferiorly based pedicled fasciocutaneous flaps and muscle flaps with overlying graft. Mean age of the patients in the current study was 41 (17.97yr). Mean age (43.3yrs) comparable to our results and male preponderance was also reported in an epidemiological study by court-brown<sup>22</sup>. Another study has also reported similar mean age of 42 yrs in open tibial fracture<sup>23</sup>, Another study done in Malaysia reported median age as 24.5yrs (24). The difference is probably due to the fact that authors have included pediatric patients as well. Most of the study subjects were male 21(91.3%). Variable percentages but overall male preponderance has been reported by various studies in open tibial fractures. Similarly, road traffic accidents has been reported as the most common cause of open fractures of lower limb<sup>25,26</sup>.

Infection rate among patients was calculated as 4.3% in the study. Decreased incidence of complications in patients of open tibial fracture has been stated previously. Researchers have reported that high rate of infection in open traumatic injuries is due to nosocomial infection and require anti-biotic prophylaxis against nosocomial as well as environmental contaminants to prevent this<sup>13</sup>. Lack et al. has suggested that immediate anti-biotic prophylaxis is

associated with improved wound healing and decreased infection rates in open fractures<sup>27</sup>.

Mean flap size in patients treated with muscular flaps was 7.55±1.37 cm compared to patients with fasciocutaneous flaps (10.83±5.23 cm) but was not statistically significant. Similar results have been reported in other studies where they have used free flaps for larger defects and these were associated with higher infection rate<sup>8</sup>. Other researchers have also reported more complications, greater operative time and lengthy hospital stay with free flap coverage<sup>28</sup>. This difference is probably due to the reason that free flap coverage in such studies were placed by orthopedic surgeons.

Average hospital stay in patients was 6.22 ±0.90 weeks. It was less in patients with muscular flap 5.91± 0.70 compared to patients with fasciocutaneous flaps 6.50±1.00 but was not statistically significant. Studies have reported increased cost of hospitalization, need of microsurgical training, availability of special instruments and involvement of multi-team approach with use of free flaps in open tibial fracture<sup>29</sup>. Reconstructive surgery by plastic surgeons for soft tissue coverage at early or later stage may address the major issues of increased cost and lengthy hospital stay in open bony fractures.

This is the first study where effectiveness of use of muscular flap and fasciocutaneous flaps placed by plastic surgeons in the treatment of open tibia fracture has been compared. We found equal effectiveness in use of both types of flaps in the management of open tibial fractures. However, large scale studies with inclusion of certain variables e.g. other orthopedic injuries, simple vs. complex injuries, cost per patient, patient preference for type of flap and treatment protocol may be done to validate the results of our study.

## CONCLUSION

Management of open tibial fractures needs multi-disciplinary approach. Coverage of open tibial fractures by both techniques, fasciocutaneous flaps and muscle flaps with overlying graft, are equally effective.

**Conflict of interest:** There is no conflict of interest. The study was not funded by hospital or any other agency.

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