

Evaluation of Result of Muscle Flap in the Management of Gustilo Type-III B Open Fracture Tibia-Fibula

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Abstract

Original Research Article

Background: It is hopeful procedure for helpless patient when injury is so severe that amputation of a limb is going to be mandatory for many reasons even for life threatening conditions. It is also beneficial for the patients in the prevention of infection, bone necrosis and also for early mobilization. Success of muscle flap coverage in Gustilo type III B open fracture of tibia-fibula will establish it as an effective standard treatment in our country. So early referral as well as early stabilization of fracture according to future plan of flap coverage will come in practice. Hence this procedure will save many limbs as well as will reduce many disabilities. **Objective:** To assess the effectiveness of muscle flap (Gastrocnemius, soleus or combined) for the coverage of wound in open tibia-fibula fracture Gustilo- type IIIB. **Methodology:** This experimental surgical procedure was done on patients of Gustilo type- IIIB open fracture Tibia and fibula in Orthopedics and Traumatology department of Dhaka Medical College hospital and National Institute of Traumatology and Orthopedic Rehabilitation (NITOR). During the period of July 2006 to June 2008. This study was done on 20 patients. It was a Purposive sampling method following preset inclusion and exclusion criteria. **Results:** This prospective study on soft tissue coverage by Gastrocnemius and soleus flap in management of open Gustilo type IIIB fractures of upper Two third of tibia fibula was carried out at Department of Orthopedics and Traumatology, Dhaka Medical College and National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka during the period of July 2006 to June 2008. This study was done on 20 patients. Age incidence in this series ranged from 16 to 60 years with a mean age was 34.25 and 32.65 years respectively. Among them maximum (50%) was between the age group 16 to 30 years. Male patients (90%). Motor vehicle accident was the most common cause of injury (90%). Most common configuration of fracture was comminuted + segmental type (45%). External fixator was used in 65% cases, IM nail in 35% cases. Either Gastrocnemius muscle flap or Soleus muscle flap each was done in 35% cases; both Gastrocnemius +soleus were done in 30% cases. Mean area covered by Gastrocnemius 36.14 cm² +/- 3.51 cm Soleus 28.88 cm² +/-3.67 cm Gastrosoleus 53.57 cm² +/- 10.26 cm. Total follow up were <6 months to >12 months. Medium follow up period were 7.83 months. Inter Quartile Range (IQR) was 6 months to 11.25 months. In 60% Gases different type of complications occurs. Among complications 45% was sagging of flap 20% was soft tissue infection 10% was pin tract infection. Regarding hospital stay 21.67 days (11027) was the mean period in cases where Hap, coverage was done within 10 days. Mean hospital stays 62.63 (i33_29) days in cases where flap surgery was delayed. Muscle coverage done within 10 days of injury showing significant percentage of satisfactory outcome (p<0.05). No tetanus or gas gangrene developed among the patients in this series. In this series 15 cases (75%) patients achieved satisfactory outcome whereas 5 cases (25%) patients could not achieved satisfactory outcome. **Conclusion:** Open fracture shaft of tibia and fibula are common injuries which are considered as surgical emergency. Early wound toileting, as adequate debridement and soft tissue coverage by Gastrocnemius and soleus flap with fracture fixation by locally made A.O. External fixator or intramedullary nail are important for prevention and elimination of infection and union of fracture. Soft tissue coverage of the exposed bone in Gustilo type IIIB fractures of upper two third of tibia fibula can be satisfactorily done by Gastrocnemius and soleus flap and acceptable results can be obtained if the flap is done within 10 days' time after injury.

Key words: Muscle flap, Gustilo type-IIIB, Open fracture.

INTRODUCTION

An open fracture of Tibia-fibula has been the most challenging problem of all long bone injuries [1]. A severe, open fracture is the result of high-energy injury. It is assumed to be contaminated, and may threaten the survival of the injured leg and occasionally life [2, 3].

Treatment of open fracture of tibia is difficult, because of the poor soft tissue coverage and blood supply of tibial shaft. Tibial fractures are also associated with high risk of infection, nonunion and malunion. About 40 years ago Charnley said, "We have still a long way to go before /Ute best method of treating a fracture of the shaft of tibia can be stated with finality. The operative management is complex, time consuming and considered Dreary to create significant morbidity [4].

According to the sub classification of Gustilo type III open fracture at 1 "H a type III B fracture is characterized by extensive injury to the soft tissue with stripping of the periosteum and exposure of min M 5 may associated with massive contamination. Early aggressive reconstruction of soft tissue to cover exposed bone significantly reduces the risk of infection, non-union, and subsequent amputation [5].

The question of amputation or salvage for the more severe injuries still generates heated debate. While limb salvage is the initial aim, medium and long-term problems with soft-tissue cover, infection and nonunion are all too common and results in serious disability. The unique anatomy of the tibia with its associated soft tissues and their vulnerability to severe injury produces most of these problems [5-7]

There is universal agreement that open fractures require emergency treatment, including adequate debridement and irrigation of the wound [1].

In most orthopedic Centre in our country these injuries "are managed by wound debridement and application of plaster cast or external fixator with subsequent referral to a department of plastic surgery for delayed soft tissue reconstruction, individually they usually have limited personal experience of the more serious injuries[8].

Delay of wound coverage by soft tissue and inadequate fixation by external fixator may lead to necrosis and bone death which enhances chronic osteomyelitis and nonunion.

Interlocking intramedullary nailing of tibial shaft fracture provides the ability to control length,

angulations and rotation. Primary intramedullary nailing has gained wide acceptance in the treatment of open fracture shaft of tibia as fracture stabilization and soft tissue care simultaneously. But debridement may need repeating because of the difficulty of assessing tissue viability. Soft tissue cover is delayed to allow the post-traumatic tissue edema to reduce significantly and thus facilitates a second-look procedure to re-assess tissue viability, although widely accepted, this treatment has been challenged as repeated debridement and delayed closure may lead to additional tissue loss because of desiccation and infection[7].

Plastic surgery has progressed to modern microvascular technique has revolutionized the potential for reconstruction. Use a vascularized muscle flap rapidly and reliably converts the severe open fracture from an open to a closed injury in a single stage. This facilitates the use of any appropriate implant for skeletal stabilization. The choice of flap depends on numerous factors, including the age and needs of the patient: the location, size and condition of the defect; the likelihood that subsequent reconstruction will be needed; the associated zone of soft tissue injury; and the tissues that are available for the flap. The potential benefit of muscle Hap coverage is that, after a severe fracture, the muscles contiguous to the wound are the primary source of blood supply to the site of fracture because the intramedullary blood supply is disrupted. The muscle envelope is also critical for avoidance of infection. Wounds with muscle flaps can clear larger inoculums of bacteria than those with poor muscle coverage [9].

Several works have been done in past at National institute of Traumatology and Orthopaedic Rehabilitation (NITOR) on the treatment of open tibial fracture, like as external fixator, indigenous external texture, un-reamed inter locking SIGN nail, SIGN nail, soft tissue coverage by gastrocnemius muscle flap, intramedullary interlocking nailing, combined Gastrocnemius and Soleus Muscle flap[10-12].

By considering above circumstances, treatment of open fracture tibia- fibula Gustilo type III-B as 'stabilization of fracture immediately (either by external fixator or interlocking nail) and wound coverage by muscle Hap as early as possible' may salvage a limb or reduce the prolong sufferings to a minimum level in our population. So, I have taken a clinical trial on this procedure.

OBJECTIVES

To assess the effectiveness of muscle flap (Gastrocnemius, soleus or combined) for the coverage of wound in open tibia-fibula fracture Gustilo- type IIIB

METHODOLOGY

This experimental surgical procedure was done on patients of Gustilo type- IIIB open fracture Tibia and fibula in Orthopedics and Traumatology department of Dhaka Medical College hospital and National Institute of Traumatology and Orthopedic Rehabilitation (NITOR). During the period of July 2006 to June 2008. This study was done on 20 patients. It was a Purposive sampling method following preset inclusion and exclusion criteria.

Study Design: Quasi Experimental Study.

Place of study: DMCH and NITOR.

Period of study: July 2006 to June 2008.

Study population:

Patients admitted in the Orthopedics and Traumatology department of Dhaka Medical College Hospital and NITOR during this study period with clinical features suggestive of open fracture Tibia-Fibula Gustilo IIIB subsequently' proved by radiological evidence.

Inclusion criteria

- Age between 16 to 60 years.
- Fracture Tibia-fibula of any side, either right or left
- only open fractures tibia and fibula Gustilo type III B with exposed bone of upper and middle third of Tibia-fibula irrespective of fracture configuration like oblique, transverse, spiral, segmental, comminuted or with loss of bone.

Exclusion criteria

- Polytrauma patients
- Diabetic patients
- patients with peripheral vascular disease
- Any open fracture except Gustilo type III B.
- Patient not fit for general or spinal anesthesia.
- Severe crush injury over the calf damaging gastrocnemius or soleus muscle or both.

Observations & Results

This experimental surgical procedure was done on patients of Gustilo type- IIIB open fracture Tibia and fibula in Orthopedics and Traumatology department Dhaka Medical College hospital and NITOR. After surgery Patients were followed' up prospectively at

OPD according to a formulated outcome Sheet. Minimum follow up period was 6 months and maximum 16 months. Final Outcome was scored according to Tucker *et al.* criterions [13]. Observation result were presented under 4 key variables

- Demographic variables
- Injury variables
- Treatment variables
- Follow up variables

Tables were used. Biostatistical analyses were also shown in details.

Demographic information

Among 20 patients 18 were male, 2 were female. Mean age was 34.25 and 32.65 respectively. Most were in 16-30 years.

Table-1: Age and sex distribution among the participants

Sex Age (in years)	Number		Total
	Male	Female	
16-30	10	0	10
31-45	3	2	5
46-60	5	0	5
Total	18	2	20

Almost all groups of occupations suffer from Gustilo type IIIB fracture tibia fibula in this series Table showing results of wound CS.

Table-2: Distribution of occupation among the injured patient

Occupation	Number of pt	percentage
Motor vehicle driver	02	10%
Manual Labor	04	20%
Farmer	04	20%
House wife	02	10%
Service man	04	20%
Business	01	5%
Student	02	10%
Teacher	01	5%

Among 20 Patients 90% were victim of Motor Vehicle Accident (MVA), right and left both sides were affected equally.

Table-3: Causes of injury and side involvement

Side and cause	Number Rt leg	percentage	Number Left leg	percentage	Total number	Total percentage
MVA	10	50%	8	40%	18	90%
Fall from height	-	-	2	10%	2	10%
Total	10	50%	10	50%	20	100%

External Fixator was used in 65% and IM nail in 35%.

Table-4: Fracture Configuration and Method of Fixation

Fracture Configuration	Number Mx by Ext Fix	percentage	Number Mx by IM nailing	percentage	Total No of Patient	Total Percentage
Comminuted	06	30%	-	-	06	30%
Oblique	03	15%	04	20%	07	35%
Transverse	01	05%	03	15%	04	20%
Segmental	03	15%	-	-	03	15%
Total	13	65%	07	35%	20	100%

In 25% cases Pseudomonas found in wound CS: which were mostly delayed cases.

Table-5: Results of wound CS

Name of organism	Number of cases	percentage
Streptococcus	05	25
Staphylococcus	03	15
Pseudomonas	05	25
E Coli	02	10
Klebsiella	02	10
Proteus	02	10
No Growth	01	5

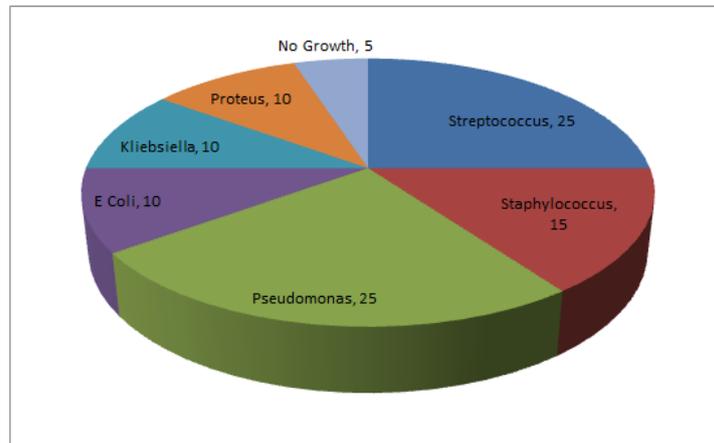


Fig-1: Pie charts of results of wounds

Table-6: Relation between time of Flap coverage and hospital stay

Time of Flap	Hospital Stay Mean +/- SD	SE	T value	P value
< 10 days	21.67+ 10.27	8.79	2.79	P<0.02
10 days	62.63 + 33.29	11.78		

So, there is significant different of hospital stay between patient whose flap coverage done before and after 10 days of injury.

Table-7: Types of Flap

Name of Flap	Number of patient	percentage
Gastrocnemius	7	35
Gastrocnemius medial half + soleus	6	30
soleus	7	35

Either gastrocnemius or Soleus muscle flap each was done in 35% cases and combined Gastrocnemius + Soleus muscle flap done in 30% cases.

Table-8: Distribution of different types of Flaps

Types of Flap	Exposed part of Tibia	Mean area coverage(cm)	Standard Deviation +/- cm
Gastrocnemius	Upper 1/3	36.14	3.51
Soleus	Middle 1/3	28.86	3.67
Gastro-soleus	Lower 1/3	53.57	10.26

Mean area covered by

Gastrocnemius 36.14 cm² +/- 3.51 cm²

Soleus 28.88 cm² +/- 3.67 cm²

Gastro-soleus 53.57 cm² +/- 10.26 cm

Table-9: Follow up period after surgery

Follow up period in months	Frequency	Cumulative frequency	Median Follow up time	Inter Quartie Range IQR
< 6 months	5	5	7.83 months	6 months to 11.25 months
7-8 month	6	11		
9-10 months	3	14		
11-12 months	4	18		
>12 month	2	20		
Total	20			

Total follow up were < 6 months to > 12 months. Median follow up period were 7.83 months. Interquartile Range (IQR) was 6 months to 11.25

months. In 60% cases different types of complications occur.

Table-10: Occurrences of complications- in percentage

Complication / no complication	Number of patients	Percentage
No Complication	08	40%
Complication occurs	12	60%

Among complications flap retraction occurred in 45% cases, in 20% cases soft tissue infection, in 10% cases pin tract infection.

Table-11: Distribution different types of complications

Complications	Number of Patients	Percentage
Flap Retraction	09	45%
Soft tissue infection	04	20%
Pin tract infection	02	10%
Bone infection	01	5%
Limb length discrepancy	02	10%
Fracture nonunion	02	10%
Unacceptable granulation	02	10%
Unacceptable rotation	02	10%

Showing significant percentage of satisfactory outcome

Table-12: Significance of functional outcome scoring

Group	Number of patients	Percentage of	Z proportion test	P value
Group - 01	12	91.67%	2.14	<0.05
Group -02	08	50%		

Table-13: Percentage of final outcome

Grade	No of cases	Percentage
Excellent	07	35%
Good	08	40%
Fair	03	15%
Poor	02	10%
Total	20	100%

Satisfactory = Excellent+ Good
 =7+8 = 17
 = 75%

Unsatisfactory = Fair + Poor
 = 3+2 = 5
 =25%

DISCUSSION

This study was designed to find out an appropriate and accepted technique for re-surfacing of exposed bone at the upper two third of tibia-fibula for management of Gustilo type IIIB open fractures. As tertiary hospitals lot of cases from near and far comers of the country either comes directly or referred to National institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka and Dhaka Medical College Hospital.

Age incidence in this series ranged from 16 to 60 years with a mean age of 34.25 and 32.65 years respectively. Among them maximum (50%) was between the age group 16 to 30 years. This result is nearer to study carried out by Eshaque *et al.* of open fracture tibial-fibula at middle third of the shaft in same geographical distribution where age group varied from 20 to 40 years with a mean age of 26 years. This age incidence is similar with the study carried out by Fischeer *et al.* where mean age was 32 years with age ranging from 12 to 65 years. In the study of Caudle and Stem, the age group ranged from 17g to 80 years with an average of 36 years. Similar pattern of incidence in these different studies point active and ambulant group exposed to the usual cause of fractures and as they are highly active earning group, they require early return to their jobs. Like all other trauma cases open fracture of the upper two thirds of the shaft of tibia-fibula are more common in the male. In this randomly selected series 18 cases were male (90%) and 2 (10%) were female with a ratio of 9:1 it is due to obvious reason that the male is more ambulant as far as the frequency of traveling concerned in our country. In a previous thesis of Bilal, on management of Gustilo type III3 open fractures of middle third of tibia-fibula by soleus flap and locally made A.O. external fixator, the ratio of mid shaft fracture in male: female were 9:1 in the thesis of Hafiz, in the management of Gustilo type IIIB open fractures of upper third of tibia fibula by Gastrocnemius flap and locally made A.O. external fixator, the ratio of upper third fractures in male: female were 4:1. In the present series right side of the limb was involved in 10 cases and left side was involved in 10 cases. Result is statistically insignificant and shows no particular predilection. Most of the patients were victim of Motor Vehicle accident 118 patients, (90%) Among them 2 (10%) were motor vehicle driver, 4 (20%) were manual labor, 2 (10%) were farmer, 2 (10%) were house wife, 2 (10%) service man, 2 (10%) were student and 1 (5%) were teacher.

Configuration of fractures was comminuted in 6 patients (30%) indicating a high velocity trauma. In 7 patients (35%) configuration of fractures was oblique, in 20% patient transverse and in 15% segmental fractures. In wound C/S 25% cases *Pseudomonas* found in wound c/s; which were mostly delayed cases. 70% of open fractures are contaminated with bacteria at the time of injury [2].

Although the study was not a case-control or comparative one and timing of flap surgery was not the only parameter, but flap delay an important factor regarding better result. This is definitely better in the group where coverage was done between 5 to 10 days as recommended by Gustilo *et al.* better results were evident from shorter period of hospital stay and less incidence of flap necrosis and bone infection. In this series gastrocnemius and soleus flaps were done within 10 days after injury in 12 cases. There is significant difference of hospital stay ($p < 0.02$) between patients in whose flap coverage were done within 10 days of injury and in whose flap, coverage was done >10 days later.

Regarding hospital stay 21.67+ 10.27 was the mean period in cases where flap coverage was done within 10 days. Mean hospital stays 62.63 + 33.29 days in cases where flap surgery was delayed. This result came out to be highly significant and consistent with the study of Fischer *et al.*, (1991). In their study early flap coverage within 10 days required an average of 37.5 days hospital stay, delayed coverage within 11 to 42 days required 77 days and late coverage after 42 days required 138 days hospital stay.

Combined gastrocnemius and soleus flap were required to cover the exposed bone in 6 cases (30%) in this series. Only gastrocnemius flap required in 7cases (35%), only soleus flap required in 7 cases (35%). In 13 cases (65%) external fixators were used for fracture stabilization. In another 7 cases (35%) intramedullary nail were used for fracture stabilization.

In 60%cases different types of complications occurred. Among complications 45% were sagging of flap, 20% were soft tissue infection, 10% were pin tract infection. Fracture nonunion occurred in 2 cases (10%). According to Tucker *et al.* criterions final outcome were evaluated.

In this series 15 cases (75%) patients achieved satisfactory outcome whereas 5cases (25%) patients could not achieved satisfactory outcome. By calculating confidence interval, we can say that muscle flap coverage in Gustilo type III B fracture of tibia fibula will be satisfactory procedure in at least 56.02% cases and as much as in 93-98% cases among the whole population. So, it is quite acceptable procedure.

I have divided all cases into two groups; patients whose flap was done within 10 days and whose flap were done after 10 days. Muscle coverage done within 10 days of injury showing significant percentage of satisfactory outcome ($p < 0.05$).

None of the patient developed neurovascular complication or compartment syndrome in this series. Our impression, after this effort is, if wound coverage was possible within 10 days in all cases, sufferings of the patients, cost involvement, laborious surgical procedures and mental and physical stress will be minimum but functional outcome will be maximum. We can also conclude that for Gustilo RB open fracture involving upper two-third of tibia fibula can be satisfactorily covered by Gastrocnemius and soleus muscle flaps where functional outcomes are quite acceptable.

CONCLUSION

Open fracture shaft of tibia and fibula are common injuries which are considered as surgical emergency. Early wound toileting, as adequate debridement and soft tissue coverage by Gastrocnemius and soleus flap with fracture fixation by locally made A.O. External fixator or intramedullary nail are important for prevention and elimination of infection and union of fracture.

Soft tissue coverage of the exposed bone in Gustilo type III B fractures of upper two third of tibia fibula can be satisfactorily done by Gastrocnemius and soleus flap and acceptable results can be obtained if the flap is done within 10 days' time after injury.

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