

Early Versus Delayed Local Fasciocutaneous Flap Coverage for Type III B Open Tibial Shaft Fractures: A Comparison of Results

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Sixteen Type III B open tibial shaft fractures are presented with a treatment protocol based on prompt surgical debridement, fracture stabilization and wound closure, using local fasciocutaneous flap and thorough rehabilitation. Wound coverage was classified as early (0-7 days) or delayed (18-40 days). The overall results were excellent in 3 (18.8%) cases, good in 6 (37.5%) cases, fair in 3 (18.8%) cases and poor in 4 (25%) case. Of the 8 cases treated by early wound coverage (group I), the result was excellent in 3 (37.5%) cases, good in 3 (37.5%) cases and fair in 2 (25%) cases. Of the 8 cases treated by delayed wound coverage (group II), the outcome was good in 3 (37.5%) case; fair in 1 (12.5%) case and poor in 4 (50%) cases. The difference between two groups was highly significant ($p < 0.001$). We conclude that early coverage of the exposed bone in Type III B open tibial shaft fracture significantly reduces the healing time, minimizes postoperative complications and improves final outcome.

[Dinajpur Med Col J 2010 Jul; 3 (2):76-80]

Key words: Tibia, open fracture, local fasciocutaneous flap

Introduction

One hundred and fifty years ago, mortality was common following open fracture.^{1,2} With the advent of newer techniques, the outcome has improved dramatically. The location of tibia make it exposed to frequent injury because one third of it's surface is subcutaneous throughout most of its length, open fractures are common in tibia than any other long bones³.

The classification of open fractures has evolved through the last two decades and has delineated five types. Type III B open tibial fractures are characterized by extensive soft tissue injury or loss with periosteal stripping and bone exposure.⁴ This is the most

problematic open tibial fracture in terms of treatment and prognosis.

The goals of treatment of open tibial fracture are to prevent infections, achieve bone union and restore function. The results of treatment is largely affected by the initial soft tissue loss, wound contamination, fracture stability and neurovascular status.⁵ There are a number of methods for achieving closure of open tibial fractures, including direct suturing, split-thickness skin-graft, local muscle flap, local fasciocutaneous flap or free vascularized flap. Fasciocutaneous rotation flap has been recognized in 1980's and the discovery is a milestone in reconstructive surgery of open tibial fracture.⁶ In this study, sixteen type III B open tibial fracture were treated using local fasciocutaneous flap and the result was evaluated.

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Methods

This prospective study has been carried out at Pabna General Hospital, during the period between March 2008 and December 2009 to evaluate the results of management of Type III B open tibial fracture using local fasciocutaneous flaps in adults. During the period, 20 patients were included in the intent to treat group and 16 were evaluated for analysis. Wound coverage was classified as early (Group I) when it was done within first week of injury or delayed (Group II) when done later.

Operative technique

An open tibial fracture is a surgical emergency. Surgery was performed as soon as the patient's general condition permitted. Once the diagnosis was made of a Type III B tibial fracture, definitive treatment was planned. The essential element in the treatment were antibiotic therapy, wound debridement and irrigation, stabilization of fractures, wound closure using local fasciocutaneous flap and rehabilitation.

Dissection technique

The knowledge of blood supply of the flap was the most important aspect of dissection technique. Perforating vessels from the three main arteriovenous system pass towards the surface in the intermuscular septa to reach the investing layer of deep fascia forming a plexus from which branches pass superficially to perfuse the skin. The specific blood supply of the flaps are as follows:

A. Proximally based flaps

1. Medial flap - The saphenous artery that enters the leg between the tendon of the sartorius and gracilis muscle.
2. Anterolateral flap - Perforators from peroneal vessels along the anterior & posterior border of lateral compartment of leg.

B. Distally based flaps

1. Lateral flap - Two constant perforators arising from peroneal artery at 5-10 cm above the lateral malleolus respectively.
2. Medial flap - Two constant perforator arising from posterior tibial artery at 4cm & 7.5 cm above the medial malleolus respectively.

Flaps were based proximally or distally to provide coverage of upper two thirds and lower one third of the leg respectively. The wound was measured and the flap was designed accordingly. The skin and fascia was carefully elevated as one unit remembering the specific blood supply and rotated to cover the wound. The donor area was covered with a split thickness skin graft.

Among the 8 patients of group I, 6 (75%) cases were distally based and 2 (25%) cases proximally based. In group II, 5 (62.5%) cases were distally based and 3 (37.5%) cases proximally based. In group I, the minimum time interval between injury and flap coverage was 3 days and the maximum was 7 days (mean 5 days). In group II, the minimum time interval was 18 days and the maximum was 40 days (mean 25.1 days).

The operative limb was elevated and supported by pillow for about 48 hours. Parenteral antibiotics were given for 3 days followed by oral antibiotics till stitches were removed. Analgesics were given as and when necessary. The dressing was changed on the next day of operation to see the vascularity of the flap. Quadriceps exercise and active movement of the toes were encouraged as soon as possible. Stitches were removed between 10 to 14 days. Non weight bearing crutch walking was allowed when stable soft tissue coverage was achieved. The fixator was left in place until fracture healing was stable enough as evidenced by clinical and

radiological examinations. After removal of the fixator the patients were discharged with long leg plaster cast or a patellar tendon bearing cast. The patients were advised to attend out patient department with the check x-ray of leg including knee and ankle. They were advised to attend every six weeks interval for first six months, then every twelve

weeks interval for next one year. The plaster cast was removed when there was definite evidence of bone healing.

Taking help from the article of two different authors, the following criteria were used to evaluate the results.^{7,8} Each criteria was graded A,B or C (Table I).

Table I: Criteria used in this study to evaluate the result

Criteria	A	B	C
Skin condition	Normal	Slightly discolored	Ulcer or fistula, persistent infection
Muscle atrophy	0 to 1 cm	1 to 2 cm	>2 cm
Deformity	None	Slight, not noticeable	Considerable, noticeable, shortening >2 cm
Loss of knee movement	<10 degree	10 to 20 degree	>20 degree
Loss of ankle movement	<5 degree	5 to 10 degree	>10 degree
Deep infection	Mild asymptomatic	Moderate	Severe symptomatic
Radiographic evidence of healing	Complete healing	Delayed union	Established nonunion
Return to employment	Activities unchanged	Incapacitated for some works	Stop working because of injury

Results were classified into excellent, good, fair and poor groups.

Excellent	- All of the criteria of grade A
Good	- All of the criteria of grade B
Fair	- one criterion of grade C and others of grade A or B
Poor	- More than one criteria of grade C

Results

Patients were followed up for a minimum of 6.3 months and maximum of 18.3 months (mean 12.5 months). The mean healing time was 6.1 months (range 3.5 to 11 months). In group I, the healing time averaged 4.9 ± 0.5 months (range 3.5 to 7.5 months) while in group II, the healing time averaged 9.3 ± 1.0 months (range, 7.5 to 11 months). This difference was significant (Table II). Among the 8 patients of group I, there were 1 deep infection (12.5%), 1 malunion (12.5%) and 1 partial flap failure (12.5%). Among the 8 patients of group II, there were 6 deep

infections (75%), 5 nonunion (62.5%) and one malunion (12.5%). The difference between two groups was highly significant (Table III).

Table II: Mean healing time of group I and II patients

Mean healing time(months) \pm SE	
Group I (n=8)	Group II (n=8)
4.93 ± 0.53	9.33 ± 1.02

P < 0.01(Significant)

Table III: Incidence of postoperative complications in group I and II patients

Complication	Group		p value
	Group I (n=8)	Group II (n=8)	
Deep infection	12.5%	75%	3.24 <0.001*
Non union	0%	62.5%	3.65 <0.001*

* Highly significant

Of the 8 cases treated by early wound coverage (group I) the result was excellent in 3 (37.5%) cases, good in 3 (37.5%) cases and fair in 2 (25%) cases. Of the 8 cases treated by late wound coverage (group II), the outcome was good in 3 (37.5%) cases, fair in 1 (12.5%) case and poor in 4 (50%). The difference between two groups was highly significant (Table IV, Fig.1).

Table IV: Final results in Group I & II patients

Group	Excellent (%)	Good (%)	Fair (%)	Poor (%)
Group I	37.5	37.5	25	0
Group II	0	37.5	12.5	50

$X^2 = 91.66$; $df = 3$; $p < 0.001$ (Highly significant)

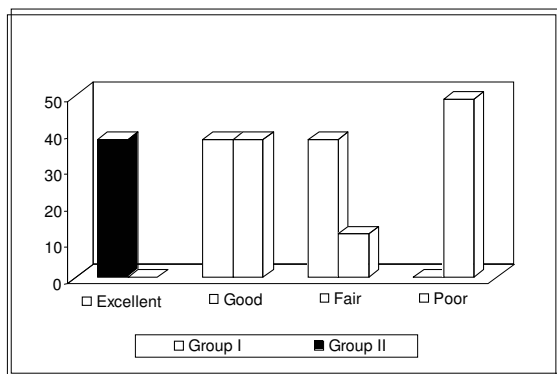


Fig I - Final results in Group I & II patients

Adequate debridement and irrigation are the most important steps in the treatment of an open fracture. It must be systemic and complete and later it must be repeated.

Treatment with antibiotic although not universally accepted in the past has been well documented in the literature.^{9,10,11} It must be started before debridement and irrigation to prevent sepsis. In the management of open fractures, achieving fracture stability is as important as debridement and irrigation. It maintains fracture alignment, facilitates care of the wound, preserves integrity of the remaining viable tissue and provides early rehabilitation.

Discussion

The essential elements in the management of open tibial fracture are thorough wound debridement, antibiotic therapy, stabilization of fractures, wound closure with local or free flaps and early rehabilitation. These principles have been strictly employed in this series.

Adequate debridement and irrigation are the most important steps in the treatment of an open fracture. It must be systemic and complete and later it must be repeated. Treatment with antibiotic although not universally accepted in the past has been well documented in the literature.^{9,10,11} It must be started before debridement and irrigation to prevent sepsis. In the management of open fractures, achieving fracture stability is as important as debridement and irrigation. It maintains fracture alignment, facilitates care of the wound, preserves integrity of the remaining viable tissue and provides early rehabilitation.

Historically, the closure of open fracture wounds has been delayed to prevent infection with Clostridium and other contaminating organisms. While this strategy remains the generally accepted approach in settings characterized by substantial contamination (such as the barnyard and the battlefield), many orthopedic surgeons practicing in the developed world have begun to consider earlier closure of open fracture wounds that

have been adequately derided. There are a number of methods for achieving closure. In this series we have treated 16 Type IIIB open tibial fractures using local fasciocutaneous flap to cover the exposed bone. The advantage of this flaps are greater versatility, easier execution and a lesser donor effect. It was observed that the mean healing time in group I patients (early closure) was 4.9 ± 0.5 months while in group II patients (delayed closure) it was 9.3 ± 1.0 months. The incidence of post operative complications was significantly lower in group I patients. The final outcome was significantly better in patients treated by early flap coverage. Several studies have documented significantly better outcome with early closure than with late closure ($p < 0.05$).¹²⁻¹⁵

Conclusion

Open fractures represent a challenge to even the most experienced orthopedic surgeon. Antibiotics should be administered as soon as possible. Wound debridement and copious irrigation is crucial. Early fixation of fracture is safe and has a number of benefits. This study has documented significantly better outcome with early local fasciocutaneous flap coverage and it supports the current trend toward earlier coverage and closure of open fracture wounds.

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