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Original article

Single stage management of Gustilo type III A/B tibia fractures: Fixed with nail & covered with fasciocutaneous flap

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ABSTRACT

Purpose: To evaluate the role of immediate and definitive management of Gustilo type III A/B tibia fractures with intramedullary nailing and fasciocutaneous flap.
Methods: From August 2010 to July 2012, 22 patients with Gustilo Grade III A/B tibia fractures were managed with a single stage treatment of ipsilateral fasciocutaneous flap & reamed intramedullary nailing and were included in the study. The severity of the injury was calculated with Ganga Hospital injury severity score.
Results: The mean age of patients was 41 years and the follow-up time ranged from six months to one year. Among the 22 patients, 73% were type III B fractures with upper leg involved in 55% of them. The time interval from injury to completion of surgery was 8–14 h. The incidence of bone infection requiring secondary procedure was 9%; the major and minor soft tissue complication rate was 9% and 14% respectively. The limb salvage rate was 100%.
Conclusion: Multidisciplinary management of severe lower limb trauma is important and provides good outcomes. Intramedullary nailing and immediate flap fixation can achieve early bone union and good soft tissue coverage, leading to good outcomes in patient with Grade III A & B tibia fractures.

Introduction

The management of open tibia fractures with loss of skin and soft tissue coverage is complex and requires combined orthopaedic and plastic surgery expertise. The early bone fixation and wound coverage provides fast bone union, early mobilisation and reduced infection rate & hospitalisation costs. The treatment of Gustilo type III tibia fracture is fracture fixation with intramedullary nailing, external fixator and plating. In order to achieve a quick healing of the bone, apart from rigid fixation, good soft tissue coverage is mandatory and the commonly followed protocol is to use gastrocnemius muscle flap for the upper leg, soleus muscle flap for the middle leg and reverse sural fasciocutaneous flap or free tissue transfer for the lower leg defects. Though bone fixation is done immediately after debridement, the soft tissue coverage is not performed immediately in fear of the high incidence of bone infection and major flap complications. In present study, we evaluated the use of ipsilateral fasciocutaneous flaps for the immediate & one stage management of soft tissue defects associated with open tibial fractures (Gustilo type III A/B) after wound debridement and fracture fixation with reamed intramedullary nail.

Materials and methods

During the period from August 2010 to July 2012, 37 patients of Gustilo Grade III A/B tibia fractures were treated at our centre. Among them 22 patients received the single stage treatment of reamed intramedullary nailing and ipsilateral fasciocutaneous flap, and were included in this study (Table 1). The remaining 15 patients were excluded from this study due to multiple debridements,

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Table 1
Demographics, clinical features and complications of the 22 patients.

No.	Age (yr)	Sex	Location of leg defect	GHSS score	Associated injuries and comorbitities	Complications & treatment	Hours from injury to surgery
1	20	M	Proximal	10	–	–	8
2	44	M	Middle	18	Thoracic injury Diabetes mellitus	Infected nonunion Debridement and bone grafting	9
3	38	M	Proximal	12	–	–	8
4	30	M	Middle	12	–	–	10
5	36	M	Proximal	18	Thoracic injury Diabetes mellitus	Flap tip necrosis Excision & flap advancement	9
6	44	M	Middle	16	–	Superficial skin necrosis Conservative treatment	10
7	60	M	Proximal	20	Diabetes mellitus Ischemic heart disease	–	14
8	22	M	Middle	22	Head injury	–	11
9	54	M	Proximal	20	Head injury	–	8
10	35	M	Proximal	20	Head injury	–	9
11	74	M	Proximal	20	Head injury	–	10
12	31	M	Proximal	14	–	Infected nonunion Debridement and bone grafting	9
13	25	F	Distal	16	–	–	10
14	35	M	Proximal	18	–	–	12
15	44	M	Proximal	18	Abdominal injury Diabetes mellitus	–	14
16	52	M	Proximal	20	Abdominal injury Diabetes mellitus	Superficial skin necrosis Conservative treatment	12
17	41	M	Distal	14	–	Flap tip necrosis Excision & skin grafting	10
18	20	F	Proximal	12	–	–	10
19	60	M	Distal	18	Abdominal injury Hypertension	–	8
20	43	M	Proximal	16	–	–	10
21	47	M	Proximal	14	–	–	8
22	49	M	Proximal	12	–	–	11

Note: "–" means no associated injuries and comorbitities or complications.

application of external fixators, cross-leg flaps, microvascular flaps and muscle flaps with skin graft coverage. The ethical committee approval was taken and the patients consent was obtained.

Patients' age ranged from 20 to 74 years, mean 41 years. There were 20 male & 2 female patients. Out of the 22 patients, there were 6 (27.3%) Grade III A and 16 (72.7%) Grade III B. The soft tissue defect respectively located at the proximal leg (13, 59.1%), middle leg (5, 22.7%) and distal leg (4, 18.2%). The procedure of debridement and fracture fixation & flap coverage was performed within 8–14 h after trauma. The Ganga Hospital injury severity score (GHSS) ranged from 10 to 22, mean 16.[1] The concomitant injuries were found in 9 patients (40.9%), including head injuries in 4 patients (18.1%), thoracic injuries in 2 patients (9.1%) and abdominal injuries in 3 patients (13.6%). Co-morbid medical conditions were found in 6 patients (27.2%): 4 diabetes mellitus (18.1%), 1 hypertension (4.5%) and 1 diabetes mellitus with ischemic heart disease (4.5%). There were 16 patients (72.7%) combined with ipsilateral fibula fractures.

Surgical management

The polytrauma patients were managed with multidisciplinary team approach. The protocol used in management of Gustilo type III A & B fractures consisted of joint management by orthopaedic and plastic surgical team. Wound debridement was first performed, followed by profuse lavage. The fracture fixation was planned according to the fracture anatomy and the requirement of soft tissue coverage. In current study we only included the cases of fracture fixation with intramedullary nailing. The choice of implant was based on the fracture pattern i.e. transverse fracture or oblique fracture. The entry point for intramedullary nailing was made through an infrapatellar approach by splitting the patellar tendon (transtendinous approach). Entry awl was used and guide wire was introduced. Fracture reduction was achieved with direct technique at open fracture site. Reaming was performed over beaded guide wire. Intramedullary nail of appropriate size was placed and proximal and distal screws were placed. Immediate, definitive soft tissue coverage with a vascularised muscle flap plus a split skin graft was performed. The choice between a pedicle and a free muscle flap depended on the anatomy of the injury to the soft tissue and location at the leg. The postoperative rehabilitation included initial support with a plaster slab, which was converted to cast after wound healing until bone union. The patients were allowed partial weight-bearing until early bony stability was obtained.

Results

The proximal leg defects (55%) were managed with proximally based fasciocutaneous flaps (Fig. 1), the middle leg defects (23%) with proximally based fasciocutaneous flaps in 3 patients (Fig. 2) and bilateral advancement flaps in 2 patients, and the distal leg defects (18%) were managed with propeller flaps in 3 patients and reverse sural flap in 1 patient (Fig. 3). The mean follow-up was 36 (24–60) months.

The fracture union time was from 12 to 20 weeks with a mean of 16 weeks. Non-weight bearing ambulation was started within one week in 13 patients (59.1%) with only lower limb involvement, and by three to four weeks in 5 patients (22.7%) with thoracic or abdominal trauma. Full weight bearing was started as early as ten weeks from the date of surgery depending on the bony union. However, mobilisation was delayed in patients with concomitant head injures by 12–14 weeks from the date of surgery. The limb salvage rate was 100%. Bone infection, major & minor soft tissue

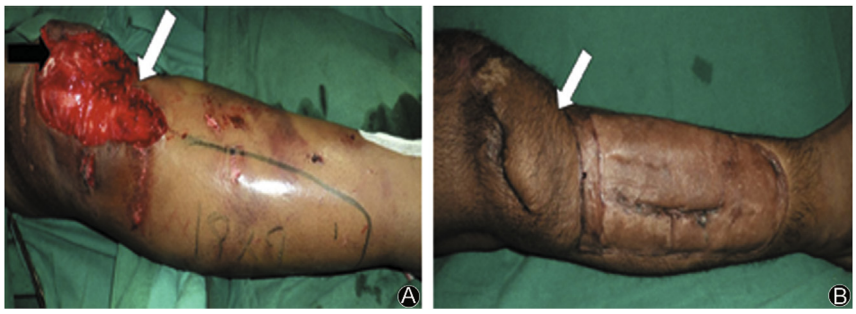

Fig. 1. A: Gustilo type III B fracture of the proximal third of tibial shaft (white arrow) and soft tissue defect over the knee joint (black arrow). B: Postoperative picture of well-moulded fasciocutaneous flap (white arrow) with colour and contour defects observed.

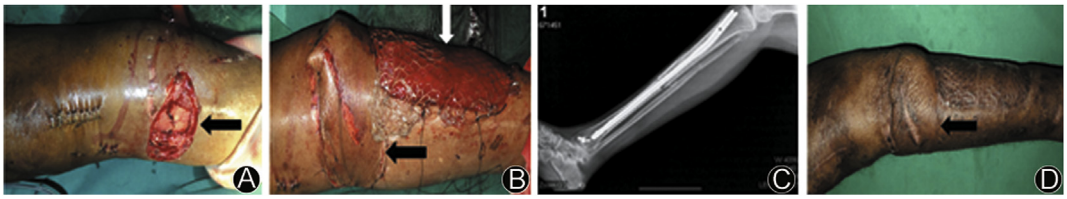

Fig. 2. A: Gustilo type III B fracture of middle third of tibial shaft (black arrow) with soft tissue defect overlying the fracture. B: Intraoperative picture of flap (black arrow) and the flap donor site covered with skin graft (white arrow). C: Lateral radiograph of tibia with intramedullary nail fixation. D: Postoperative picture of healed fasciocutaneous flap (black arrow).

Fig. 3. A: Gustilo type III A fracture of distal third of tibial shaft with soft tissue defect over the medial malleolar region (flap marked). B: Intraoperative picture of the propeller flap covering the primary soft tissue defect (white arrow) and the flap donor site covered with skin graft (black arrow). C: Postoperative picture of completely healed fasciocutaneous flap.

complications were found in 2 (9.1%), 2 (9.1%) & 3 (13.6%) patients respectively. The infected nonunion were treated with debridement, exchange nailing and bone grafting. The major soft tissue complication was flap tip necrosis which was managed with excision and further advancement of the flap. The minor soft tissue complications were superficial skin necrosis which was managed conservatively.

Discussion

Severe open fractures management is based on holistic approach and requires multiple disciplinary team involvements. It requires a thorough wound debridement and lavage followed by fracture fixation and soft tissue coverage.[2–4] The fracture can be stabilized with an external fixator, plating and intramedullary nailing.[2] There is question about use of minimal metallic instrumentation into a contaminated field. The timing of soft tissue coverage in lower limb trauma is a critical determinant of outcome. Early coverage reduces the risk of osteomyelitis and fracture nonunion. Early reconstruction improves flap survival. Microvascular treatment is difficult in trauma setting due to an increased thrombosis, tissue oedema and the friable vessels.

The concept of fix & flap involves reconstruction of compound fractures of tibia with radical debridement, fracture fixation and soft tissue coverage.[2] The advantages of early management of tibial fracture and soft tissue coverage are quick healing, early mobilisation, reduced rate of infection, and can avoid the drawbacks of open wound therapy and delayed reconstruction such as fibrosis, tissue oedema and chronic bone infection, which may preclude local tissue & microvascular free tissue transfer.[3–11] Delayed soft-tissue coverage may lead to additional tissue loss because of desiccation and infection.

Results of Gopal et al[2,3] shows external fixation was associated with practical difficulties for the plastic surgeons and a number of chronic pin-track infections and malunion (the only one case of malunion in our study). External fixator pins are a common source of contamination or infection; nailing may spread infection through the medullary canal and should be avoided. The use of external fixators was associated with increased time to bony union, malunion, and difficulty in the microvascular surgery and skin grafting.

Intramedullary fixation is valuable and appropriate for the majority of tibial fractures.[2,4,10] Intramedullary nailing is well-suited for the middle diaphysis. With newer nail designs and proper technique, nailing can be extended to both proximal and distal extraarticular fractures. We preferred to use internal fixation with intramedullary nailing in the current study and the results show good bony union with minimal complications.

In a series, a solid nail (upper tibial nail, AO-UTN) inserted by an unreamed technique achieved a as low as 3% infection rate, and 74% of patients achieved union without a secondary procedure.[2] These results are comparable with the results of current studies, which shows that intramedullary nailing is useful in open fractures of tibia. Reamed intramedullary nailing was used for fracture fixation because it provides stable fixation resulting in early fracture union and early mobilisation. As the rate of infection is directly proportional to the time interval between fracture fixation and soft tissue coverage, we covered the soft tissue defects immediately after debridement and fracture fixation.

The most commonly used methods for covering soft tissue defects are gastrocnemius muscle for the proximal leg defects, soleus and tibialis anterior muscle flap for the middle leg defects and reverse hemisoleus muscle flap, reverse sural flap or microvascular free tissue transfer for lower leg defects.[12–16] Gopal et al[2] used pedicled or microvascular muscle flaps and skin grafts for soft tissue coverage. In the present study, ipsilateral fasciocutaneous flaps were used to cover soft tissue defects and Gustilo type III A & B tibial fractures when there was no degloving of the skin. The ipsilateral fasciocutaneous flap was used to cover the soft tissue defect because of easy planning and harvest, proximal blood supply, preserved intact muscle unit and in case of fracture nonunion. It is easy to approach the fracture site for bone grafting by lifting the fasciocutaneous flap.

The limb salvage in the present study was 100% despite high GHSS score due to aggressive debridement, stable fracture fixation and immediate soft tissue coverage. The results of present study suggest that good bone healing, minimal soft tissue complications and early mobilisation can be achieved following early debridement, stable fixation with reamed intramedullary nailing and immediate soft tissue coverage with ipsilateral fasciocutaneous flap. The muscles adjoining the fracture site may be injured rendering them unsuitable for covering the fracture site. Fasciocutaneous flaps offer excellent soft tissue coverage in non degloving injuries. Ever since described by Ponten[17] the fasciocutaneous flaps have evolved over the period of time with several modifications such as propeller flaps for coverage of soft tissue defects in various regions of the body, especially in the leg.[17–23] The most commonly used fasciocutaneous flaps in the lower leg are reverse sural, lateral supramalleolar, posterior tibial and peroneal artery perforator based flaps.[18–23]

The advantages of fasciocutaneous flaps include being ipsilateral, adjacent to the soft tissue defect, easy harvest, reliable, good contouring of the defect and providing one time definitive soft tissue cover without sacrificing a healthy and functional muscle. Even in situations where there is no injury to the muscles near the fracture site, fasciocutaneous flaps can be used as the first choice while the uninjured muscle can be used as back up if the fasciocutaneous flap fails. The disadvantages are the contour and colour differences in the flap donor site though it settles over a period of time.

The limitations of present study are the limited study population, no control group as we excluded the patients with staged soft tissue reconstructive procedures. A multi-institutional study with comparison of different methods of fracture fixation and different modalities of flaps would provide better scientific data with statistical analysis.

In conclusion, multidisciplinary management of severe lower limb trauma is important and provides good outcomes. Intramedullary nailing and immediate flap fixation provides early bone union and good soft tissue coverage leading to better outcomes in patient in Gustilo type III A & B tibial fractures.

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