



SOFT TISSUE RECONSTRUCTION IN SEVERE OPEN LEG FRACTURES

Dr. Mahmood Abd Alrazak Mahmood*

Specialist Orthopedic Surgeon. *Corresponding Author

Dr. Raid Mubarak Ali

Specialist Orthopedic Surgeon.

Dr. Nibras Salim

Specialist Orthopedic Surgeon.

ABSTRACT Methodology Eighteen patients who sustained severe open leg fractures (Gustilo's III) were treated, average age of 25years.

Aims of study:The project is to evaluate: the benefit of early over late soft tissue reconstruction in severe open leg fractures (Gustilo type III) regarding the flap and bone healing.

All patients were treated by meticulous wound excision with stabilization of fracture and then wound cover, which is done early in 6 patients (before 7 days) and late in 12 patients (after 7 days). local muscle flap was done in 9 patients (50%), local fasciocutaneous flap in 6 patients (33/3%) and free flap in 3 (16.7%).

CONCLUSION: primary reconstruction of Gustilo type III open tibial fractures had advantages compared with secondary reconstruction. Smoking plays an important role in increasing complication.

KEYWORDS : open tibia fracture , Gustilo , flap

INTRODUCTION:

Severe open tibial fractures are the result of high energy injury. High-energy injuries of the lower leg include a traumatic amputation, a Gustilo type III tibial fracture, a disvascular limb after knee dislocation, a closed tibial fracture, or a penetrating wound requiring vascular repair, a major soft-tissue injury of the tibia, and a severe ankle and foot injury [1, 2].

Lower extremity trauma, with open high-energy soft-tissue injuries, is frequently encountered at trauma centers and often requires plastic surgery involvement. Open fractures have high incidences of malunion and infection, especially when they involve the tibia [3].

Numerous studies have demonstrated that compound fractures are best managed by aggressive early wound debridement, rigid orthopedic fixation and definitive wound closure by plastic surgical means, if necessary, ideally within the first 7 days of injury [4].

One of the most important goals in the treatment of severe injury of the tibia is to obtain adequate soft-tissue coverage. Soft-tissue coverage procedures are performed to provide a closed wound, to promote revascularization of the injured bone and soft bone tissue, and to prevent infection and nonunion that may occur secondary to persistent bone ischemia. The type of flap used for soft-tissue coverage of a soft-tissue defect is generally chosen on the basis of anatomical considerations, specifically the location of the defect on the leg, the size of the defect, and the availability of local tissues for coverage [5, 6].

authors have recommended gastrocnemius rotational flaps for defects over the proximal third of the tibia, soleus rotational flaps for defects over the middle third and free flaps for defects over the distal third. Others have postulated that the timing of coverage is more important than the type of flap and that flap coverage should be performed in less than seven days after the injury to decrease the prevalence of complications such as osteomyelitis and flap infection [7].

Etiology:

The most frequent causes are motorcycle accidents (28% of atients), vehicle accidents (24%), domestic accidents (13%), pedestrian accidents (12%), crushing lesions (8%), firearm accidents (2%), and miscellaneous causes such as work-and sports-related accidents (13%) [8].

Blast injury to the extremities is the most common form of injury in recent military campaigns and in civilian terror attacks. Most orthopedic trauma is caused by the secondary effect of blast—penetrating fragment injury [10].

Classification of open fracture: (Gustilo and Anderson)

Type	characteristics
I	Wound measure less than 1 cm. Generally, low energy injury, minimal bone injury.
II	Wound measure (1 to 10) cm. Minimal damage to bone and soft tissues.
IIIA	A fracture resulting from a high-energy injury with extensive damage to soft tissues, fracture can still be closed primarily.
IIIB	A fracture resulting from a high-energy injury as with a type IIIA fracture but requiring rotational flap covering or free-tissue transfer.
IIIC	A fracture resulting from a high-energy injury as with a type IIIA or type IIIB fracture and resulting in vascular injury requiring repair.

Principle of treatment:

ALL open fracture, no matter how trivial they may be seen, must be assumed to be contaminated; it is important to try to prevent them from becoming infected. The five essentials are [10].

- antibiotic prophylaxis;
- wound debridement;
- stabilization of the fracture;
- early wound cover;
- rehabilitation.

indication of Flap:

- It results from careful evaluation of all local and general factors.
- Local factors; include the size and type of the defect as well as existing vascular disorder.
- General factors, include the patient general status and expectations and the experienced surgical team moreover, social and economic pressure must be considered [13].

To amputate or not to amputate:

In the past, the surgeon made the choice of amputation versus prolonged limb salvage based on his initial clinical evaluation and impression. Controversy has developed recently regarding the criteria for limb salvage or amputation. In 1985, Gregory et al. reported the mangled extremities syndrome index. MESI. This index is most comprehensive and includes 10 variable for the decision making process. The predictive salvage index (PSI) reported by Howeeelat(s) in

1987 take into account only four variables: skin and muscle, bone, ischemia, and vascular injury. In 1990, Johanson et al. reported on the mangled extremity severity score (MESS) the limb salvage index (LSI) by Russell et al is very detailed and requires a careful intraoperative evaluation of the limb [14].

Absolute indication for primary amputation: [14]

- Insensate foot from nerve injury.
- Vascular injury of 10 to 12cm.
- Severe crush injury .
- Traumatic amputation.

Local Flaps:

• **Gastrocnemius flap:**

It has been used to reconstruct lower leg and knee defects because the procedure is easy to perform and there is minimal donor site morbidity in 1978, Feldman and colleagues used a medial gastrocnemius musculocutaneous flap for reconstruction of the upper third of the lower leg[11].

Gastrocnemius. muscle flaps or muscle-skin flaps are a safe and relatively simple flap, but there have been many modifications, such as dividing the muscle origin, scoring the muscle fascia, and grafting the saphenous vein muscle flap to increase the, length of the vascular pedicle because of its short pedicle length [11].

Indications

Medial and lateral muscle bellies each carry long flaps of skin and fascia from the posterior calf and are most often used as myocutaneous flaps; these flaps are most useful for upper tibial defect reconstruction [18].

• **Medial hemisoleus flap:**

The use of a hemisoleus muscle flap was advocated first by Tobin. The reliability and the usefulness of a medial hemisoleus muscle flap for soft-tissue coverage of a distal third tibial wound have been contentiously debated among plastic surgeons.

• **Flexor hallucis longus flap:**

Indications

The flexor hallucis longus (FHL) is suitable for defects of the distal third of the leg. In its reverse-flow configuration, it can cover defects of <5 cm in diameter and reach down to the hind foot [13].

Fasciocutaneous flap:

• **Saphenous flap:**

These Fasciocutaneous flaps that are based on the paraneural network and neurocutaneous perforators have been used successfully since 1992 for lower leg reconstruction. These neurofasciocutaneous flaps are popular because they do not sacrifice any major artery or muscle, they have a wide arc of rotation, and they are dissected easily and quickly, and have acceptable donor site morbidity. Also, saphenous nerve sacrifice is not a problem in the patients reconstructed with saphenous neuro-fasciocutaneous flaps, because most of the defects to be reconstructed involve the area supplied by the nerve [21].

Indications

The saphenous-flap is designed on the medial aspect of the leg.

• **Lateral supramalleolar flap:**

The lateral supramalleolar flap was described in 1988, thereby expanding the armamentarium of local regional flaps for coverage of the ankle and foot.

Indications

Indications are defects in the distal third of the leg the ankle, and the hind foot [13].

Free Tissue Transfer:

More properly termed free tissue transplantation, but commonly referred to as a "free flap,"

Type of free flap [23]

- Latissimus dorsi muscle.
- Rectus abdominis muscle.
- Serratus anterior muscle.
- Gracilis muscle.
- Iliacus muscle.

Patients and Method:

This prospective comparative study conducted on 20 patients (44 male and 6 female) their age were ranging from (4-53) years, with severe open leg fracture resulting from high energy injuries.

All patients dealt with in orthopedic and plastic department.

After stabilization of the patients general condition, wound debridement were done under general anesthesia, fixation to the bone were done either internal (plate and screw, K nail), external (AO type, Hoffman or Illizarov) or gypsum, then the wound closed either early (before 7 days) or late (after 7 days) according to situation of wound, degree of contamination, availability of flap, the time till the patient reach to our department and general conditions of the patients.

Types of flap were gastrocnemius muscle and saphenous flap in upper third defect, medial hemisoleus, medial gastrocnemius and saphenous flap in middle third defect, while in lower third defect, free flap (Latissimus dorsi muscle), saphenous and lateral supramalleolar flap were done.

Bone losses (which are found in 6 patients) were dealt with by either primary or secondary bone graft (cancellous, cortical or combined bone graft) or by carrying segment.

Post operatively, the injured limbs were maintained in elevated position, all patient received parental antibiotics (third generation cephalosporin and flagyl). The alignment and healing of bone and soft tissue were followed by clinical examination with frequent change of dressing and serial radiograph every 2-4 week; patients were followed up every other week for three months, then monthly till end of study for 12-16 months.

RESULTS:

Table 1: Distribution of patients according to mechanism of injury.

MOI*	Number of patients	Percent
Missile (high velocity)	7	38.9
RTA*	6	33.3
Gunshot (low velocity)	4	22.2
FFH*	1	5.6
Total	18	100%

*MOI=Mechanism of injury, RTA= road traffic accident, FFH=fall from height

Table 2 : Distribution of the patients according to the time and the type of the soft tissue reconstruction.

Time of reconstruction	Local F-C flap* No. %	Local M-flap* No. %	Free flap* No. %	Total No. %
Early (less than 7 days)	2(11.1%)	4(22.2%)	0(0%)	6(33.3%)
Late (more than 7 days)	4(22.2%)	5(27.8%)	3(16.7%)	12(66.7%)
total	6(33.3%)	9(50%)	3(16.7%)	18(100%)

M Flap=muscle flap. F-C Flap- fasciocutaneous flap

Table 3 : relation between early and late local reconstruction and complication.

Level	No. of patients	Flap infection No. %	Non-union No.%	Flap necrosis No. %	Osteomyelitis No. %
Early local Flap	6	1(16.6%)	1(16.6%)	1(16.6%)	1(16.6%)
Late local Flap	9	5(55.5%)	3(33.3%)	2(22.2%)	3(33.3%)

Table 4: Relation between smoking and complication.

smoking	No. of patients	Flap infection No. %	Non-union No. %	Flap necrosis No. %	Osteomyelitis No. %
+ve	7	4(57.1%)	3(42.8%)	2(28.5%)	2(28.5%)
-ve	11	3(27.2%)	2(18.1%)	2(18.1%)	2(18.1%)

DISCUSSION:

The goal of open fracture management is to decrease complications and to obtain an anatomic, functional limb. This study once again confirms the importance of early soft tissue cover following radical debridement and rigid fixation.

Regarding mechanism of injury (MOI), missile injury was found in (38.9%) of patients, road traffic accidents (RTA) (33.3%), gunshot (22.2%) and fall from height (FFH) (5.6%), this agree with a study done by Yoram A., Rami M., and Meir L. G.Fenelon[10] which shows that the missile injuries to the extremities is the most common form of injury in recent military campaigns and in civilian terror attacks.

This is similar to situation of our country which results from terror attacks and explosions. On the other hand a study done by Rakesh K., Marcus T., G.Fenelon.,et al.[4] shows that (RTA) are the most common form of injury followed by work injury and then gunshot injury.

The early reconstruction had lower percentage of complications regarding flap infection, nonunion, flap necrosis and osteomyelitis compared to late reconstruction, this result agrees with a study done by Godina[15] which shows that the primary closure results in less complications, better postoperative results, than secondary soft tissue defect reconstructions which has a higher incidence of flap complications, osteomyelitis. The result is similar to a study done by R. Hertel, S. M. Lambert, S. Miller et al.,[24] which suggest that immediate reconstruction if the general condition of the patient permitting is the treatment of choice for soft-tissue coverage, another study done by Hrvoje S., Zeljko F., Darko Ekl., et al[5] shows that the primary reconstructions are the treatment of choice and should be chosen whenever the general condition of the patient and surgical facility permit its use.

This study shows that the Smoking group of patients had higher incidence of complication than the nonsmoker group, this result agrees with a study done by Adams C.L., Keating J.F., Court-brown C.M.,[25], they found that flap failure was higher, bone healing was slower and rate of non-union was higher in the smoking group. The smokers had gained less (or lost more) weight, had poorer health, less immunity, ischemia because of microangiopathy effect on small blood vessels and then interfere with the normal processes of flap and bone healing.

CONCLUSIONS:

Early reconstruction had a lower percentage of complications regarding (flap infection, nonunion, flap necrosis and osteomyelitis) in relation to the late reconstruction and should be chosen whenever the general condition of the patient and surgical facility permit its use, in order to convert the open fractures to closed one and then doing further steps of operations such as internal fixation, bone grafting and decrease risk of infection.

Recommendations:

- 1- A time of evacuation is very important for various reasons, many patient reach hospital only after long delay leading to increased morbidity in type III tibial fracture so it is important to get the right patient, to the right hospital at the right time.
- 2- We recommend the need of new trauma center capable of dealing with this type of injury with adequate equipment of orthopedic, plastic and vascular surgery and expert staff, also combination of orthopedic and plastic surgeon in the same center as one team and training the staff on different types of flap in special center.
- 3- We recommend our patient to give up smoking because of its ill effect on infection and bone healing, their general health and economic status.
- 4- This study is wide spectrum subject, one report alone will never cover all.

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