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AO external fixator for definitive treatment of an open distal tibia fracture during the COVID-19 pandemic

Stellenwert des AO Fixateur Externe in der definitiven Therapie einer offenen distalen Tibiafraktur während der COVID-19-Pandemie

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Open tibial fracture; Degloving; free flap; External fixation; Pin track

Abstract

\textbf{Background:} The accepted gold standard for primary treatment of long bone open fractures consists of aggressive debridement, irrigation and temporary external fixation. Removal of the external fixator followed by definite internal fixation is recommended within the first two weeks after the injury to obtain a more stable fixation, alleviate rehabilitation and to avoid pin infection.

\textbf{Materials \& Methods:} Here, we report a case of a Gustilo IIIB open tibia fracture with extended soft tissue degloving of the distal tibia. Following removal of the AO external fixator, plate fixation and soft tissue coverage with a free flap, implant loosening occurred warranting a return to external fixation. The patient did not return for follow-up due to a prolonged COVID-19-quarantine and no further treatment was installed.

\textbf{Results \& Conclusions:} The patient returned after 6 months with the fractures and soft tissues fully healed. In specific situations, the external fixator may be used as a definitive form of treatment.

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**SCHLÜSSELWÖRTER**
Offene Tibiafraktur; Degloving; Freier Lappen; Fixateur externe; Pininfekt

**Zusammenfassung**

**Hintergrund:** Der allgemein anerkannte Goldstandard für die primäre Therapie offener Frakturen der langen Röhrenknochen besteht in einem aggressiven Wunddebridement, ausgiebiger Spülung und temporärer Anlage eines Fixateurs externe. Die Abnahme des Fixateurs externe und eine anschließende definitive interne Osteosynthese werden allgemein innerhalb von 2 Wochen empfohlen, um eine stabile Fixierung und erleichterte Mobilisierung bei niedriger Rate an Pininfekten zu erzielen.

**Material & Methoden:** Dieser Falldarstellung schildert die initiale Therapie einer Gustilo IIIB offenen distalen Unterschenkelfraktur mit ausgedehntem Weichteilschaden bei großflächigem Degloving der distalen Tibia. Nach Abnahme des AO Fixateur externe Plattenosteosynthese und Weichteildeckung mit einem freien Lappen kam es zu einer Implantatlockerung, weswegen ein erneuter Verfahrenswechsel auf Fixateur externe notwendig wurde. Die Patientin erschien im Anschluss nicht mehr zur Nachuntersuchung und Planung weiterer Maßnahmen aufgrund einer prolongierten Quarantäne im Rahmen der COVID-19-Pandemie.

**Ergebnisse & Schlussfolgerungen:** Die Patientin erschien nach 6 Monaten zur Nachkontrolle mit vollständig konsolidierten Frakturen und Weichteilen. In speziellen Situationen kann der Fixateur externe auch als definitive Form der Osteosynthese eingesetzt werden.

**Introduction**

It is generally accepted that the gold standard for primary treatment of open fractures of long bones including the distal tibia is aggressive debridement, irrigation and external fixation [1,2]. Removal of the external fixator followed by closed or open reduction and definite internal fixation is recommended within first two weeks of treatment in order to obtain a more stable fixation, alleviate rehabilitation and to avoid pin infection.

However, in some situations, the external fixator may be used as definitive treatment [3–5]. These include soft tissue or bone infection, an unstable or critical clinical condition of the patient or extraordinary external conditions such as war, poor economic situation, or prolonged quarantine. The latter has been experienced by millions of individuals during the recent Covid-19 pandemic.

Here, we report a case of a Gustilo IIIB open tibia fracture with extended soft tissue degloving of the distal tibia treated with aggressive debridement an irrigation, AO external fixator and ALT flap to cover the exposed bone as a definitive treatment due to a prolonged Covid-19 quarantine.

**Case report**

A 60-year-old obese female, suffering from asthma and arterial hypertension was transferred to the our emergency room from another institution where she was offered a below knee amputation due to extensive distal tibial soft tissue degloving (Fig. 1) and a Gustilo IIIB open fracture of the distal tibia classified as 43B2, 4F3B according to the AO/OTA classification [6–8] (Fig. 2).

Aggressive debridement, extensive irrigation, and external fixation were performed within the first six hours. Prophylactic antibiotics were administered. Limb vitality was not threatened as no neurovascular damage to the foot was found at this time. It was therefore decided to salvage the limb and staged reconstruction was indicated. Second

**Figure 1.** Soft tissue status at the time of admission showing extensive degloving of the anteromedial tibia without obvious neurovascular or tendon damage.
After one week without clinical or laboratory signs of infection, “fix and flap” surgery was performed. Following open reduction under direct visualization, internal fixation of the distal tibia was achieved using an anterolateral locking titanium plate bridging the bone defect.

Fibula plating was made subsequently using a push-pull technique to achieve an anatomic fibular length (Fig. 4).

An anterolateral thigh (ALT) free flap was used for coverage of the extensive anteromedial soft tissue defect that resulted from degloving. The procedure was performed by a reconstructive plastic surgeon using the anterior tibial artery which was anastomosed termino-laterally to the ALT free flap vascular bundle. (Fig. 5). The thigh skin flap fully covered the remaining soft tissue defect. After 5 days, flap vitality and bone alignment were assessed clinically and radiographically using AP and lateral views.

Early ankle and knee mobilization was indicated and a good clinical result was seen after two weeks. Partial weight-bearing was allowed at 2 months and full bearing at 3 months (Fig. 6).

Five months later the patient returned, complaining of lower leg pain and erythema. Loosening of the proximal screws in the tibial plate and non-union at the tibial fracture site was demonstrated.
on x-rays. The fibular fracture was already healed (Fig. 7).

Hardware removal and soft tissue debridement was performed including bone and soft tissue samples for bacteriological analysis. An AO external fixator was placed to stabilize the tibial fracture bridging the ankle joint (Fig. 8). Bacteriological analysis revealed no germs. Specific intravenous antibiotic therapy was administered during the fourteen days of hospitalization and then continued orally for 3 months.

The patient was lost to follow-up due to the COVID-19-quarantine and 6 months later she presented for a routine control. At that time, the
The patient was pain free and freely ambulating. Radiographs demonstrated tibial bone healing with some residual impaction resulting in shortening of the tibia of 2.5 cm. No signs of infection were found. The patient did not want to undergo any further surgery (Fig. 9).

Discussion

The gold standard for the treatment of open fractures of the long bones consists of aggressive debridement, irrigation and temporary external fixation accompanied by antibiotic prophylaxis [1,2,6,7,9–11]. Subsequent removal of external fixation and definite fixation with intramedullary nailing or plating is generally recommended within 2 weeks to achieve better stability for bone healing and diminish the risk of infection [12,13].

However, under several circumstances this type of treatment may not be feasible, and external fixator has to be used as a definitive mode of fixation. Has et al. [5] reported a series of 147 lower limb fractures treated definitively with external fixator. The authors found complications such as osteitis in 8.8% and non-union in 3.7% of all cases. Alhammoud et al. [3] obtained 70.3% of bone healing in open lower limb fractures using external fixation and reported 18.1% of deep infection that required secondary debridement. Pin site infection is an immanent complication in external fixation. The reported rates of pin track infections range from 10 to 100% depending on the pin type, the time and site of application [2,12]. Superficial pin contamination can be treated with local pin care while deep pin track infection requires removal and replacement of the affected pin. If osteitis develops external fixation has to be discontinued. Several strategies for preventing pin site infections such as iodine or antibiotic coated Schanz screws have been employed [12–14].

Rodrigues et al. [15] reported 84.6% bone healing in open fractures treated with intramedullary nailing and 90.3% when treated with biplanar external fixator.

The most important issue in treatment of open fractures is aggressive debridement and irrigation, temporary external fixator and an early and stable soft tissue coverage, if possible within 72 hours [16,17]. Definitive stabilization using
Figure 9. Follow-up at months with no further interventions due to the restrictions of the COVID-19 pandemic showing soft tissue and bone healing with residual impaction and 2.5 cm shortening of the injured leg.

either intramedullary nailing or plating should be performed as soon as possible.

Bhandari et al [18] in their meta-analysis reported the absence of a pin track infection or contamination to be a positive prognostic factor in open fractures. When present, surgery must be delayed until pin track infection is resolved [13]. When external fixator is used for a short period of time (less than 14 days) only the risk of infection risk is diminished by up to 83% [13,16]. In addition, external fixation is less stable than internal fixation under most conditions increasing the risk of malunion or nonunion [2]. In the present case, a shortening of the affected limb of 2.5 cm resulted which was tolerated by the patient at the time of latest follow-up. However, special shapewear of later intervention may be required.

Conclusion

The external fixator is very helpful for troubleshooting in critical conditions. It is typically applied in the initial management of open fractures and soft tissue damage control but may as well be used as definitive treatment under several circumstances when definitive internal fixation is not possible. In the present case, a satisfying clinical result could be obtained for a challenging injury in uncertain times.

Ethical Statement

Not applicable for this article.

Conflict of Interest

There are no conflicts of interest for the authors of this article.

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