

# Complex Foot Injury

## Early and Definite Management



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### KEYWORDS

• Complex foot • Reconstruction • Amputation • Outcome

### KEY POINTS

- Complex foot occur infrequently, but are life-changing events; treatment is difficult and, if the necessary facilities are not available, referral should be considered.
- The first step in severe trauma should be the trauma screening and resuscitation according to the ABCDE principle following the Advanced Trauma Life Support system.
- The initial treatment of a complex foot injury consists of preventing progression of ischemia/necrosis, prevention of infection, and considering salvage or amputation.
- Definitive treatment (salvage) consists of anatomic reconstruction with stable internal fixation and early soft tissue coverage followed by aggressive rehabilitation and adequate orthopedic shoe modifications.
- Overall, the prognosis is hard to predict and determined by the severity of injury, comorbidities, complications, secondary interventions, and individual demands.

### INTRODUCTION

In the fracture epidemiology study by Court-Brown and Caesar,<sup>1</sup> the percentage of fractures involving the foot was approximately 12% out of a total of approximately 6000 patients in 1 year, of which metatarsal and toe fractures accounted for 85%. In an additional analysis on open fractures, the portion of open foot fractures was 10.5% of all open fractures out of almost 2400 open fractures in 15 years.<sup>2</sup> A crude calculation using both studies would show that looking only at the foot injuries (excluding toe fractures) about 1% of all foot injuries is an open fracture, making it a rare injury. In war time, up to 12% to 22% of injuries are foot related.<sup>3,4</sup> A complex trauma to the foot is associated with polytrauma or multiple injury in 22% to 50% of cases, making the management of these injuries an even greater challenge.<sup>5-8</sup>

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An increase in more severe foot ankle trauma has been reported in several studies.<sup>9–11</sup> They occur not only as combat-related injuries, but also in daily life. One theory is that, for example, in car accidents the passenger's upper body is protected well, but the area of the lower leg is less well-protected.<sup>10,12</sup> A second theory relates to the advancing age and a more active elderly population.<sup>13</sup>

Severe injuries of the foot are a life-changing event.<sup>11,14,15</sup> They often lead to some form of disability, and are therefore a real challenge to manage. Injuries of the extremity, and especially of the foot and ankle, are distinct predictors of poor outcome in polytrauma patients.<sup>16–24</sup> Injuries to the foot should, therefore, receive similar attention and treatment as do long bone injuries.<sup>25</sup>

In complex foot trauma, there is a gray area between injuries that are and are not able to be reconstructed. In this article, we present guidance and tools to aid in the treatment and decision making, which, owing to its infrequent occurrence, can be a difficult process at times.

## TERMINOLOGY, DEFINITIONS, AND CLASSIFICATION

Complex injuries of the foot are those injuries that occur infrequently, have a major impact on the quality of life, frequently lead to disability, are accompanied by high complication rates, require special expertise, and should therefore be treated in a dedicated level 1 trauma center.<sup>5,26,27</sup> They are often a combination of both bony and soft tissue damage.

Complex injuries of the foot (and ankle) are also called mangled or smashed extremity injuries, or high-energy lower extremity trauma. In an epidemiologic study on open fractures by Court-Brown and colleagues,<sup>2</sup> the most common trauma mechanisms were crush injuries, falls from a height, and motor vehicle accidents. Crush injuries are the result of a body part being forcefully compressed between 2 hard surfaces. Compression of the muscle mass blocks the flow of blood and oxygen to tissues (ischemia), resulting in tissue death (necrosis) within a few hours. A particular entity are combat-related and mine blast injuries (“pied du mine”) resulting from explosives.<sup>28–31</sup>

Damage to the soft tissue is often classified by the Tschérne–Oestern classification of closed skin injuries (Table 1).<sup>32</sup> It ranges from minimal soft tissue damage to extensive contusion or crush. It is invariably correlated with the energy of the trauma, and therefore also with the severity of the fracture, if present. Closed fractures with skin at risk owing to bone or joint dislocation should be included in this group as well.

Even though Tschérne also proposed a classification for open injuries, the most frequently used classification for open fractures is that by Gustilo and Anderson

**Table 1**  
**Tschérne classification of closed fractures**

Grade 0	No or minor soft tissue damage. Indirect injury with simple fracture.
Grade 1	Superficial abrasion or skin contusion. Medium severity fracture pattern.
Grade 2	Deep (contaminated) abrasion with skin or muscle contusion. Severe fracture pattern by direct trauma.
Grade 3	Extensive skin contusion, crush injury with severe damage to underlying muscle. Compartment syndrome, Morel-Lavallee, and/or vascular injury. Complex fracture patterns.

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