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,[1] 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.[2] 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.[3,4] 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.[5–8]

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An increase in more severe foot ankle trauma has been reported in several studies.[9–11] 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.[10,12] A second theory relates to the advancing age and a more active elderly population.[13]

Severe injuries of the foot are a life-changing event.[11,14,15] 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.[16–24] Injuries to the foot should, therefore, receive similar attention and treatment as do long bone injuries.[25]

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.[5,26,27] 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,[2] 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.[28–31]

Damage to the soft tissue is often classified by the Tscherne–Oestern classification of closed skin injuries (**Table 1**).[32] 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 Tscherne also proposed a classification for open injuries, the most frequently used classification for open fractures is that by Gustilo and Anderson

Table 1
Tscherne 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.

Table 2
Gustilo classification of open fractures

Grade 1	Clean wound (<1 cm). Minimal soft tissue damage. Simple fracture pattern.
Grade 2	Soft tissue damage moderate, no tissue loss, wound >1 cm. Simple fracture pattern.
Grade 3	A. Extensive soft tissue damage, adequate coverage of bone. B. Extensive soft tissue injury, soft tissue loss, bone exposed, periosteal stripping. Wound contamination. C. Open fracture with arterial damage.

(**Table 2**).[33,34] It classifies open injuries according to the size of the wound and neurovascular involvement. Complication rates are associated strongly with the grade of open injury with complication infectious complication rates of greater than 40% in grade 3 open injuries.[34] Because the interobserver agreement is low for the Gustilo classification, the injury should not be graded in the emergency department, but in the operating room after debridement.[35]

Zwipp and associates[8,27] proposed a scoring system for foot and ankle injuries to define a complex injury (**Fig. 1**). The foot and ankle are divided into 5 major areas (Lisfranc, Chopart, calcaneus, talus, and ankle/pilon). Each injured area (dislocation or fracture) equals 1 point, to which points are added for the severity of the soft tissue injury according to the Tscherne and Oestern grade in the most affected area. When the sum of the score is 5 points or higher the injury is considered a complex foot trauma. If a hospital is less familiar with a certain injury, it might be deemed a complex injury even at a lower total score and subsequent referral to a trauma center should be considered.

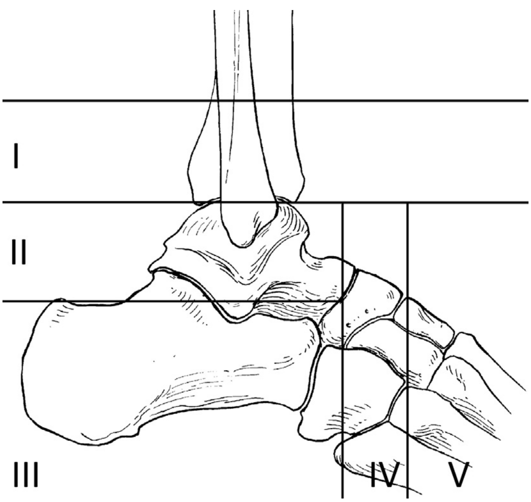

Fig. 1. Zwipp classification of complex foot and ankle injury.

INITIAL TREATMENT

If a patient with a severe injury of the foot presents at the emergency department the following 2 phases can be recognized: (1) initial or early treatment and (2) definite treatment. The initial or immediate treatment of a complex injury of the foot has several goals and can be divided into 3 (overlapping) subphases (**Fig. 2**): prevention of

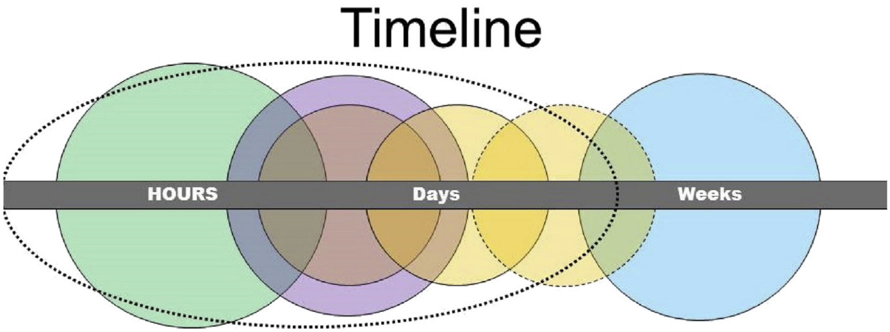

Fig. 2. Timeline of complex foot management. Dotted white field indicates initial treatment.

progression of ischemia and necrosis, prevention of infection, and consideration of salvage or amputation.

Prevent Progression of Ischemia and Necrosis

The first step for every patient with a severe trauma should be the trauma screening and resuscitation according to the ABCDE-principle following the Advanced Trauma Life Support system (“life before limb”; **Fig. 3**). Only gross displacement (at fracture site or dislocation of joints) causing impairment of perfusion can be addressed briefly, ideally at the site of accident. If there are no other life-threatening injuries that need attention first or the patient is stabilized, than the foot injury is assessed and treated.[6]

The second step is diagnostics. Using a physical examination (if possible before intubation), conventional radiographs, and (angio-) computed tomography scans, one should assess vascular injury (palpable pulses, capillary refill, temperature, color, Doppler pulse device), neurologic impairment (sensibility, motoric deficit), soft tissue injury (closed and open), and assess bone and joint injury. Usually at the primary assessment conventional radiographs are sufficient to determine the early treatment (eg, external fixation). During the planning of the definite treatment computed tomography scans are valuable (span–scan–plan principle).

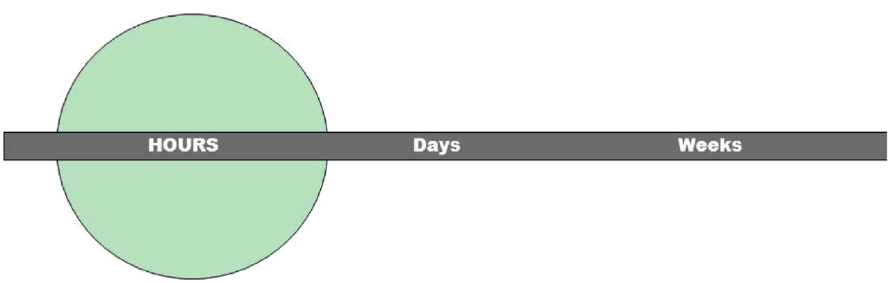

Fig. 3. Phase 1: prevention of progression ischemia/necrosis.

Often in a complex (open) foot injury the strategy chosen is not early total care but damage control orthopedics (limb damage control orthopedics).[36] The individual steps of damage control orthopedics of the foot are as follows:

- Treat the open injury as soon as possible.[37]

- Aggressively debride open wounds using washouts with saline and removal of dead tissue and loose (osseous) fragments.[27,38–42] The use of high-pressure lavage is discouraged.[43]
- Fasciotomy for (impeding) compartment syndrome to prevent ischemia and contractures (**Fig. 4**).[44–49] Early fasciotomy is associated with less morbidity and improved outcomes.[50,51] The sequelae of misdiagnosed or untreated foot compartment syndromes are persistent pain, equinus and cavovarus deformity, clawing of the toes and short foot syndrome.[14,46,48,52–55] The ischemic (dead) tissues can become infected, which has a major impact on future treatment options. The fasciotomy is performed depending on the location of the injury and depending on the subsequent treatment of the injury.[56] A medial approach combined with 2 dorsal approached over the second and forth metatarsals is the workhorse in the release of all 9 compartments of the foot.[49,56] A single incision dorsal (Hannover) approach has been described, as well as an extended single medial approach (Henry approach).[5,57–62] A plantar (Loeffler) approach is not encouraged because it potentially leads to a painful scar. The possibility of a concurrent compartment syndrome of the lower leg and foot through a connection from the deep posterior to the foot with the subsequent need of an extended fasciotomy should be kept in mind.[63]
- Rigid (temporary) fracture fixation using external fixation or Kirschner wires.[64–70] The external frame stabilizes the fracture, allows for frequent inspection and healing of the soft tissues, and prevents the occurrence of equinus deformity.[42] In selected cases with simple fractures and clean wounds, one could decide to perform primary definitive fracture fixation.[71,72] This treatment option should be chosen if both the patient's condition and the local conditions are fit enough to withstand the duration of the procedure and the second hit from surgery. Stabilization of the open fracture is thought to be protective of infection.[37] Many different frame configurations exist (**Fig. 5**), and the type of bone and soft tissue injury are leading in choosing the appropriate frame.[65–67] The tibia is almost always chosen for half-pin placement. Other distal locations are calcaneus (transfixation pin), talus, cuneiform, and the first and fifth metatarsals. The configuration should allow

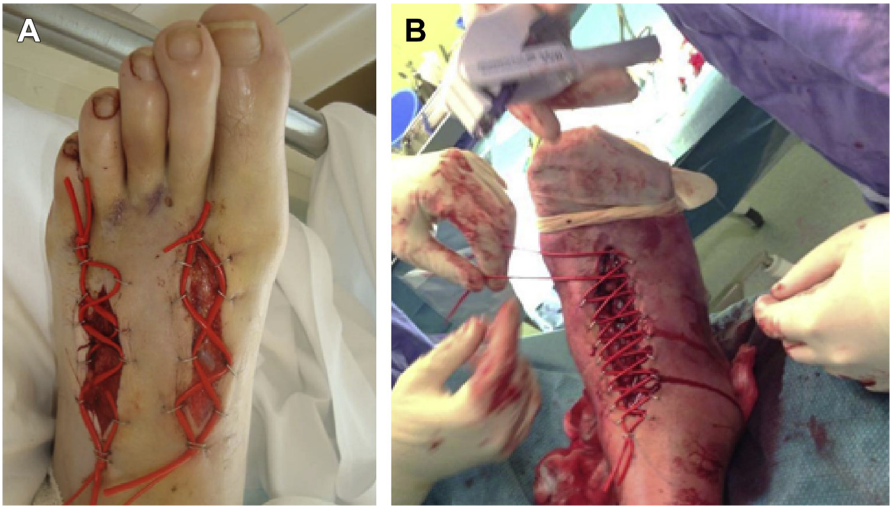

Fig. 4. Two examples of fasciotomy of the foot. (*A*) Classical Manoli approach. (*B*) Hannover approach.

Fig. 5. Various different foot–ankle external fixator configurations.

for wound inspection and dressing (eg, negative pressure wound therapy [NPWT]) changes. Preferably the frame should be on the most injured side, so that the other side is preserved for the definite surgical approach. Attention to pin care should prevent the occurrence of pin track infections.

- Indications for immediate (external) stabilization are as follows[42]:
  - Fracture-(dislocation) with compromised neurovascular structures or skin at risk;
  - Grade 3 open (unstable) fractures;
  - Fracture-(dislocation) with concomitant compartment syndrome; and
  - Gross instability at fracture site or joint.

Although the evidence is not solid, the use of hyperbaric oxygen (HBO) therapy in the treatment of complex foot injuries has been described in several studies.[73,74] Crush injuries are an approved indication for HBO treatment.[74–79] The concept behind the use of HBO in complex trauma is an improved tissue oxygenation (hyperoxygenation), decrease in swelling (vasoconstriction), and preventing the release of toxic oxygen radicals (reperfusion) and its possible aid in the repair of injured tissues (host factors).[74] One randomized trial from 1996 showed improved healing and a reduction in repeat surgery in extensive crush injuries.[73] Therefore, in the presence of ischemia after a crush injury and the availability of a hyperbaric unit, the use of HBO therapy should be considered strongly.

Prevention of Infection

Open fractures should be covered quickly with sterile wound dressings (Fig. 6). Fewer than 20% of infections in open fractures are caused by microorganisms present after trauma and more than 90% of infections are hospital-acquired infections.[80–82]

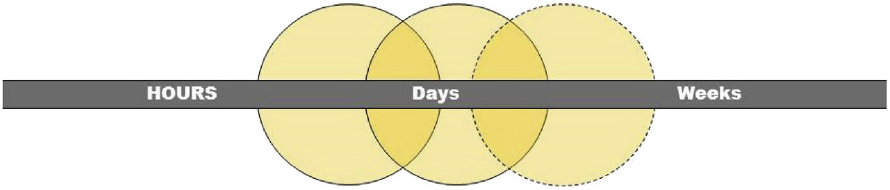

Fig. 6. Phase 2: Prevention of infection.

Digital photographs should be taken to facilitate communication and for patient records.

After the initial washout and debridement, repeated and aggressive debridement and irrigation should be performed as deemed necessary. Depending on the initial contamination and the expectation of ongoing necrosis owing to the force of the trauma (zone of injury),[83] a second (and third if necessary) look should be performed after 24 to 48 hours.[5,27,37,41,52] Traumatized tissue is highly susceptible to infection.[37]

In open fractures, appropriate antibiotics should be started as soon as possible.[41,84,85] A first-generation cephalosporin is usually first choice. Gentamycin might be added in case of gross contamination or grade 3 open fractures.[37] Tetanus prophylaxis should be administered.

When bone defects arise from bone loss or removal owing to infection, necrosis, or gross contamination, gentamycin beads are frequently used.[37,86,87] They release high-dose antibiotics (far higher than serum levels) and maintain therapeutic levels for more than 1 week.[37] However, when used in the treatment of infection, the gentamicin beads act as a biomaterial, which becomes colonized at a high percentage.[88] An alternative solution is the use of polymethylmethacrylate antibiotic-loaded cement spacer (PMMA G/V antibiotic cement).[89–92] The benefit over gentamycin beads is that it fills out the entire cavity, leaving no room for empty voids that can fill with hematoma or debris and might lead to infection. Second, it adds stability to the foot in combination with implants or external fixation (**Fig. 7**). Third, the duration of release is longer than with beads, and can be as long as 8 to 10 weeks.[93,94] Based on the results of cultures from wound swabs, different antibiotics can be added.[93,94] After a chosen period, which depends on the indication of placement, the cement can be removed and

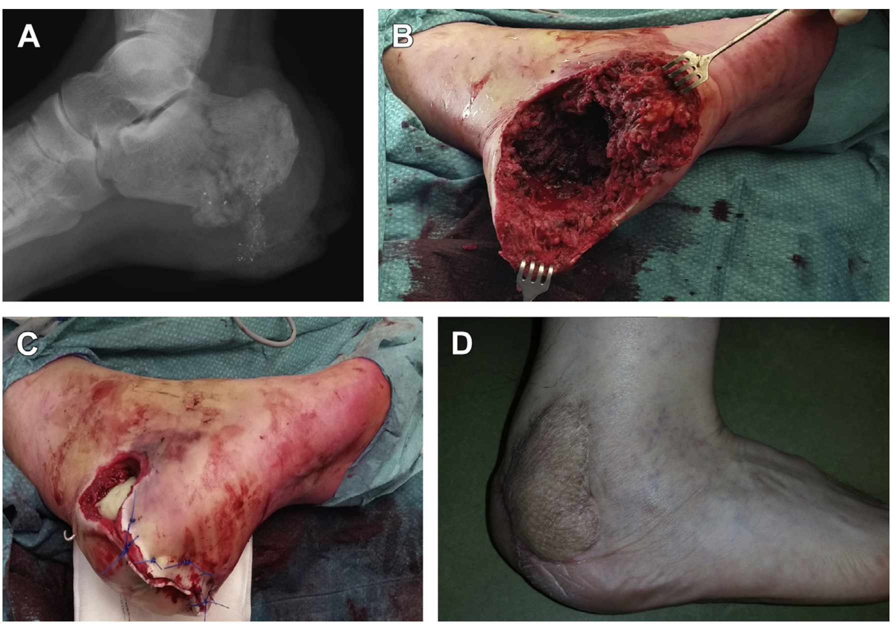

Fig. 7. Use of temporary polymethylmethacrylate antibiotic-loaded (PMMA) cement spacer. (*A*) Radiograph of foot after hail shot to the heel. (*B*) Cavity left after debridement. (*C*) After insertion of vancomycin PMMA spacer. (*D*) Final follow-up with free gracilis flap.

exchanged for tricortical (iliac crest) or cancellous bone graft (eg, from the proximal tibia). Bone grafts may be enhanced with the use of a reamer irrigator aspirator system.[95]

Open wounds in complex foot (and ankle) injuries can be closed temporarily using artificial skin, NPWT (also known as vacuum-assisted closure) or using the antibiotic bead pouch.[96–106] The use of NPWT in open fractures has been investigated more extensively and has shown fewer infectious complications, lesser reoperation rates, and a decrease in hospitalization.[100,103,106,107] In cases in which wounds of open fractures can be closed after the initial debridement, vacuum-assisted closure therapy has been shown to aid in wound healing,[108,109] similar as in high-risk surgical incisions.[110] Combining the concepts of the antibiotic bead pouch and NPWT has been proposed as well, with the fluid-draining effect of the vacuum device on the availability of the antibiotics is still subject to debate.[111,112] For wounds that need soft tissue transfer, early definite flap coverage has been shown to lead to decreased infection rates after complex trauma.[113,114]

Consider Salvage or Amputation

Early in the treatment course, it should be discussed whether the foot is expected to be salvageable or needs to be amputated (**Fig. 8**). The combined rate of primary and secondary amputation is about 15% to 30%, depending on the severity of injury.[5,26,115,116] In case of extreme injury to the limb or when then patient's life is at risk, as in polytraumatized and polymorbid patients, a primary amputation should be performed.[6,27,117,118]

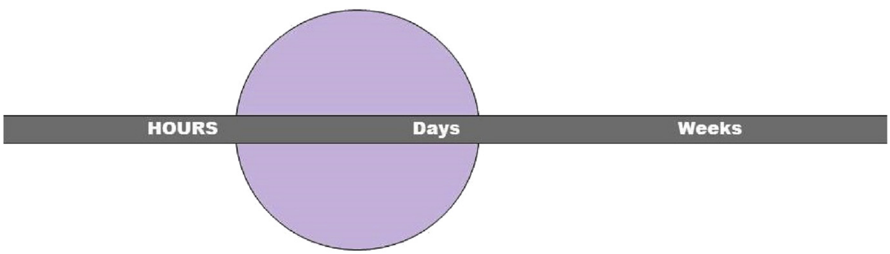

Fig. 8. Phase 3, Consider salvage/amputation.

In cases in which an amputation needs to be performed secondarily, the opinion of the patient should be considered in light of the shared decision making process, if the patients' condition allows for it. It is, however, primarily a decision based on the expertise of the treating physician combined with the results of a multidisciplinary team judgment. This team consists of (but is not limited to) the orthopedic (trauma) surgeon, emergency physician, plastic surgeon, radiologist, pain consultant (anesthesiologist), neurologist, rehabilitation manager, and psychologist.

A recent metaanalysis on severe lower limb trauma showed that reconstruction was psychologically more acceptable to patients compared with an amputation, although outcome scores for both treatment options were comparable.[119] In addition to a primary amputation or a late secondary amputation after failed salvage, regular assessments (early delayed decision) should be performed including the patient's perspective and rehabilitation progress.[120]

Whether or not an amputation is considered is based on patient-related and injury-related factors.[115] In general, an amputation leads to a shorter treatment time, fewer surgical procedures, and a quicker recovery.[121] However, prosthesis costs are greater than reconstruction costs, depending on the patient's age at the time of injury.[122]

Data from the LEAP (Lower Extremity Assessment Project) study showed that severe muscular damage at the lower leg, absence of plantar sensation, venous injury, ischemia, the need for soft tissue coverage, and a high Injury Severity Score are the most important factors leading to amputation.[115] Other factors that should be taken into account are pre-existing peripheral vascular disease and poorly controlled diabetes.[123] Indications for amputation, both primary and secondary, are as follows.[114,124,125]

- Absolute amputation indications
  - Severe polytrauma (previously classified as a score of 3–4 on the polytrauma score by Oestern)[126]
  - Uncontrollable bleeding (Advanced Trauma Life Support system [life before limb])
  - Resources and a lack thereof (war time or less well-equipped hospital)[127]
  - Complete amputation or remaining "skin bridge" only, without the resources for replantation
- Relative amputation indications (**Fig. 9**)
  - Nonreconstructable vascular injury[117]
  - Objectified tibial nerve transection
  - Loss of the talus
  - Loss of the weight-bearing foot sole
  - Crush injury to the forefoot (prolonged ischemia)

Fig. 9. Relative indications for primary amputation. (*A*) Nonreconstructable (vascular) injury. (*B*) Proven transection of tibial nerve. (*C*) Open talar extrusion with severe cartilage damage. (*D*) Loss of weight-bearing sole of foot. (*E*) Crush injury with ischemia of more than 6 hours.

Box 1
Predictive scores for limb salvage

AIS: Abbreviated Injury Score (A.A.A.M,[154] 1971)

Gustilo classification (Gustilo and Anderson,[33] 1976; Gustilo et al,[34] 1984)

HFS-97: Hannover Fracture Scale-97/98 (Tscherne,[155] 1983)

MESI: Mangled Extremity Syndrome Index (Gregory et al,[156] 1985)

PSI: Predictive Salvage Index (Howe et al,[157] 1987)

MESS: Mangled Extremity Severity Score (Johansen et al,[136] 1990)

LSI: Limb Salvage Index (Russell et al,[158] 1991)

NISSSA: Nerve injury, Ischemia, Soft Tissue Injury, Skeletal Injury, Shock, Age Score (McNamara et al,[159] 1994)

FASS: Foot and Ankle Severity Scale (Manoli et al,[160] 1997)

The Ganga Hospital Injury Severity Score (Rajasekaran,[161] 2005)

List of available limb salvage prediction scores. See text for references.

Over time, many investigators have tried to compute the need for an amputation and successfully predict limb salvage (**Box 1**).[127–137] These limb salvage scores were designed to decrease subjectivity and provide guidance in the difficult process of complex foot injury management. Ideally, a trauma limb salvage system would be 100% specific (all salvaged limbs have scores below the threshold) and 100% sensitive (all amputated limbs have scores at or above the threshold). In daily practice as reflected in the literature on several scoring systems, the specificity is mostly greater than 95%, but sensitivity lies at less than 60% to 70%.[128–137]

Results of the LEAP study showed the inability of scoring systems to predict the need for amputation accurately, although low scores may predict salvage.[130] An initial absence of plantar sensation was a poor predictor, because in one-half of the cases sensation returned.[131] Psychological and social factors proved more important than scoring systems in predicting outcome.[138] Future research should focus on the first postoperative phase, to prevent morbidity from prolonged salvage attempts, late amputations, salvaged limbs without sensation, and functional failures.[123,128]

Scoring systems are of limited use and should not be the sole criterion on which the decision to amputate is based.[139] They may aid in strengthening a clinical decision. One should keep in mind that predicting salvage or amputation is a prediction of neither outcome nor function.[114,132] Although the LEAP study, dealing with all severe lower extremity injuries, revealed no differences in outcome after salvage versus amputation, studies that focused on isolated severe foot injuries (“mangled foot and ankle”) showed significantly inferior functional results after foot salvage in both civilian and military cohorts.[29,31,140] All of these studies showed higher rates of complications and revision surgeries as well as prolonged hospitalization and rehabilitation in the salvage groups.[141,142]

DEFINITE TREATMENT

After the initial management and patient counseling, the definite treatment is undertaken. The different strategies are amputation and salvage (**Fig. 10**). Salvage includes anatomic reconstruction of the axial alignment and functional columns of the foot,

Fig. 10. Phase 4: Definite management.

early stable soft tissue coverage, and primary arthrodesis in cases of severe cartilage injury or gross instability. The timing of definitive treatment depends on the condition of the patient and the soft tissues. A recent prospective study demonstrated that multiply injured patients subjected to secondary definitive surgery between days 2 and 4 had a significantly (P<.0001) increased inflammatory response compared with that in patients operated on between days 6 and 8.[143]

Amputation

If primary amputation is warranted, it should be performed at the lowest, most distal level possible.[141,142] In case of high-energy trauma, it is rarely wise to create a definite stump early in the process. Skin and muscle necrosis might develop for several more days, and recurrent debridement is frequently necessary.[118] The type of amputation is largely affected by the level of injury and the availability of viable soft tissues. There is no clear evidence that a certain amputation technique is significantly better. However, in series comparing below the knee, through the knee, and above the knee amputations, the percentage of patients eventually walking with a prosthesis is greater in the below the knee amputation group.[144–146]

After more distal (Chopart, Lisfranc, or transmetatarsal) amputations, muscle balancing is mandatory.[123,147] Flexor and extensor tendons should be reinserted into the most distal remaining bones, if possible. To avoid flexion contracture, primary or secondary fusions may be considered, above all after Chopart amputations.[147] More proximal amputations (Pirogoff and Syme) still allow the patient to load their own heel. After a successful Pirogoff amputation, patients are still able to walk barefoot for short distances without the need for an orthosis. Results with this technique are better for posttraumatic amputation than after amputation for diabetic vasculopathy and the average loss of limb length is less than 3 cm.[147,148]

Stable Internal Fixation

Important surgical principles in posttraumatic foot surgery are precise reconstruction of the foot axes, the functional length of the medial and lateral foot column, and the longitudinal and transverse arches, that is, restitution of the normal foot anatomy.[52] Stable internal fixation has to be accompanied by early and durable soft tissue coverage.[113] Early free tissue transfer has the potential to lower infection rates after third-degree open fractures and allow for functional rehabilitation.[113,149,150]

Reconstruction

- Osseous first (from proximal to distal, but starting with the talus before pilon/ankle).[6,52]
- Primary fusions for severely comminuted intraarticular fractures.[123,151–153]

- Delayed closure using NPWT/vacuum-assisted closure[97-100]
- Early and stable soft tissue coverage (discuss the reconstructive ladder with the plastic surgeon from primary closure or split thickness skin grafts to pedicled or free flap closure as needed).[113,150]
- Frequently, depending on function deficit or deformity, a patient can significantly benefit from shoe adaptations, such as insoles, rocker bottom soles, stabilization in orthopedic shoes, orthesis, or silicone prostheses.

Outcome

There are 6 areas of outcome expectation: (1) the final expected function, (2) cosmesis and chronic swelling, (3) pain and loss of sensation, (4) duration of treatment, (5) cost of treatment, and (6) emotional factors.[123] Few studies report explicitly the results after complex foot trauma. Kinner and colleagues[5] reviewed 50 patients who fulfilled the Zwipp criteria for complex foot trauma[8,52] treated according to the principles as discussed after an average of 4 years follow-up. The mean American Orthopaedic Foot and Ankle Society score was 66.2. The Short Form-12 score showed a physical component of 38.2. And the visual analog scale foot/ankle score was 51.9. Eleven patients underwent primary and 7 patients secondary amputation. Secondary amputation was associated significantly with an Injury Severity Score of greater than 16 and primary soft tissue damage. The overall complication rate was 32%, with 8 patients requiring a free flap for soft tissue coverage. A total of 53% of the patients returned to their preinjury occupation, and 41% were able to perform sports (as compared with 77% before their injury). The complex foot trauma score correlated with the American Orthopaedic Foot and Ankle Society score and the restrictions in the activities of daily living.

When following 19 patients with similar severity of injury over an average of 6 years, Ferreira and colleagues[7] found nearly the same American Orthopaedic Foot and Ankle Society score (average 68.0) but also chronic pain in 15 cases (79%) and a chronic regional pain syndrome in 7 cases (37%). Eleven patients (58%) had a stiff foot, 6 (32%) had chronic ulcerations, and 2 (11%) had chronic osteitis. Still, almost one-half of the patients could return to their previous occupation. Possible reasons for the inferior results as compared with the study of Kinner and colleagues[5] were that most patients were treated with external fixation only and subjected to longer immobilization Most important, Ferreira and colleagues[7] reported 68% as having residual deformities.

Overall, the prognosis after complex injuries to the foot and ankle is hard to predict because of the relatively scarce literature and the high variability of the injury pattern. Results are determined by various confounders, such as overall severity of injury, comorbidities, complications, secondary interventions, and individual demands.[5,7,14] A subgroup analysis of the LEAP population with complex foot injury showed that patients with severe foot and ankle injuries who require free tissue transfer or ankle fusion have Sickness Impact Profile scores that are significantly worse than with below the knee amputations.[140]

SUMMARY

The treatment of complex foot injuries has come a long way in the past decade. One should always keep the end result in mind. Although saving the limb might be psychologically better at first, an insensate, nonfunctional, and/or painful stiff foot with the need for secondary interventions and prolonged hospitalization and rehabilitation might be a far worse outcome. Treatment should be individualized based on patient and injury characteristics. If the necessary facilities are not available, referral should be considered. If the decision to salvage the foot is made, anatomic reconstruction of the foot and ankle with stable internal fixation and early soft tissue coverage followed by an aggressive rehabilitation protocol and adequate orthopedic shoe modifications must be pursued to achieve maximal functional recovery. Complex foot injuries are difficult to treat and may take up to several years to manage.

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