

Timing of Operative Debridement in Open Fractures



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KEYWORDS

• Open fracture • Debridement • Surgical timing • Antibiotics

KEY POINTS

- Patients with open fractures are at high risk of infection if not treated expediently.
- The historic 6-hour time limit for debridement of open fractures has been challenged in contemporary publications.
- In the context of early antibiotic administration, debridement within 6 hours has not been shown to be an independent risk factor for infection after open fracture.
- Delayed versus primary wound closure is determined based on the clinical experience of the surgeon, but may not have an effect on infection rates.

BACKGROUND

An open fracture is defined as a fracture that involves a violation of the soft tissue envelope with communication through to the fracture fragments, the associated fracture hematoma, or both.¹ Although Gustilo and Anderson² espoused universal agreement that open fractures require emergent treatment to include adequate irrigation and surgical debridement of the open wound, few issues in orthopedics today are debated more than the appropriate timing and management of open fractures.^{3–11} However, there is consensus that these low- or high-energy injuries result in wound contamination, devitalized tissue, local edema, and surrounding ischemia that interfere with the body's natural immune defense mechanisms to resist infection.¹² As a result of thorough surgical techniques, antibiotic options and administration, and advanced techniques for soft tissue coverage, the ability to manage open fractures has improved. The treating orthopedic surgeon must be able to address these

injuries appropriately to limit the risk of infection and promote adequate healing.

This article addresses the evaluation of a patient with an open fracture and analyzes the evidentiary support regarding the historic "6-hour rule" in the timing of operative management.

HISTORICAL PERSPECTIVE

The use of excisional debridement to prevent wound infection dates back to the time of Hippocrates.¹³ In 1898, a German military surgeon and bacteriologist, Paul Leopold Friedrich, conducted an experiment using guinea pigs whereby he created open wounds in the triceps region and contaminated them with mud and house dust. Wounds were cleaned in intervals of 30 minutes. He found that when wounds were debrided within 6 hours of inoculation, the guinea pigs survived. All of the guinea pigs whose wounds were debrided after 8.5 hours died. Thus, Friedrich showed that the early phases of bacterial growth within contaminated

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wounds terminated within 6 to 8 hours after inoculation and that extensive debridement to viable tissue within this time period could decrease the risk of infection.^{14–16} Of note, Friedrich's work did not involve administration of local or systemic antibiotics. Before World War II, open injuries were left to heal by secondary intention.^{17,18} Military surgeon Joseph Trueta aptly described treatment of an open wound (ie, soft tissue injury) as the principal part of the treatment of an open fracture. He believed that the greatest danger of infection lay not in the infection of the bone, but rather the muscle. By the end of the war, Friedrich's study was adopted to reflect the time required to close open wounds.¹⁴ This "6-hour rule," although based primarily on historical opinion and limited clinical evidence,¹¹ has since been extrapolated to open fractures and was adopted as a treatment guideline in the orthopedic community for many years.^{9,19,20} Not until recently have many studies started to challenge the 6-hour rule, shifting away from the previous doctrine of emergently operating on open fractures.²¹

EPIDEMIOLOGY

The tibia is the most common location for an open fracture.¹ Its proximity to the skin and limited soft tissue envelope enable even low-energy fractures to violate the soft tissue envelope.^{6,22} Most open fractures occur in the fifth decade of life, commonly as a result traffic accidents, crush injuries, or falls.^{23,24} As with most fracture patterns, there is a bimodal distribution: lower energy injuries occur in the elderly most commonly from falls, whereas higher energy injuries occur in younger patients.²⁴ In a recent review, Court-Brown and colleagues²⁵ evaluated the epidemiology of open fractures over a 15-year period. They reported 30.7 open fractures per 100,000 person-years, a steady increase as compared with previous reports of 11.5 per 100,000 person-years.^{15,24} In their cohort, 69.1% occurred in males and 30.9% occurred in females.

As a result of the disruption of the protective skin barrier, injuries with exposed bone and soft tissue are more prone to infection. For open tibia fractures, an infection rate of 13% to 25% has been reported.¹⁰ Further studies have elucidated the differences in infection rate based on the Gustilo-Anderson classification system^{2,26} and the timing of operative debridement.^{6,11,27,28} In a retrospective review by Templeman and colleagues,²⁹ none of 29 type I fractures, 1 of 36 (3%) type II fractures, and 14 of 68 (21%) type III fractures became infected. Early administration

of antibiotics has been shown to be an extremely important factor in the prevention of infection following open fractures. Although antibiotic administration has been deemed "prophylactic," work by several authors has shown that antibiotic use is actually therapeutic.^{30,31} Most current recommendations suggest that antibiotics should be administered for 24 to 48 hours after the last debridement.^{5,11,18,21,32}

CLASSIFICATION

The Gustilo-Anderson classification of open fractures is the most commonly used system in current practice.³³ This system takes into consideration the energy of the fracture, soft tissue damage, and the degree of contamination.³⁴ In their retrospective (n = 673) and prospective (n = 352) reviews of 1052 open fractures,² a type I injury was defined as a low-energy injury with minimum soft tissue damage and a small (<1 cm) wound. These were typically inside-out puncture injuries with minimal comminution. A type II injury described a low- to moderate-energy injury with moderate soft tissue damage and an open wound up to 10 cm, but without periosteal stripping. Originally, a type III injury was an umbrella category for either an open, segmental fracture with extensive soft tissue damage, or a traumatic amputation. This description was found to be too inclusive, so Gustilo and colleagues²⁶ modified their type III classification several years later. A type IIIA injury has adequate soft tissue coverage despite the high-energy comminution and segmental nature, irrespective of the wound size. However, an injury with a wound greater than 10 cm was also characterized as IIIA. A type IIIB open fracture necessitates local or distant flap coverage of areas of exposed bone (not including skin grafting). In addition, these fractures are commonly associated with extensive periosteal stripping (Fig. 1). Finally, a type IIIC injury results in a vascular injury that requires repair to preserve limb survival. Isolated injuries to the anterior or posterior tibial artery are not included in this description (Table 1). Importantly, the final classification of the injury is determined in the operating room.³⁴ To test the reliability of this system, 245 surgeons were given clinical histories, physical examinations, radiographs, and video footage of the operative debridement of 12 open fractures. The overall interobserver agreement was a moderate 60% (range, 42%–94%).³⁵

More recently, the Orthopedic Trauma Association developed a more comprehensive

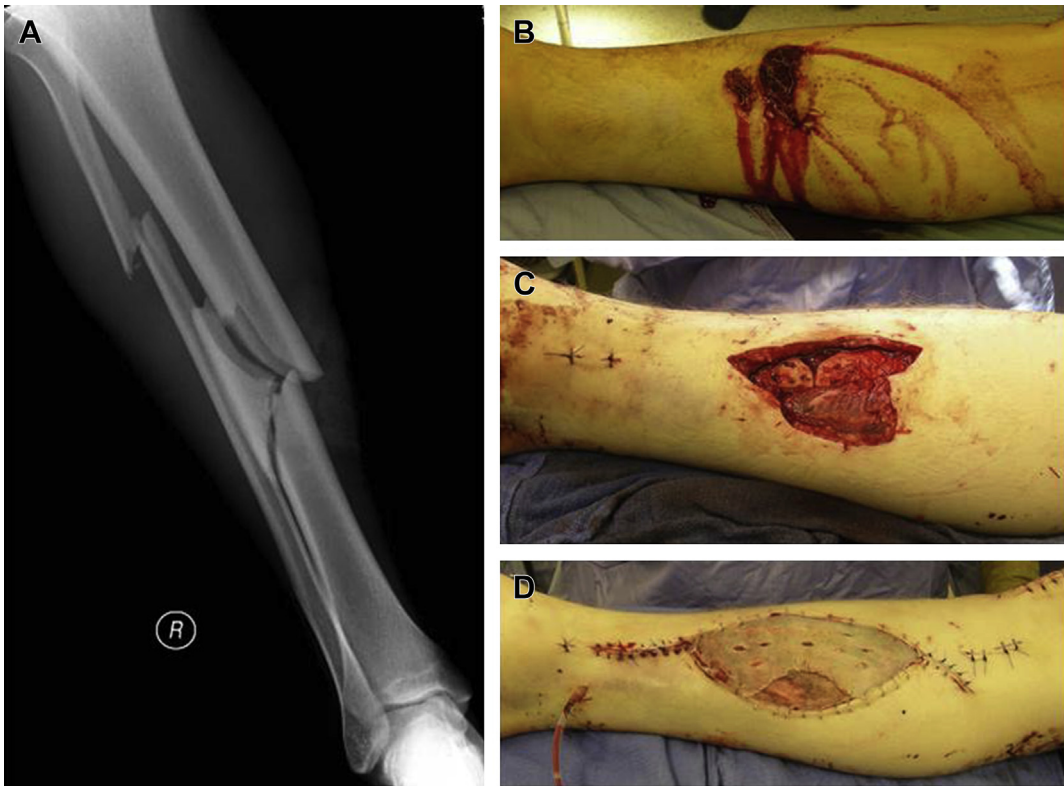


Fig. 1. Anteroposterior radiograph (A) and clinical image (B) of the right tibia in a 27-year-old male who sustained a Gustilo-Anderson type IIIB fracture after a motor vehicle accident. (C) Soft tissue defect after operative debridement. (D) Delayed soft tissue coverage with a rotational soleus flap and split thickness skin grafting. (Courtesy of [D] S. Kovach, MD, Philadelphia, PA.)

Table 1
Gustilo-Anderson classification of open fractures

Subtype	Description
I	Wound <1 cm; clean; simple fracture pattern; minimal comminution; minimal soft tissue damage
II	Wound 1–10 cm; simple fracture pattern; moderate soft tissue injury
IIIA	Wound >10 cm; extensive soft tissue injury with maintained soft tissue coverage over bone; high energy, comminuted, or segmental injuries
IIIB	Extensive soft tissue damage with periosteal stripping; inadequate soft tissue coverage of the area of injury
IIIC	Vascular injury requiring repair

Adapted from Cross WW, Swiontkowski MF. Treatment principles in the management of open fractures. *Indian J Orthop* 2008;42(4):381; with permission.

classification of open fractures, because the Gustilo Anderson classification was designed only for tibial shaft fractures and was shown to have only moderate interobserver reliability.³⁵ Therefore, based on an extensive review of the literature, the workgroup ranked 34 factors to classify open fractures independent of body site and age. The highest ranking factors included the presence of a skin defect, muscle injury, arterial injury, bone loss, and wound contamination. Contamination was included for its overall contribution to the risk of infection. These factors were each divided into 3 subcategories based on severity. The system was then applied to prospectively collected data of 99 open fractures to determine the clinical feasibility. To accurately assess the zone of injury and the tissue damage, the classification was implemented after the initial operative debridement (Table 2).³⁶ Although this system represents a comprehensive method to classify open fractures, further study is warranted to evaluate its reliability and validity on a larger scale.

Table 2
Orthopedic trauma association classification
of open fractures

Category	Severity
Skin	1. Able to approximate closure 2. Not able to be approximate closure 3. Extensive degloving injury
Muscle	1. No muscle death, intact muscle function 2. Muscle loss but function remains; some necrosis 3. Loss of function, necrotic muscle, disruption of muscle–tendon unit; muscle defect not able to be approximated
Arterial	1. No arterial injury 2. Arterial injury without ischemia 3. Arterial injury with distal ischemia
Contamination	1. None or minimal 2. Superficial contamination 3. (A) Deep contamination; (B) high-risk environment (ie, farm, fecal, dirty water)
Bone loss	1. No bone loss 2. Some bone loss but cortical contact between fragments remains 3. Segmental bone loss

From Orthopedic Trauma Association: Open Fracture Study Group. A new classification scheme for open fractures. J Orthop Trauma 2010;24:460; with permission.

INITIAL MANAGEMENT

The management of an open fracture begins in the emergency department. Antibiotics and tetanus prophylaxis should be administered in a timely fashion as early as possible.^{9,21,32,34} Any patient presenting with an open fracture who has not completed the tetanus toxoid immunization series or has not had their booster in the last 5 years should be given a tetanus toxoid booster. If the wound is prone to contamination with *Clostridium tetani*, the tetanus toxoid should be combined with human tetanus immune globulin. If more than 10 years have elapsed since the last tetanus booster or the patient has a compromised immune system, both tetanus toxoid and human tetanus immune globulin should be administered.³⁴

After an initial evaluation of the soft tissue injury and neurovascular status, the wound should be covered with a sterile dressing and the limb immobilized in a well-padded splint.²² The splint will assist in stabilizing the fracture and limit further shear forces across the soft tissue by limiting excessive motion of the bone fragments. Repeated uncovering and covering of the wound has been shown to increase the rate of infection by 3- to 4-fold,^{1,37} so a sterile or betadine-soaked¹⁸ dressing should be applied and not removed until the patient is in the operating room. If there is obvious debris or contamination this should be removed and irrigation at the bedside with a gentle normal saline lavage considered, but deeper debridement should be avoided at the risk of further contamination of the tissues with nosocomial organisms.²²

ANTIBIOTIC ADMINISTRATION

The urgent administration of antibiotics is a well-established critical step in preventing infection of open fractures. A systematic review of antibiotic administration in open fractures by the Eastern Association for the Surgery of Trauma produced several recommendations for treatment. This review found Level 1 evidence for 4 statements:

1. Systemic antibiotic coverage directed at gram-positive organisms should be initiated as soon as possible after injury,
2. Additional gram-negative coverage should be added for type III fractures,
3. High-dose penicillin should be added in the presence of fecal or potential clostridial contamination (eg, farm-related injuries), and
4. Fluoroquinolones offer no advantage compared with cephalosporin/aminoglycoside regimens (Table 3).

Moreover, these agents may have a detrimental effect on fracture healing and may result in higher infection rates in type III open fractures. Additionally, Level 2 recommendations were:

1. In type III fractures, antibiotics should be continued for 72 hours after injury or not greater than 24 hours after soft tissue coverage has been achieved, and
2. Once-daily aminoglycoside dosing is safe and effective for types II and III fractures.³⁸

Another recent review of management of open tibial fractures concluded that a first-generation cephalosporin in conjunction with an aminoglycoside is a reasonable antibiotic regimen for type III

Table 3
Recommended antibiotic prophylaxis regimen according to Gustilo-Anderson fracture type

Injury Type	Recommended Antibiotic Prophylaxis
Gustilo-Anderson type I	Systemic first-generation cephalosporin.
Gustilo-Anderson type II	Systemic first-generation cephalosporin.
Gustilo-Anderson Type III	Systemic first-generation cephalosporin plus aminoglycoside. Optional addition of local antibiotic-laden polymethylmethacrylate for large bone or soft tissue defects.
Farm injury or gross soil contamination	Addition of penicillin to above regimen.

open fractures, with the caveat that sufficiently powered randomized trials are still necessary to provide unequivocal evidence.³⁹ Regarding timing to antibiotic administration, Patzakis and Wilkins³² previously established that delays of greater than 3 hours resulted in a 1.63 times greater odds of infection compared with those receiving antibiotics less than 3 hours from injury. More recently, a retrospective study found that for type III open tibia fractures, antibiotic administration beyond 66 minutes was independently predictive of infection in multivariate analysis.⁴⁰

The effect of local delivery at the site of wound contamination in open fractures has been the focus of more recent studies on the subject. The utilization of antibiotic-impregnated polymethylmethacrylate cement beads has been shown to be an efficacious tool in the management of open fractures with severe bone or soft tissue defects.²³ Craig and colleagues⁴¹ conducted a metaanalysis of open fractures treated with intramedullary nailing comparing the use of locally delivered antibiotics plus systemic antibiotics with the use of systemic antibiotics alone. They found that the infection rate decreased from 31% for type IIIB and IIIC fractures to 9% for those treated with the addition of locally administered antibiotics. For type IIIA fractures, the rate decreased from 14.4% to 2.4% with the addition of local antibiotics. Included in this review was a retrospective study of 704 open fractures by Osterman and colleagues,⁴² which showed an infection rate of 4.2% for those treated with local antibiotics compared with 17% for those treated with systemic antibiotics alone. The available evidence regarding the efficacy of antibiotic-laden cement in large defect open fractures is compelling; however, most studies are of poor quality evidence and larger well-designed comparative studies on the subject are required to better classify the treatment effect accountable to local antibiotic delivery.

TIMING OF DEBRIDEMENT

The effect of delaying debridement beyond the 6-hour time frame is not entirely clear.⁴³ The pre-antiseptic war era observations and extrapolation of infection risk related to bacterial doubling times were likely contributing factors to development of the 6-hour guideline.^{26,44} Three early studies advocated debridement within 6 hours in keeping with the historical perspective.^{45–47} Kreder and Armstrong⁴⁵ reviewed 56 open tibia fractures in children, reporting that a delay of more than 6 hours was associated with a 25% increased overall infection risk compared with 12% in patients debrided within 6 hours. However, only 8 of the 56 patients were treated after 6 hours of injury, a number too small for statistical analysis of sufficient power. Kindsfater and Jonassen⁴⁶ showed a statistically significant difference in the rate of infection for types II and III open tibia fractures debrided beyond 5 hours (38% vs 7%, respectively).

In 1997, the British Orthopedic Association and British Association of Plastic, Reconstructive and Aesthetic Surgeons stated that the first orthopedic debridement procedure should be undertaken within 6 hours of injury.⁴⁸ In addition to the notion that deliberately delaying debridement of an open fracture may be unethical, there are a multitude of confounding variables that render a prospective, randomized study on the timing of debridement difficult to implement in a clinical setting.²¹ These include surgeon availability, mobilization timing of hospital and operating room resources, and the patient's clinical status. However, over the past 20 years, a large number of studies have sought to investigate and potentially challenge the 6-hour rule, prompting the British Orthopedic Association and the British Association of Plastic, Reconstructive and Aesthetic Surgeons to revise their

guidelines in 2009 in favor of debridement within 24 hours of injury. Much of this clinical evidence is derived from retrospective studies suggesting that, with the early administration of antibiotics, surgery may be delayed up to 12 to 24 hours without increasing the risk of infection.⁴⁹

In a rat femur model contaminated with *Staphylococcus aureus* and treated with a 3-day course of a first-generation cephalosporin along with operative debridement, no animal that received antibiotics and surgery 2 hours after injury had detectable bacteria.⁴⁸ Extrapolating this time frame to a clinical study, Khatod and colleagues⁶ evaluated 106 open fractures and found that there was no increase in infection with respect to patients treated after 6 hours compared with those treated within 6 hours. Further, no infections in any fracture type occurred if the initial operative treatment began within 2 hours of the injury. The overall rate of soft tissue infection was 22.6%, and the incidence of osteomyelitis was 5.7%.⁶ Similarly, Tripuraneni and colleagues²⁷ showed in a retrospective review of 206 patients with open tibia fractures that there was no difference in infectious outcomes based on irrigation and debridement at less than 6 hours (10.8%), 6 to 12 hours (9.5%), and 12 to 24 hours (5.6%). Patients were followed for at least 2 years. Over a 9-year period, Al-Arabi's group included 237 patients in a prospective study of open fracture debridement, citing no significant difference in infection rates for operative management earlier or beyond 6 hours (7.8% vs 9.6%; $P = .64$).²⁸ They also noted that a delay in antibiotic administration beyond 24 hours was associated with higher infection rates.

Most investigators have limited the evaluation of open fractures to the lower extremity and specifically the tibia given the increased incidence in this location.²⁰ In a retrospective analysis of 114 open extremity fractures, time delay was not identified as an independent risk factor for the development of deep infection. No difference in the injury-to-operation interval was found between infected patients (5.0 ± 2.0 hours) and uninfected patients (5.7 ± 3.2 hours). Three independent risk factors for fracture infection were identified: higher Gustilo-Anderson type (particularly types IIIB and IIIC), the use of external or internal fixation, and the location of the fracture within the lower leg.⁵⁰ By comparison, multiple studies have shown a 0% infection rate in patients with a type I open fracture.^{12,29,51–53} Harley's group, in a retrospective review of 215 open fractures, similarly identified increasing fracture severity as a predictor of an higher infection rate. However, a time to debridement of up to

13 hours after injury did not show an increased risk of infection. Univariate logistic regression analysis demonstrated that infection, increasing Gustilo-Anderson type, lower extremity fracture location, mode of fracture fixation, and duration of antibiotic treatment were found to be significantly related to the development of a nonunion.⁸

A recent prospective study of 315 patients with an open extremity fracture analyzed the timing of operative debridement on infection risk. Patients were grouped into categories of 6-hour time intervals and all patients were formally debrided within 24 hours. Type I injuries comprised 22.2%, 29.8% were type II, and there were a total of 48% of type III injuries. All patients received antibiotics. In univariate and multivariate analysis, there was no difference in infection risk between all of the groups up to 1 year after injury. The overall infection risk was 4.4%.²⁰

Weber and colleagues⁵⁴ used the time to orthopedic intervention to prospectively assess the development of deep infection, but also sought to evaluate the correlation between the timing of antibiotics, Gustilo-Anderson type, fracture location, and transfusion rate on the incidence of deep infection. Overall, 686 subjects completed the 1-year follow-up interview or the 90-day or greater clinical follow-up. Multivariate logistic regression showed no significant association between time to initial debridement and deep infection risk. Because most patients received antibiotics within 3 to 4 hours, there was no correlation between timing of antibiotics and infection risk in this cohort. The more severe injuries (type III) and lower extremity fractures were more likely to develop deep infection (16% and 17%, respectively) compared with type I injuries or upper extremity fractures (1% and 1.5%, respectively). Patients who received a blood transfusion were also more likely to develop a deep infection.⁵⁴ These results may help to delineate whether low-grade open fractures and those about the upper extremity require operative debridement emergently (ie, in the middle of the night).

The treatment algorithm for open fractures may also be applied to children. In contrast with Kreder and colleagues' prior study, a large retrospective multicenter review performed by Skaggs and colleagues¹³ evaluated 554 open fractures in children 18 years or younger and reported that the infection rates were similar regardless of whether surgery was performed within 6 hours or beyond 7 hours after the injury. The authors note that in the presence of antibiotic therapy, early debridement offers no additional benefit with regard to infection risk. This

becomes important for children who need to be referred to tertiary care centers for definitive management of their open fracture.

MULTIPLE DEBRIDEMENTS

In cases of gross wound contamination or a tenuous soft tissue envelope, delayed wound closure allows for multiple debridements and reassessment of the open wound. After the initial debridement, the use of sterile moist dressings, antibiotics beads, or negative pressure wound therapy closure devices can be used temporarily in preparation for further operative management while allowing the egress of bacteria under neutral or negative pressure. Illustrative of the efficacy of negative pressure, in a prospective, randomized study of 25 open fractures comparing standard saline dressings and negative pressure devices, patients in the negative pressure group developed zero acute infections and 2 delayed deep infections, compared with 7 total infections in the standard dressing group.⁵⁵

However, there are no objective clinical guidelines to determine when a wound is amenable to closure and thus the timing of wound closure falls on the experience of the operative surgeon.⁵¹ As such, debate continues regarding the value of immediate versus delayed wound closure in decreasing infection rates.^{4,18} Immediate primary closure may decrease patient length of stay, thereby decreasing the incidence of nosocomial infections which account for more infections after open fracture than contamination at the time of injury.⁵⁶

In an early study evaluating delayed versus primary closure for open tibia fractures, Russell and colleagues⁴ found that wounds closed primarily after the first debridement had a significantly greater risk of infection compared with wounds closed in a delayed fashion (20% vs 3%, respectively). They supported earlier findings that delayed primary closure at 5 to 7 days after injury is optimal.

In contrast, more recent studies have begun to challenge this approach. Using 6 different wound management techniques, DeLong and colleagues¹⁸ sought to compare the infection and union rates of open fractures. There were 25 type I fractures (21%), 43 type II fractures (36%), 32 type IIIA fractures (27%), 12 type IIIB fractures (10%), and 7 type IIIC fractures (6%) included. Closure methods included immediate primary closure, second-look primary closure, delayed primary closure, delayed skin grafts, delayed flaps, and primary amputation. No

differences were found either in union rates or infection rates among the different methods of closure after accounting for injury severity.¹⁸ In light of these results, immediate primary closure may reduce postoperative complications and the potential morbidity associated with repeated operative debridements.

In an effort to form a more objective basis for wound closure, Lenarz and colleagues⁵¹ instituted a protocol for open fracture debridement in which operative cultures were obtained after each washout. The patient was returned to the operating room every 48 hours until cultures were negative before definitive wound closure. If cultures became positive after 48 hours, the patient was observed clinically. For the 248 lower extremity open fractures studied, the mean number of days to closure for type I injuries was 0.76 whereas types IIIB and IIIC injuries required a mean of 14.47 and 18.5 days, respectively, to closure. The rate of deep infection was 4.3% and there was overall no difference in infection rate between upper and lower extremity injuries. The low rate of infection, specifically in type III injuries compared with other studies, may be reflected in their multiple debridement protocol. In addition, the presence of a positive culture did not seem to have an effect on the rate of deep infection and wound closure in patients with late positive cultures did not increase the risk of infection. The use of continuous antibiotic therapy during the entire course of treatment up to 6 weeks may have confounded this result, but the authors argue that from a surgical perspective, the best defense against infection is the quality and thoroughness of the surgical debridement.⁵¹

The ideal irrigant for the washout of open fractures has been investigated thoroughly.^{9,39,57,58} In a survey of 984 orthopedic surgeons, there was no consensus on the type of irrigant used and the intensity of lavage for open fracture debridement. The predominant preference, however, was normal saline alone via low-pressure lavage with 3, 6, and 9 L for type I, II, and III fractures, respectively.^{23,39,59} Anglen⁶⁰ conducted a prospective, randomized study of 400 open fracture patients and found that there was no difference in infection risk if castile soap or bacitracin-impregnated irrigation was used (13% vs 18%, respectively). A significant difference was found, however, in wound healing failure: 4% in the castile soap group and 9.5% in the bacitracin group. This study was followed with a multicenter study including 2447 patient evaluating both the type of irrigant used and the lavage pressure. Patients were followed for

12 months after injury. Reoperation occurred in 13.2% of patients in the high-pressure group and 12.7% of patients in the low-pressure group, which was not significant; reoperation occurred in 14.8% of the castile soap group and 11.6% in the saline group, which was significant. However, with regard to secondary endpoints of nonoperatively managed infection, wound healing problems, and bone healing problems, there were no differences across the groups.⁵⁸

Although conflicting evidence exists regarding the timing of wound closure, most orthopedic surgeons continue to abide by the original work of Gustilo and Anderson. "If there is the slightest doubt in the surgeon's mind as to whether there has been an adequate debridement of the wound after an open fracture, the wound should not be closed regardless of the type of open fracture."²

SUMMARY

Open fractures pose an increased risk of infection and require prompt attention and treatment. It is likely that multiple factors including fracture severity, adequacy of debridement, time to initial treatment, and antibiotic administration, among other variables, all contribute to the likelihood of infection and complicate isolating an optimal time to debridement. There is conflicting and insufficient evidence to suggest that debridement of all open fractures in accordance with the historical 6-hour reduces the risk of infection. However, unnecessarily delaying management of open fractures has not been shown to be appropriate. It is consistent with the information in this review to recommend debridement be performed once the patient is adequately resuscitated and stable for surgery with trained staff available. Early administration of appropriate antibiotics has been shown to be a critical factor in reducing and treating the open fracture, and delays in receipt of antibiotics should be considered in managing infection risk. The process of definitive fixation and wound coverage begins with the initial debridement, focusing on bony stability and infection prevention, while also taking into account patient comorbidities and overall nutrition and health status. The combined experience of the orthopedic and plastic surgeon in assessing the soft tissue and bony injury will improve patient care and favor earlier reconstruction, when appropriate. Until such a time when quality studies provide better evidence of the effect of delays in treatment on infection, surgeons should maintain a sense of urgency, but perhaps not emergency, in surgical debridement of open fractures.

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