Timing Issues in Fracture Management
A Review of Current Concepts

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Abstract
The timing of operative fracture care is often confounded by multisystem injuries, conflicting or absent literature, and lack of communication between orthopaedic surgeons and other physicians providing care to the patient. Much has been published regarding the proper sequence of events in providing care to patients with multisystem injuries. Only recently has the role of complex musculoskeletal injuries and the timing of fixation in multiply-injured patients been explored in detail. Timing of care for pelvic injuries is frequently determined by the presence of injury to other organ systems, the presence of open wounds, and hemodynamic status. There is likely an optimal time window for fixation. However, existing data is often difficult to compare, given varying definitions and protocols. Furthermore, reports are often conflicting, making the determination of an optimal time-window difficult. Similar concerns are present with lower extremity long bone fractures. Injury to other organ systems must be considered with timing of femur fixation, particularly in the presence of lung injury. Tibia fractures are frequently complicated by the presence of a tenuous soft tissue envelope and other injury factors that often alter the timing of fixation. These issues and, last, the timing of care for calcaneus and talus injuries are reviewed, as risk of avascular necrosis and quality of articular reduction are related to the timing of fixation.

In a 2005 national survey, fractures represented a significant proportion of severe injuries, with over one million hospital admissions related to musculoskeletal injury. For 2004-2005, fractures were and continue to be the leading cause of injury-related hospital admissions, and account for over half of all injury admissions. In people under age 65, lower extremity fractures are the leading cause of trauma admissions. Timing of operative fracture care is pertinent to both outcome and fiscal issues. By appropriately prioritizing and optimizing fracture management, decreases in morbidity, mortality, and hospital stays result in improved utilization of resources and reduced societal costs in association with a frequent injury of this population. From the patient’s perspective, appropriate timing of fracture care can improve long-term outcomes. This review focuses primarily on controversies and critical issues regarding the timing of operative fracture management. In addition, timing relative to pelvic, acetabulum, and femoral shaft fracture care are often affected by the presence of organ system injuries, and will be discussed in the setting of the multiply-injured patient.

General concerns related to the timing of fracture care include the presence of soft tissue injury and open fractures. Condition of the soft tissues in closed injuries is often the primary determinant of delays in management and the methods chosen for fracture fixation. Open fractures conversely increase the urgency of fracture care. The timing of debridement, closure, and coverage are controversial, with variable data supporting previous protocols. Gunshot wounds represent a unique subset of open fractures, the approach to which is partially determined by the energy of the injury.

Some fracture types warrant separate discussion. Femoral neck fractures are treated differently, depending on patient age and the energy of injury. Femoral shaft fracture treatment timing is often affected by other injuries and the general condition of the patient. Fractures of the tibia are particularly troublesome due the largely subcutaneous position of...
Fracture Care in the Multiply-Injured Patient

Multiply-injured patients can be divided into two general and distinct categories: those that are hemodynamically stable and those that are unstable. Strict adherence to Advanced Trauma Life Support® (ATLS®) principles is mandatory, as overlooked injuries or inadequate treatment of injuries will be detrimental or life threatening. The role of the orthopaedic surgeon in this setting is to determine the nature of the bony injury and the subsequent urgency of care in the setting of concomitant injuries. Of particular importance in the early phase of trauma care is the presence of pelvic or long bone fractures and the extent of associated soft tissue injury. The presence of vascular injury, neurologic deficits, and compartment syndrome are also within the province of the orthopaedic evaluation.

Hemodynamic Stability

Most of the classic literature on hemodynamic stability is based on evaluation of penetrating trauma (Fig. 1). The “triad of death” is a term coined to describe patient decompensation in the presence of acute blood loss, resulting in hypothermia, coagulopathy, and acidosis. Prevention or reversal of these factors avoids death by exsanguination. More recent studies account for the influence of orthopaedic injuries on this triad. In some cases, delaying or limiting early orthopaedic intervention can be beneficial. Applying these principles has been termed as “bail out” or “damage control” orthopaedic surgery, and represents a crucial part of appropriate management of the multiply-injured patient.

Prior to the extensive studies in the multiply-injured patient, the previous gold standard was fixation of long bones within 24 hours of injury. This was thought to minimize ongoing hemorrhage and possibly fat embolization. Due to the high incidence of complications associated with early fixation, this approach in multiply-injured patients has been called into question. With early fixation of long-bone fractures, blunt trauma patients fared worse than those patients who had surgical delays. Blunt trauma patients have a high incidence of thoracic and soft tissue injury, and represent the “first hit.” Early definitive fixation of long bones, par-

Figure 1 A 19-year-old female presenting with hemodynamic instability. A sheet was placed prior to laparotomy, followed by external fixation during the same procedure. Definitive fixation followed 1 week after admission. A, admission radiograph demonstrating an open book pelvis. B, Temporary external fixation and reduction of the symphysis. C and D, Definitive fixation of the right anterior column and pubic symphysis.
tic response to resuscitation are a serum lactate of under 2.5 mmol/L and base deficit of less than 8 mEq/L. These are useful in dictating the timing of fracture fixation were determined from the collective data of these studies.

Damage control orthopaedics (DCO) was a primary focus of this meta-analysis review. Its development was in response to poorer outcomes observed with early definitive fracture fixation and the associated "second hit." Temporizing external fixation allowed for the avoidance of lengthy procedures that may have worsened the trial of death. Particularly damaging were procedures lasting more than 6 hours, as these were associated with increased rates of ARDS and multisystem organ failure (MOF). The investigators concluded that factors of direct concern to orthopaedic surgeons were associated with adverse outcomes; these were, namely, the presence of multiple long bone fractures, pelvic trauma in the presence of hemorrhagic shock, presumed operative time of greater than 6 hours, and PA pressures over 6 mmHg during IM nailing, which is indicative of significant lung injury. By examining the indicators of adverse outcome, four physiologic factors resulting in decompensation in multiply-injured patients were identified. In addition to the previously described triad of death, soft tissue injury was a fourth and equally important factor affecting blunt trauma patients. This factor is intentionally nebulous, as fractures, compromise of extremity soft tissue, and chest injury all significantly affect the early phase course. Thus, fracture care is an important component in successfully managing multiply-injured patients.

Timing of fracture care is dependent on adequate resuscitation. Patient data readily available as markers of adequate response to resuscitation are a serum lactate of under 2.5 mmol/L and base deficit of less than 8 mEq/L. Urine output, pulse rate, and blood pressure should ideally all normalize prior to fracture stabilization. Of particular importance to outcome are reversal of coagulopathy and correction of core body temperature. One study noted a 100% mortality rate if core body temperature was not restored during the early phase. Assessment of these factors and the initial response to resuscitation allows placing patients into one of four categories during the early phase of resuscitation: stable, borderline, unstable and in extremis.

Some associated injuries are particularly problematic. Only one study investigated the influence of thoracic trauma as an independent marker of increased morbidity, and noted increased rates of MOF in the presence of thoracic trauma. Multiple studies demonstrate worsened lung function with thoracic trauma and its association with higher mortality rates. Therefore, employment of DCO is warranted in the setting of the multiply-injured patient. Indicators that are useful in dictating the timing of fracture fixation were determined from the collective data of these studies.

Pelvic Fractures

Pelvic fractures represent the third most common cause of death in motor vehicle collisions, with mortality rates rang-
ing from 5% to 42%. The wide range in mortality can be ascribed to numerous factors, including age, injury severity score, bony instability, open fractures, and bowel injury. As high energy pelvis injuries are rarely isolated, patient status ranges from stable to in extremis, depending on the extent and type of involved multiple organ system injuries.

Avoiding iatrogenic harm to the patient via inappropriate surgical timing and sequence requires an organized, multidisciplinary approach. Orthopaedic surgeons play a crucial role by engaging early in decision-making regarding timing of fracture fixation. Prior to the work of Letournel and Judet in the 1970s, pelvic fractures were managed nonoperatively with predictably dismal outcomes. Over the last 30 years, much has been written about the management of pelvic injuries. However, interpretation of this literature is confused by an inconsistent use of terms. “Early” surgery ranges from 8 hours in some studies to a week in others or as late as 21 days in another study. “Late” might encompass the period of 2 weeks to 3 months. Terms such as clinical and functional outcome are sometimes used interchangeably, further complicating the interpretation of existing data. Moreover, these are rarely isolated injuries, adding to the complexity of decision making.

Several factors play into the initial approach to bony stabilization, including hemodynamic status and response to resuscitation, fracture pattern, associated injury, and inflammatory status. Hemodynamic status is of particular concern, as the pelvis may be the primary source of bleeding or be contributing very little to bleeding. In the presence of ongoing thoracic or abdominal hemorrhage, orthopaedic management beyond placement of a pelvic binder is delayed. Associated long bone fractures should be immediately splinted with coverage of open wounds. Frequently, radiographs are delayed. Data presented recently suggest that temporary placement of a pelvic binder is safe, regardless of fracture pattern, and may reduce mortality in conjunction with early angiography.

Not uncommonly, debate will arise in the early management of the multiply-injured patient with an unstable fracture pattern regarding the proper sequence of events. A study looking at this scenario found that unstable fractures are likely to be the primary source of bleeding. A 60% mortality rate was encountered if laparotomy preceded pelvic angiography, compared with a 25% mortality rate if the sequence was reversed. Although this study was limited by a small number of patients, angiography prior to exploratory laparotomy was recommended in the presence of unstable fracture patterns.

Another frequent controversy is the timing of angiography versus external fixation. Miller reviewed 1,171 pelvic ring injuries and found that if contrast blush was present on initial CT, patients that were nonresponders to resuscitation had a 73% rate of positive angiography. They concluded that in patients with a contrast blush on CT associated with any degree of hemodynamic instability, angiography should precede pelvic external fixation. In contradictory studies arterial bleeding amenable to embolization is a rare occurrence in pelvic fractures, and, therefore, recommend emergent external fixation for hemodynamically unstable patients.

If the response to external fixation is inadequate, angiography should follow. This continues to remain a controversial issue, and is likely to vary between trauma centers. It is important that institutions have a protocol agreed upon by the various services, so care of these complex patients can be delivered efficiently.

For most abdominal procedures, a pelvic binder will not interfere with the operation. In the presence of unstable fracture patterns, placement of an external fixator should be allowed during the same round of anesthesia. For patients in extremis, external fixators may be placed bedside in the intensive care unit (ICU) if clearance for the operating room (OR) is unlikely. Open pelvis fractures are associated with high mortality rates due to hemorrhage in the early phase, and overwhelming sepsis in the days and weeks to follow. Emergent irrigation and debridement with definitive fixation, even in the presence of clean wounds, is warranted. Fecal diversion and repair of vaginal lacerations may also be needed.

Management of pelvic fractures frequently occur in the setting of the multiply-injured patient and add to the complexity of managing this injury. With hemodynamic instability or associated injuries preventing extended procedures, external fixation as a temporizing measure should be done early. The timing of angiography remains controversial but should be performed early, whether before or after external fixation. With open fractures, definitive stabilization can be performed in the early phase provided there is adequate resuscitation and clean wounds. In cases where definitive fixation is delayed, there is controversy as to the ideal time window for surgery. Recent data suggests allowing the acute inflammatory phase to pass. Five studies exist comparing early versus late fixation, none of which represent Level I evidence. Furthermore, data is confused by an inconsistent definition of “early” in these studies. Of these studies, only one presented outcome at 2-year follow-up.

The overall conclusion of these studies is that fixation within 2 to 3 weeks offers the best chance for improved radiographic and functional outcomes for pelvis and acetabulum fractures. After 3 weeks, callus and scar formation severely limit the ability to obtain an anatomic reduction, require more extensive approaches, and result in worsened functional outcomes. For high energy pelvis and acetabulum fractures, a delay in definitive fixation is the rule rather than the exception. Based on available literature, the ideal window for secondary procedures is 6 days to 3 weeks post-injury.

**Open Fracture Debridement**

The standard of care over the last century for open fractures has been emergent irrigation and debridement within 6 to 8 hours. However, no human studies supporting this protocol exist. These timing recommendations are likely derived from the pre-asepsis war era, data on bacterial doubling times, and limited animal studies. Several studies that call into
question the urgency of open fracture care exist. Skaggs and associates reviewed 554 open fractures in children and found only an association of time of antibiotic administration with decreases in infection rates. Debridement was performed as late as 24 hours post-injury. This study was limited by involving only pediatric fractures, and no attempt was made to examine other variables. Noumi and coworkers reviewed 88 patients and examined factors contributing to deep infection after IM nailing of open long bone fractures. Only the fracture grade was consistent with increased infection risk. AO classification was predictive of nonunion. However, no association was found between timing of debridement and the risk for infection or nonunion. Harley and colleagues reviewed 241 long bone fractures and recorded transport time from the field to hospital admission, which was frequently in excess of 8 hours. A weak association between debridement time after 13 hours and infection was found. The role of extended transport time and delay in antibiotics was not explored.

Timing of debridement should be determined by adequacy of resuscitation, presence of appropriate and alert staff, and OR availability. Open fractures should be considered an emergency rather than an admission in excess of limb-threatening injury. Although no Level I data exists, it is unlikely that the quality of data will improve, as there are numerous uncontrollable factors preventing such a study.

Timing of Open Fracture Wound Closure
Timing of delayed versus primary closure of open fractures is largely derived from wartime experience in the pre-antibiotic era as well. Trueta advocated closed treatment of open fractures. This introduced the principle of thorough debridement of devitalized tissue, after which the wound was encased in a cast not to be removed until healing occurred. According to Trueta, the cast was left in place, “unless it became wet and soft, or there was an intolerable stench, or the patient’s condition showed that some complication had developed.” With the introduction of penicillin, in 1943, debridement was no longer emphasized, and local wound complication rates increased. This introduced the principle of the second look, with closure between day 4 and 7 or closure by secondary intention if the wound bed was not clean. This is currently a widely practiced approach. Advances in wound care have improved soft tissue management with open fractures. At present, the best predictor of outcome is the adequacy of irrigation and debridement.

Confusion in the interpretation of the literature exists due to poor observer reliability in grading open fractures and the existence of few well-conducted studies regarding the timing of closure. Of the six studies regarding timing of open fracture closure in the English literature, five were retrospective case series or a mixed series. The only prospective study failed to grade wounds, and one study had only 62 patients. However, some conclusions of these studies are noteworthy. Benson and associates found that infection was independent of closure method. Cullen found no increased infection rate with primary wound closure of clean wounds in children after irrigation and debridement. DeLong reviewed six management methods, and found no correlation with infection rates.

Some studies examined the factors that affect the timing of wound closure. Gustilo and Anderson noted that wounds left open greater than 2 weeks were likely to develop nosocomial infections. Patzakis followed culture results obtained at initial irrigation and debridement, and found only an 18% correlation of isolates obtained initially with species identified in late deep infections. These studies suggest the wound may be most sterile after the initial irrigation and debridement. Although no Level I studies exist, primary closure is warranted on the basis of available data in clean wounds when atraumatic closure is possible. Delayed closure after a second look should be employed if the quality of tissue is in question after the initial irrigation and debridement.

Flap Coverage of Open Wounds
When flap coverage is required, it may be performed either during fracture stabilization or as a secondary procedure. One study investigated free flap coverage at three time intervals in 532 patients: immediately, within 72 hours of fracture stabilization, and after 72 hours. Earlier bone healing and reduced infection rates were seen if coverage was completed within 72 hours of fracture stabilization. A secondary benefit was a 10-fold decrease in length of stay. Another study involving 84 patients with type IIIb or IIIc tibia fractures found an increase in infection rate if flap coverage was delayed (30%, more than 72 hours vs 6%, fewer than 72 hours). Available data suggests flap coverage should occur within 72 hours in the presence of a clean wound bed and a stabilized fracture. Immediate skin grafting obviates a separate procedure.

Fractures Associated with Gunshot Wounds
Gunshot wounds always involve some degree of soft tissue injury (Fig. 3). The extent of injury is best described in terms of energy and velocity; high mass projectiles will...
impair a high quantity of energy and shotgun blasts result in massive soft tissue injury despite being low-velocity weapons. Fortunately, most gunshot wounds are low energy in the civilian setting. This results in the fracture rather than soft tissue dictating management strategy. Roughly half of all bony injuries involve the femur, 23% involve the forearm, 17% result in humerus fractures, and 11% include the tibia. With stable fracture patterns in low energy injuries, exploration may lead to increased risk of nonunion and infections. As a result, these injuries are often treated nonoperatively.

Unstable fracture patterns necessitate operative fixation. Irrigation and debridement should be undertaken in the setting of massive soft tissue injury that occurs with high energy and shotgun injuries. External fixation versus immediate definitive fixation is determined by the extent of soft tissue coverage, soft tissue viability, and wound contamination. Several studies found no increased risk of infection when definitive fixation was delayed. However, early surgery can significantly reduce length of stay and associated costs, and allow for early limb mobilization. Early antibiotic administration is essential, and includes a first generation cephalosporin. Studies support continued administration for 24 to 72 hours with low-energy injuries. Single dose aminoglycosides should be added if contamination is suspected or present up to 24 hours before surgery. High-energy wounds are always treated as open fractures. Addition of an aminoglycoside should be routine. These injuries require aggressive debridement, as the zone of injury always extends well beyond the missile tract. A vacuum effect seen with high velocity wounds will often drag foreign material into the wound, furthering the need for aggressive debridement. Any question of compartment syndrome should result in early fasciotomy.

Multiple debridements are often required in these cases, and are generally repeated every 48 hours on days 2 through 10 or until the wound edges are viable. Closure within 10 days has been associated with decreased length of stay, earlier mobilization, and lower risk of nosocomial infection.

**Femoral Neck Fractures**

Femoral neck fractures represent a wide spectrum of injuries, the consideration of which can be grossly divided into those that occur in the younger population versus those occurring in the elderly and the issue of high versus low energy. These categorizations may influence the urgency of fracture care. Hip fractures in the elderly are associated with a high mortality rate and are associated with poor functional outcomes. A recent investigation representing four centers and 1,206 patients is the first prospective trial associating timing of femoral neck and intertrochanteric hip fractures with outcomes. Fixation was performed either within 24 hours of admission or after more than 24 hours following admission. One-third had early surgery, with no improvement in mortality rates, no improvement in ambulation potential, and no difference in postoperative pain or length of stay after surgery. However, due to performing the procedure early, a decrease in duration of severe pain and overall length of stay was observed. The investigators concluded that early surgery is warranted in medically stable patients to reduce costs and control pain, although no functional improvement was seen at 6 months.

**Young Patients and Femoral Neck Fractures**

The risk of avascular necrosis (AVN) in young patients sustaining femoral neck fractures is 30% to 35%. It was thought that early anatomic reduction and decompression of the intracapsular hematoma were essential in reducing this risk. Indeed, anatomic fixation has been shown to reduce the risk of AVN, and femoral head blood flow is improved with early fixation. However, little is known regarding the long-term functional implications of this data. A recent study using a retrospective cohort of 38 patients examined the effect of early versus delayed fixation of femoral neck fractures in patients 60 years of age or younger. This particular age was chosen as it was the most common cutoff for performing a primary total hip or hemiarthroplasty. Patients were followed for at least 2 years and consisted of an early and late cohort; 29 patients had displaced fractures at an average age of 46 years. Functional outcomes and AVN rates were compared. Although no difference in functional outcome scores was present, there was a statistically significant increase in AVN in the late fixation group. The investigators conclusions were tempered by limitations in the study that included a small cohort and a shorter average duration of follow-up in the late fixation group. It is also possible that the end results of increased AVN rates may not manifest for many years, warranting further study.

Concern over the effects of increased intracapsular pressure secondary to hematoma has also raised questions about...
the risk of AVN. Of the 29 femoral neck fractures in this study, decompression was performed in only one case, and no increase in AVN was observed. Previous studies documented increased pressure with femoral neck fractures, but do not correlate this with increased AVN rates. One study exists that found increased rates of AVN, but discovered a correlation with the severity of the fracture pattern rather than the presence of hematoma. The investigators conclude the utility of the functional scores would be best with approximately 1,200 patients, necessitating a large multicenter trial. Furthermore, a follow-up of 10 years would be needed to determine the long-term effects of AVN. At present, the best conclusion that can be drawn is that early fixation for patients under 60 when feasible may reduce the rate of AVN, although this may not have any effect on outcome.

**Femoral Diaphysis Fractures**
As previously discussed with multiply-injured patients, early external fixation with all but stable patients is standard. Bhandari and coworkers conducted a meta-analysis of existing literature concerning conversion to definitive fixation. Of the 185 patient cohort, all studies were Level IV evidence and included open fractures, which limits applicability to closed injuries. Low infection rates across all studies were observed if conversion occurred within 28 days. Although not significant, there was a trend to increased infection after 28 days. Nowatarski and colleagues reviewed 59 femoral shaft fractures, of which 40 were closed injuries. Most were converted within 7 days, and 4 underwent staged conversion secondary to pin drainage. They likewise encountered low infection rates, and high healing rates. The study concluded that conversion within a week is safe, and staged conversion in the presence of draining pin sites yields good results. Limited data regarding the ideal time to conversion from external fixation exists. However, the general window of 2 to 4 weeks yields high rates of union and low infection. After 4 weeks of external fixation, consideration to completion in external fixation should be given. Bhandari reviewed nine studies concerning IM nail conversion of tibial fractures; all studies included open fractures. However, the overall trend was decreased infection rates for conversion to IM nailing within 28 days.

**Tibial Fractures**
Tibial plateau fractures can be categorized by age of the patient and the energy of the injury. Higher energy injuries are often associated with ligamentous, vascular, and degloving injuries. Additionally, high energy fractures are characterized by comminution and typical fracture patterns. Shatzker types IV through VI are associated with extensive soft tissue injury and poor outcome. The treatment goals of these injuries are restoration of the mechanical axis, restoration of joint congruity, and minimization of iatrogenic soft tissue injury. Early management of high energy tibial plateau fractures includes a thorough neurovascular examination, assessment of swelling, fracture blisters, skin avulsion, and maintaining a low threshold for suspicion of compartment syndrome. Each of these factors has a bearing on the timing of operative management. Immediate surgery is indicated in the presence of vascular injury and compartment syndrome. Open fracture care timing is controversial as discussed previously. Early knee spanning external fixation is appropriate for nearly all high energy injuries and may be indicated by significant pre-tibial swelling and articular incongruity, or either alone.

Soft tissue conditions ultimately dictate the timing and method of tibial plateau fracture fixation, as the condition of the soft tissue envelope is the best predictor of postoperative wound complications. Some have advocated immediate fixation prior to the development of swelling. However, surgery is rarely able to be completed within 8 hours of injury, by which time significant swelling has occurred and will likely complicate wound closure. Furthermore, swelling will progress after surgery, potentially worsening the risk of wound complications.

**Soft Tissue Injury and Tibial Fractures**
Tscherner devised a classification scheme for soft tissue injuries in closed tibial shaft fractures. However, as with many classifications, its use is limited by poor observer reliability. These injuries are also a continuum, defying discreet categorization. Nevertheless, it is still used to provide a general idea of injury severity. Injuries are graded C0 to CIII based on severity and presence of associated conditions. In addition to wound grade, clinical signs are also of importance. Loss of skin wrinkles indicates extensive swelling, as does delay in capillary refill or blanching of skin edges during closure. Fracture blisters are problematic, as bloody blisters indicate an incompetent epidermis and are associated with a high incidence of wound complications. Three options for surgical management of tibial fractures exist: immediate definitive fixation, delayed stabilization after provisional splinting, and staged external fixation. Fixation within 24 hours is acceptable for C0 or CI injuries, and is not precluded by the presence of superficial abrasions and mild contusions. This situation commonly presents with simple diaphysis and low-energy ankle fractures that present early.

Delayed fixation is indicated for CII or CIII injuries. Surgery within the first week carries a high risk of complications. Early fixation of plateau fractures in this category is associated with a 42% rate of wound complications and a 33% rate of osteomyelitis. Multiple studies have identified high complication rates with early fixation of tibial plafond fractures. The study with a delay of 24 days exhibited the lowest complication rate. One study is an obvious outlier and may represent a different severity of injury from the other investigations. Two studies employed a similar protocol of early external fixation, with fibula fixation followed by delayed definitive fixation. It seems that the ideal time for definitive fixation of tibial plafond fractures is between 12 and 24 days. The data concerning management of tibia fractures suggest there is little downside to delaying definitive
fixation pending recovery of the soft tissue envelope. Early stabilization with splinting or external fixation allows for maintenance of alignment and length, shortening the time to recovery of the soft tissue, and simplifying the definitive procedure. How late is too late for conversion from external fixation is uncertain, but conversion within 4 weeks appears to correlate with reduced infection risk.

**Hindfoot Fractures**

Calcaneus injuries are also complicated by a tenuous soft tissue envelope. Available studies suggest a narrow window for fixation exists; 7 to 14 days are often required for diminution of swelling, and after 3 weeks, wound closure and fracture callus can be problematic. Early fixation of these fractures has been associated with skin flap necrosis, infection and the need for multiple surgical interventions.

The talus has a tenuous blood supply, resulting in a high incidence of AVN with displaced neck fractures. Closed reduction may be attempted, and thereby delay the need for urgent surgery. However, such reduction is difficult to obtain and maintain. Although concern over the risk of AVN was the reasoning behind emergent reduction, no decrease in AVN has been observed with early reduction. However, skin tenting often mandates emergent operative intervention.

Open talus fractures are common with Hawkins 3 and 4 fractures. If extruded and planned for reinsertion, emergent irrigation and debridement are required.99 Two out of 19 treated patients had postoperative infections, and functional outcomes were difficult to assess. Overall, the conclusion was that immediate irrigation and debridement followed by reimplantation is a safe procedure, and preserves normal anatomy. However, high failure rates are observed regardless of treatment strategy, necessitating salvage procedures such as hindfoot fusion. In cases where immediate reimplantation is not possible, delayed reconstruction and fusion with bulk allograft is an option. However, clinical experience is limited to small series and case reports.100

**Conclusion**

The timing of operative fracture care is often complicated by multiple issues, particularly in the presence of other injuries. Due to confusing and often conflicting data regarding the timing of fracture care, early involvement in patient care by the orthopaedic service is essential. Discussion with other involved specialties can facilitate appropriate care, and minimize fracture complications. Orthopaedic surgeons thus play a crucial role in ensuring the optimal patient care, and should be active participants in the decision-making process.

**Disclosure Statement**

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