Morbidity and Mortality of Bilateral Femur Fractures

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abstract

Bilateral femur fractures have been associated with frequent morbidity and mortality. Associated injuries and massive hemorrhage contributed to mortality rates that were as high as 27% in previous reports. The goals of this study were to determine the frequency of associated complications, including mortality, and to identify which patient and injury features are associated with increased morbidity and mortality. The authors proposed that some patients with bilateral femur fractures may undergo early definitive fixation with an acceptable rate of complications. Patients who had bilateral femur fractures during the same injury event were retrospectively reviewed. Demographic characteristics, associated injuries, and the type and timing of treatment were determined. Complications were identified. The authors identified 50 men and 22 women, with a mean age of 41.5 years, who had high-energy bilateral femur fractures. These patients accounted for 5.5% of all femur fractures treated at the authors’ institution over a period of 11 years. Two patients died before fixation. In addition, 13 other patients (19%) had 21 complications, including pneumonia in 6 (8.6%) and deep venous thrombosis in 7 (10%). No patient had adult respiratory distress syndrome, but 2 died of multiple organ failure. All patients with pulmonary complications had an underlying chest injury ($P=0.004$). The overall mortality rate was 6.9%, and mortality was associated with higher mean age and higher Injury Severity Score (ISS). Of the 60 patients who had definitive fixation within 24 hours of injury, 53 (88%) had no complications. Complication rates were similar to those reported in the literature, with a mortality rate of 6.9%, including 3 patients who died after femoral fixation. Mortality was associated with advanced age and higher ISS. Chest injuries were associated with pulmonary complications. Most patients had early definitive fixation without complications, but it is not possible to predict which patients may be safely treated on an early basis. [Orthopedics. 2015; 38(7):e588-e592.]

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Femoral shaft fractures are common, and most are the result of high-energy events (ie, motor vehicle collision, motorcycle crash, fall from a height, crush injury). Men 18 to 30 years old frequently sustain these fractures. Bilateral femoral fractures occur much less often, affecting fewer than 10% of all patients with femoral shaft fractures, but have greater concurrent morbidity.\textsuperscript{1-3} Substantial hemorrhage occurs with bilateral femur fractures, with mean blood loss of 2 L. Patients with open injuries may lose several liters of blood.\textsuperscript{1,4-6} Furthermore, most patients who sustain bilateral femoral fractures have injuries to other systems.\textsuperscript{1,2,4,7} Associated abdominal injuries increase the amount of total hemorrhage, severe chest injuries are a major risk factor for pulmonary complications, and head injuries are associated with prolonged hospital stay and ventilation times.\textsuperscript{2,4,5,8,9}

Previous studies showed high rates of morbidity and mortality in patients with bilateral femur fractures. Mortality rates of up to 27% have been reported, although some of these studies are more than 10 years old and included small numbers of patients.\textsuperscript{1,2,4,7} Variable strategies for the timing and type of fixation have also contributed to controversy when treating these injuries.\textsuperscript{4,7} Early definitive fixation of femoral shaft fractures can be associated with greater rates of complications and multiple organ failure in patients who are insufficiently resuscitated to tolerate definitive surgical procedures.\textsuperscript{12-15} The potential for morbidity and mortality is even greater with bilateral femur fractures because more initial bleeding and longer surgical times are anticipated compared with unilateral injury. Some institutions have adopted protocols for patients who have fractures and multiple system trauma. These protocols encourage damage control tactics, including femoral external fixation, until patients are adequately resuscitated.

The goal of this study was to review a recent large series of bilateral femur fractures in terms of clinical and radiographic results, including rates of associated complications and mortality as well as patient and injury features associated with increased morbidity and mortality. The authors proposed that some patients with bilateral femur fractures may undergo early definitive fixation with acceptable rates of complications.

**Materials and Methods**

The authors performed a retrospective review to identify femur fractures treated between 2001 and 2011 at an urban Level I trauma center. Patients included in the study had bilateral fractures with both fractures treated surgically. Isolated metaphyseal and articular distal femur fractures were excluded. Skeletally immature patients and patients with fractures as a result of neoplasms or low-energy mechanisms were excluded. During the study period, 1249 unilateral femoral fractures were identified. The authors identified 72 patients with bilateral femur fractures (5.5% of all patients), including 50 men (69%) and 22 women (31%), with a mean age of 41.5 years (range, 17-91 years) and mean Injury Severity Score (ISS) of 30 (range, 9-59) (Table 1). Of the 144 fractured femurs, 19 (13%) were open fractures. Motor vehicle collisions were the most frequent cause, accounting for 52 injuries (72%), whereas motorcycle crashes accounted for 9 (13%). In addition, 45 patients (63%) also had other extremity fractures and 20 patients (42%) had injuries to other organ systems, including 28 associated head injuries (39%), 26 chest injuries (36%), and 12 abdominal injuries (17%).

All femoral fractures were treated surgically with standard methods. Patients with open fractures underwent urgent surgical debridement and received intravenous antibiotics. Provisional external fixation was used in 2 patients because of highly contaminated wounds as a result of open fracture of the involved femur. Diaphyseal fractures were definitively stabilized with reamed, statically locked intramedullary nails, whereas associated proximal and distal fractures were treated with standard reduction and plating methods at the surgeon’s discretion. This occurred in 47 fractures. In terms of timing, 60 patients (86%) with 120 femur fractures were treated within 24 hours of injury, 5 patients (7.1%) were treated within 24 to 48 hours, 2 patients (2.9%) were treated within 48 to 72 hours, and 3 patients (4.3%) were treated more than 72 hours after injury. Two patients died of other injuries before they had femoral fixation. Postoperative antibiotic prophylaxis and deep venous thrombosis prophylaxis were standardized. Postoperative activity was at the discretion of the treating surgeon.

Medical records were reviewed to determine demographic characteristics, associated injuries, complications, and mortality. Complications included pneumonia,\textsuperscript{16} deep venous thrombosis, pulmonary embolism, surgical wound infection, sepsis,\textsuperscript{17,18} adult respiratory distress syndrome,\textsuperscript{19} acute renal failure,\textsuperscript{20} and mul-
tiple organ failure.\textsuperscript{21} The type of treatment and timing of surgery were determined. Secondary procedures to treat the femur on a delayed basis were also noted. Statistical analysis was performed with the 2-tailed Fisher’s exact test for categorical data. Unpaired \( t \) tests were used for continuous demographic variables, with \( P < .05 \) considered significant.

### RESULTS

Two patients died within several hours after injury and did not undergo provisional femoral fixation. One patient was 87 years old and had an associated closed acetabular fracture. He became hypotensive and had cardiac arrest. A second patient, 35 years old, exsanguinated while undergoing exploratory laparotomy with multiple ruptured abdominal organs. Thus, 2 of the 72 patients identified with bilateral femur fractures died before treatment of these fractures (2.8%). Of the 70 surviving patients, 13 (19%) had 21 other complications during the initial hospital course (Table 2). No surgical wound infections occurred. Deep venous thrombosis was the most common complication, occurring in 7 patients (10%). Six patients (8.6%) had pneumonia, but no patient had adult respiratory distress syndrome. Five patients (6.9%) died. In addition to the 2 patients discussed earlier, another died as a result of massive hemorrhage, with injuries that included pelvis fracture, head injury with loss of consciousness, chest injury with multiple fractured ribs, and liver laceration. Two others died as a result of multiple organ failure. All but 1 of the femoral fractures in surviving patients healed primarily. One nonunion (0.7%) occurred after antegrade nailing and was successfully treated with exchange nailing.

Patients who had early complications were reviewed in more detail to determine whether certain underlying patient or injury features were associated with morbidity and mortality. Mean age, mean ISS, and sex were not different in patients with vs without complications. However, patients who had chest injuries were more likely to have complications. Of the 13 patients with complications, 10 had a chest injury (77%). Only 16 patients with an uncomplicated course (28%) had a chest injury (\( P = .002 \)). All 7 patients who had pulmonary complications had an underlying chest injury (\( P = .004 \)). The original head or abdomen injuries were not associated with complications. Mean age of the patients who died was 66.2 years, significantly higher than the mean age of the others (\( P = .005 \)). Mean ISS in this group was also higher (44.4 vs 28.1, \( P = .002 \)). Of the 5 patients who died, all had a chest injury, 4 had an abdominal injury, and 3 had a head injury.

There was no association of surgical timing with the development of complications (\( P = .16 \)). Sixty patients (86%) had definitive fixation of femur fractures within 24 hours of injury. Two other patients had provisional external fixation within 24 hours. Fifty-three who had stabilization within 24 hours (88%) had an uncomplicated course. Five patients who were treated on a delayed basis also had an uncomplicated course, but the other 3 patients who were treated on a delayed basis had complications. However, both patients who had multiple organ failure and later died had undergone early definitive fixation of bilateral femoral fractures. Provisional external fixation may have reduced the risk of organ failure in these 2 patients.

### DISCUSSION

Although bilateral femur fractures are uncommon, they are associated with substantial morbidity and mortality because of the magnitude of associated hemorrhage and the frequency of other systemic injuries. The goals of the current study were to characterize factors associated with increased morbidity and mortality in patients with bilateral femur fractures and to determine whether early definitive fixation can result in acceptable rates of complications in some patients.

The rates of associated complications, including mortality, were determined. Complications occurred in 19% of patients who were treated surgically, and this figure compared favorably with other published literature. A large series of patients with bilateral femoral fractures reported pulmonary complications in 25% and multiple organ failure in 25%.\textsuperscript{4} None of the current patients had adult respiratory distress syndrome, which was noted in as many as 15% of similar patients.\textsuperscript{7} The definitions of such complications were not provided in previous publications, and differences from the definitions used in the current study may account for some of the variability in complication rates.\textsuperscript{19} Higher ISS and mortality rates were noted compared with patients with unilateral femoral fractures.\textsuperscript{1,4} Mortality has been reported in association with bilateral femur fractures in up to 27% of patients.\textsuperscript{1,6} Mortality rates now may be lower than earlier reported rates because of improvements in trauma care in the past 10 to 20 years.\textsuperscript{3} Further, 2 studies reported much lower mortality rates, and the authors included only patients who had definitive femoral fixation (5.6% mortality)\textsuperscript{2} and underwent fixation within 48 hours of in-
jjury (5.6% mortality). Similarly, the current study reported 5 deaths, including 3 in patients who survived the first several hours to undergo definitive fixation (3 of 70; 4.3% mortality).

In the current study, higher mortality rates were associated with advanced age and higher ISS. Advanced age inherently increases the risk of death because of pre-existing physiologic maturity and reduced cardiac, pulmonary, and other systemic reserve.

The current study found no association between a greater risk of mortality and any specific type of associated injuries that would lead to a higher ISS. However, chest injury was a strong risk factor for pulmonary and other complications. All of the patients in the current study who had pulmonary complications had a chest injury. This finding is similar to previous studies that showed higher mortality rates in patients who had both bilateral femur fractures and chest injuries.

The authors’ institution did not have a protocol in place for damage control orthopedics. During the study period, the orthopedic surgeons at the institution primarily adhered to a philosophy of early definitive care. Only 2 patients in the current study underwent provisional fixation, in both cases as a result of highly contaminated open wounds and not because of unstable hemodynamics or other extreme patient status. Early definitive fixation of most unilateral femur fractures is recommended in stable patients. Although 88% of the patients who underwent definitive stabilization of femoral fractures within 24 hours did not have complications, multiple organ failure could be mitigated in severely injured patients by incorporating damage control tactics to minimize systemic inflammation.

This approach appears most important in patients who are insufficiently resuscitated. In addition, patients with associated unstable pelvic ring or spine fractures may be not be suitable candidates for early definitive fixation. Two patients in the current study had associated pelvic fractures. One had symphysal plating and percutaneous iliosacral screw placement in the initial surgical setting, and the other had bilateral iliosacral screw fixation deferred to later surgery. A good alternative would be to use damage control tactics to address femoral fractures when associated musculoskeletal injuries preclude early safe definitive care. It is not possible to determine which patients may be safely treated with early definitive fixation. Further study will help define the group of patients for whom early fixation can expedite mobility from bed, reducing pulmonary and other complications while minimizing the costs of secondary procedures and reducing hospital stay.

Limitations

This study was limited by the relatively small sample size, which consisted of patients who were similar in age and associated injuries. It was also limited by the retrospective nature of data acquisition. Resuscitation protocols and standardized decision-making processes for surgical timing and technique were not available. To acquire these 72 patients, the authors collected data from more than 10 years. The study did not account for treatment advances and practice variations during that time. However, several issues of clinical relevance were addressed.

Conclusion

The current study findings complemented previous work that showed that patients with fractures of multiple long bones, specifically, the femur, are at increased risk for complications. Mortality and ISS in these patients have been noted to be greater than in patients with unilateral femoral fractures. Complications occurred in 19% of the current patients, comparing favorably with earlier work. Most of the complications were deep venous thrombosis and pneumonia. Patients with chest injury were more likely to have complications, and patients who died had higher mean age and ISS. Although 88% of the patients who underwent definitive stabilization of femoral shaft fractures within 24 hours of injury had no complications, the authors cannot provide recommendations about the safety of this tactic or guidelines for implementation of damage control procedures with provisional external fixation. Further study is required to address these issues.

References


