

Society of Black Academic Surgeons

Assessment of racial and sex disparities in open femoral fractures



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KEYWORDS:

Femur;
Open fracture;
Disparities;
Complications;
Trauma;
Surgery

Abstract

BACKGROUND: Open femoral fractures are common; however, many factors may affect treatment protocol. We aim to assess any racial/ethnic or sex disparities associated with the definitive fixation of open femoral fractures.

METHODS: ICD-9 codes from the National Trauma Data Bank (2007 to 2010) for patients greater than or equal to 18 years with open femoral fractures who underwent operative management at level I or II trauma centers were identified and analyzed.

RESULTS: Of the 9,406 cases, the majority were White (61%), men (73%), and aged between 25 and 44 years (41%). The odds of definitive fixation after hospital day 2 (odds ratio [OR] .96, 95% confidence interval [CI] .82 to 1.09, $P = .53$) or any complication (OR .96, 95% CI .79 to 1.15, $P = .69$) were not associated with race/ethnicity. Men were 17% less likely to have surgery after hospital day 2 (OR .83, 95% CI .78 to .96, $P < .001$), and 18% more likely to have a complication (OR 1.18, 95% CI 1.03 to 1.35, $P = .02$).

CONCLUSIONS: There are no racial/ethnic disparities associated with the timing of definitive fixation. Men are more likely to undergo fixation earlier than women; however, they are more likely to have a complication. Fixation within the first 2 hospital days may decrease complications.

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Femoral fractures are common injuries seen in orthopedic and trauma surgeries, affecting all age, sex, and racial groups. There are several well-established treatment modalities for both open and closed femoral fracture types; however, definitive timing of fixation in the management protocol of open fractures has been an evolving issue. Open

femoral fractures are true orthopedic emergencies, and initial management is governed by the Advanced Trauma Life Support System guidelines, including fluid resuscitation, prompt administration of antibiotics,^{1,2} and early irrigation and debridement (I&D).³

As many patients with open femoral fractures have been subjected to high-velocity forces, they may present with an isolated injury, but more likely, in a polytrauma setting require prioritization of fracture management and the need to stabilize the more immediate life-threatening injuries. Nonetheless, the literature agrees that common goals of open fracture management are in accordance with those outlined by Chapman and Mahoney;⁴ (1) prevention of

The authors declare no conflicts of interest.

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Manuscript received August 25, 2014; revised manuscript November 24, 2014

infection, (2) achieving bony union, (3) avoiding malunion, and (4) restoring function.⁴

Previous studies have demonstrated that immediate fixation for less severe fractures, Gustilo grade I and II, will result in a similar outcome to closed injuries. There is no significant increase in morbidity. Delayed fixation and closure have been recommended for more severe fractures (ie, grade III open fractures).^{1,5-7} Regardless of severity, the timing of early irrigation, debridement, and antibiotic administration is agreed upon by the literature and in the standards of practice, yet few publications discuss time to definitive fixation with all associated perioperative complications. A 2002 study by Harley et al reviewed the time to definitive treatment defined as operative I&D followed by fracture stabilization in open long bone fractures. The authors did not find any significant differences in those who underwent fixation early (<8 hours from injury) versus late (>8 hours from injury) with regard to infection rates.⁸

Conversely, other authors have suggested that early fracture stabilization can lead to increased morbidity and mortality based on the "2 hit hypothesis." The first hit is the traumatic event, and the subsequent surgical intervention is the second hit.^{9,10} In the management of open fractures in the polytrauma patient, fractures may be stabilized initially with something less invasive, such as external fixation, until the patient's other injuries are addressed. Delayed fixation will decrease the systemic inflammatory response, which was believed to be responsible for poorer outcomes observed at the time.¹² Nonetheless, unanimity has not been achieved regarding the management of all open femoral fracture types.

Although the field of orthopaedics is starting to place a greater emphasis on the importance of investigating race/ethnicity and sex differences,¹¹ a review of published data from 2008 to 2011 by Somerson et al¹¹ demonstrated that few orthopedic clinical trials included evaluation of race or ethnicity disparities. In addition to standards of practice, patient-related factors such as socioeconomic status (SES), insurance, or surgical comorbidities may affect the individual treatment protocol. The literature has included common covariates to control for potential confounding in many of their analyses, but has not looked to identify racial/ethnic or sex disparities in outcomes of management.

We hypothesize, based on previous literature describing disparities of the management in trauma patients,¹³⁻¹⁵ that racial minorities and women will take longer to receive definitive surgical fixation of their open femoral fractures, and will thus have increased odds of perioperative complications. As such, we aim to assess any racial/ethnic or sex disparities associated with the timing of definitive surgical fixation in the treatment of open femoral fractures and associated predictors of perioperative complications.

Methods

We conducted a retrospective analysis of the National Trauma Data Bank (NTDB). In 2010, the NTDB contained almost 2.5 million patient records submitted by over 650 trauma centers in the United States, and is managed by the American College of Surgeons.¹⁶ Since 2007, the American College of Surgeons established the National Trauma Data Standard, enhancing the reliability of the database allowing the focus of the analysis on years 2007 to 2010.¹⁷

Patients were identified using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD9-CM) codes for open femoral fractures, who were greater than or equal to 18 years old, and underwent open reduction and internal fixation (ORIF) (ICD-9 code: 79.35) of the femur at a level I or level II trauma center. We excluded patients who were dead on arrival or died in the emergency department, whose race/ethnicity was not documented, level III trauma center patients, or where the trauma center classification was unknown.

Previous literature utilized a time to surgery range of 8 to 48 hours.^{8,18} Univariate analysis demonstrated a mean of days to surgery around 2 days, as such we established our timing benchmark as having surgery within the first 2 hospital days or after hospital day 2 (HD 2). Univariate analysis was conducted to determine demographic data. Bivariate and multivariate logistic regressions were used to compare outcomes in those who had surgical fixation after HD 2 compared with those who had surgery on hospital day 1 (HD 1) or HD 2, as well as identify predictors of perioperative complications.

We controlled for covariates such as insurance type, injury severity score (ISS), age, and pre-existing comorbidities including but not limited to obesity, bleeding disorders, diabetes mellitus, smoking history, congestive heart failure, hypertension requiring medication, steroid use, and history of myocardial infarction within 6 months of presentation. Perioperative complications analyzed included acute respiratory distress syndrome (ARDS), pneumonia, deep venous thrombosis, deep surgical site infections (DSSIs), myocardial infarction occurring within 30 days of injury, organ/space surgical site infection, superficial surgical site infection, stroke/cerebral vascular accident, cardiac arrest requiring cardiopulmonary resuscitation, wound disruption, sepsis, and overall/any complication.

The NTDB provides the following fields for race: Asian, American Indian, Native Hawaiian or other Pacific Islander, Black or African American, White, and other race.¹⁷ For the analysis, we separated White and Black races, and included the remaining fields under the category of "other race." Analyses were conducted using Stata 11/MP (Stata, College Station, TX).

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