

Civilian Ballistic Femur Shaft Fractures Compared with Blunt Femur Shaft Fractures: Open or Closed?

David Albert Patch, MD; Eli Levitt, MS; Henry Vinson Bonner, BS; Jared Ross Halstrom, BS; Jared Watson, BS; **Clay A. Spitler, MD**

University of Alabama at Birmingham, Birmingham, AL, United States

Purpose: Civilian ballistic femur fractures are treated commonly in urban trauma centers but there is limited information on outcomes due to difficulty in long-term follow-up. The purpose of this study is to assess ballistic femur shaft fracture outcomes and compare them to closed and open femur shaft fractures sustained via blunt mechanisms. We hypothesized that ballistic femur shaft fractures would have similar outcomes to blunt open fractures.

Methods: A retrospective cohort study at a Level I trauma center was performed to identify ballistic femur shaft fractures treated with intramedullary nailing (IMN) between 2018 and 2020. Exclusion criteria were age less than 16 years or follow-up less than 3 months. Three distinct groups were formed: a ballistic fracture group, a blunt closed fracture group, and a blunt open fracture group. Main outcome measures included unplanned reoperations, deep infection, need for soft-tissue reconstruction, nonunion, malunion, hardware failure, and compartment syndrome. Deep infection was defined as any patient requiring surgical debridement after definitive fixation with positive cultures or the presence of positive cultures at the time of nonunion surgery.

Results: A total of 471 femur shaft fractures were identified. A group of 56 ballistic fractures and comparison groups of all femur shaft fractures sustained via blunt mechanisms and treated with IMN were included in the analysis. Among the two subgroups of nonballistic injuries, 253 were blunt closed fractures and 162 were blunt open fractures. Compartment syndrome only occurred in the ballistic fracture group. In comparison of the blunt closed and ballistic fractures, there were no differences in the rate of compartment syndrome (7.1% vs 0%, $P = 0.13$) or nonunion (3.6% vs 5.1%, $P = 0.67$). The ballistic group required fewer reoperations compared with the blunt closed group (10.7% vs 13.4%, $P < 0.001$). The ballistic group had a higher incidence of deep infection than the closed fracture group (8.9% vs 3.6%, $P = 0.041$). Soft-tissue reconstruction was higher in the ballistic group compared to the closed fracture group (4% vs 0.4%, $P = 0.02$). There were no significant differences between the ballistic group and the open blunt group in deep infections (8.9% vs 6.2%, $P = 0.49$), soft-tissue reconstructions (3.6% vs 0.62%, $P = 0.72$), reoperations (10.7% vs 9.9%, $P = 0.85$), and compartment syndrome (7.1% vs 0%, $P = 0.13$). The proportion of nonunion was 3.6% in the ballistic group and 6.3% in the blunt open fracture group ($P = 0.49$).

Conclusion: Ballistic femur fractures do not perfectly fit with blunt closed or open femoral fractures, but their outcomes more closely resemble those of blunt open fractures. A high index of suspicion for the development of compartment syndrome should be maintained in ballistic femur fractures. The overall rates of nonunion were similar between all groups, but the deep infection rate was significantly higher in the ballistic group than the closed blunt group.