

Open Proximal Femur Fractures From Ballistic Injuries Treated with an Antegrade Intramedullary Nail: The Ominous Sign of a Vascular Injury

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Purpose: Gunshot injuries to the proximal femur create uncommon fracture patterns. These injuries often present with significant comminution and soft-tissue damage, including vascular injury. As a result, they can be difficult to treat. While many studies discuss early management and outcomes of gunshot injuries to the femoral diaphysis, there is limited data evaluating the treatment of these injuries in the proximal femur. The anatomy of the proximal femur differs from the diaphysis as it consists of metaphyseal bone along with a wider medullary canal. This makes treatment with an intramedullary device more difficult, especially in the face of comminution. The aim of this study is to report clinical outcomes of a cohort of patients with open proximal femur fractures associated with gunshot injuries treated with an antegrade intramedullary nail.

Methods: A retrospective medical record review was performed of all patients with gunshot wounds and associated proximal femur fractures (AO/OTA-31/32 fracture within 5 cm of lesser trochanter) treated at our Level I trauma center with an antegrade intramedullary nail from 2008 to 2016. Patients were included if they had appropriate follow-up to determine union or if a secondary surgery was performed to address nonunion. Outcome measures included fracture union, nonunion, malalignment, vascular injury, infection, and reoperation.

Results: 57 patients met our inclusion criteria with 29 (mean age of 35 years) having appropriate clinical follow-up to determine union (average of 10 months). Using the AO/OTA classification, there were 2 (7%) 31-A3.2, 10 (34%) 31-A3.3, 5 (17%) 32-A3.1, 4 (14%) 32-B3.1, and 8 (28%) 32-C3.1 fractures. Union was achieved in 93% of the patients as determined by painless weight bearing and bridging callus on orthogonal radiographs. Malalignment ($>5^\circ$ of angulation in any plane) was present in 14%. Vascular injury requiring surgical treatment occurred in 4 patients (14%). The overall infection rate of the cohort was 14% with 75% of the infected patients having vascular injuries ($P = 0.004$). Two patients were found to have infected nonunions and both (100%) had associated vascular injuries.

Conclusion: Open proximal femur fractures associated with ballistic injuries can be treated successfully with antegrade intramedullary nail fixation. However, patients with vascular injuries that require repair are at increased risk for infection and nonunion.