Do Long-Segment Blocking Screws Increase the Stability of Intramedullary Nail Fixation in Proximal Tibia Fractures, Eliminating the "Bell-Clapper Effect?"

Derek S. Stenquist, MD*; Meghan Mccaskey, MD; Steven Munassi, DO; Miguel Diaz, MS; Giovanni Ayala, MD; David Donohue, MD; Hassan Riaz Mir, MD*
Tampa General Hospital, University of South Florida, Florida Orthopaedic Institute, Tampa, Florida, UNITED STATES

Purpose: Blocking screws are used to achieve and maintain reduction with intramedullary nailing. In many patients (especially geriatric), there is a mismatch in diaphyseal and metadiaphyseal canal size thus minimizing cortical contact with the nail. This allows for motion of the nail within the metadiaphysis, and at the most distal end of a long moment arm for metaphyseal fractures (the "bell-clapper effect"). Prior studies have demonstrated that placing blocking screws into the long-segment (rather than the short-segment) increases the stability of retrograde nail fixation in distal femur fractures by eliminating the "bell-clapper effect." The purpose of this study was to examine if the same concept would apply in proximal tibia fractures.

Methods: Unstable extra-articular proximal tibia fractures (OTA / AO 41-A3) were created; all specimens were instrumented with an intramedullary nail. All nails were locked with a standard construct (4 proximal screws and 2 distal screws). Specimens were then divided into 2 groups (6 matched pairs per group). Group 1 consisted of a proximally augmented construct, with a blocking screw placed in the proximal metaphyseal segment lateral to the nail (short-segment blocking screw). Group 2 consisted of a distally augmented construct in which a blocking screw was placed 1 cm distal to the fracture and medial to the nail (long-segment blocking screw). Specimens were then axially loaded and cycled to failure or run-out.

Results: Tibias treated with long-segment blocking screws had greater baseline stiffness (807.32 ± 216.95 N/mm) than those treated with short-segment blocking screws (583.12 ± 130.1 N/mm, P = 0.078). The average horizontal translation of the proximal tibial fragment at the osteotomy site was less with long-segment blocking screws (0.29 mm vs 1.3 mm, P = 0.07). No differences were found between the long-segment blocking screw and short-segment blocking screw groups in the average number of cycles to failure (47,383 cycles vs 46,445 cycles, P = 0.67), or stiffness after cyclic loading (768.59 ± 210.31 N/mm vs 721.04 ± 267.71 N/mm, P = 0.78).

Conclusion: Long-segment blocking screws appear to increase stiffness and decrease fracture site translation in an unstable geriatric proximal tibia fracture model treated with intramedullary nailing. The effects are less dramatic than those seen in the distal femur, likely due to differences in bone and implant geometry. Surgeons may consider adding distal long-segment blocking screws in proximal tibia fractures to help mitigate the "bell-clapper effect."