Comparison of Three Methods for Maintaining Interfragmentary Compression After Fracture Reduction and Fixation in an Osteoporotic Sawbones Model

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Purpose: The purpose of this study is to compare 3 different methods of maintaining interfragmentary compression in distal femur fractures after reduction and compression of the fracture with a reduction clamp in an osteoporotic Sawbones model. Our hypothesis is lag screws will not have a significant difference in maintenance of compression compared to positional or locking screws in osteoporotic bone.

Methods: A distal femur plate was used to place pilot holes for the lag screws, positional screws, and locking screws to ensure consistent placement between specimens and uniform, safe placement of the pressure transducer. The intra-articular fracture was then created using a jig and bandsaw to place a vertical split fracture exiting laterally 8 cm proximal to the joint. The fracture was reduced with a pressure transducer in place and clamps were placed with approximately 20 pounds of force. Two 3.5-mm cortical lag screws (group 1), two 3.5- mm cortical positional screws (group 2), and four 5.4-mm distal locking screws through a distal femur locking plate (group 3) were placed across the fracture using standard technique and with a torque-limiting screw driver (lag and positional screws at 1.3 N·m, locking screws at 4 N·m). After releasing the clamp, the interfragmentary compression force was measured. After 2 minutes a steady state was reached and the force recorded again. Statistical analysis was performed using Kruskall-Wallis analysis of variance for comparison of the initial force after clamp removal between the 3 groups. Wilcoxon sgned rank tests were used for comparing baseline force to steady state force within each group.

Results: There were no differences between the 3 groups with respect to initial force applied with the clamps (P= 0.577). Within each group, there were no significant differences between the residual (immediately after clamp removal) and steady state interfragmentary force measurements (2 minutes after removal of clamp) (P >0.232). Locking screws through the plate (group 3, n = 5) only maintained 30.5% of the initial compression force applied by the clamps (P = 0.004), whereas the steady state compression force of the positional screws (group 2, n = 5) and lag screws (group 1, n = 5) increased by 53.7% (P = 0.0586) and 64.2% (P = 0.08), respectively. The steady state forces in the lag screws group and positional screws group were significantly greater than the steady state force of the locking screws through the plate (group 3) (P <0.05 for both comparisons).

Conclusion: In an osteoporotic Sawbones model, when reducing intra-articular distal femur fractures and applying interfragmentary compression with reduction clamps, lag screws and positional screws stoutly maintain, if not increase, the compression force across the fracture, while locking screws with a plate alone result in a loss of compression force. This study supports the use of positional or lag screws outside of the plate before locking screws for fracture fixation in patients with osteoporosis.