Biomechanical Comparison of Cephalomedullary and Reconstruction Nails Used in the Treatment of Subtrochanteric Femur Fractures

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Purpose: We sought to compare the biomechanical characteristics of 2 nail-composite femur models designed to simulate reconstructed unstable subtrochanteric femur fractures.

Methods: Eight composite femora were osteotomized to produce identical models of an unstable subtrochanteric femur fracture (OTA 32-C3.i). The simulated fractures were then fixed using either a DePuy Synthes TFN- ADVANCED (TFNA) proximal femoral nailing system or the DePuy Synthes FRN-ADVANCED (FRNA) femoral recon nailing system. The reconstructed fractures were all subjected to a compressive mechanical testing protocol consisting of cyclic loading and a destructive ramp-to-failure. Interfragmentary motion of the proximal and distal bone segments was tracked at multiple identical locations using 3D motion-capture techniques.

Results: The TFNA withstood a significantly higher maximum force (3512.5 N vs 3055.22 N, P = 0.027) than the FRNA and a difference in energy to failure approached significance (35.6 J vs 18.30 J, P = 0.050). The TFNA also exhibited higher magnitudes of proximal segment displacement at the greater trochanter (7.65 vs 4.72, P = 0.045) but not at the distal segment (3.52 vs 2.62, P = 0.205). There were no differences in overall construct stiffness (506.81 N/mm vs 409.74 N/mm, P = 0.212). In all models, the implant underwent plastic deformation as the mode of failure.

Conclusion: In simulated unstable subtrochanteric femur fractures, the TFNA is both stronger and allows more proximal segment motion before failure when compared with the FRNA. Fracture site motion was the same regardless of implant, which is clinically relevant when considering strain at a healing fracture.