

PMMA Implants Increase Femoral Strength

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The number of osteoporotic hip fractures is projected to increase two to three fold in the next 30 years. This will lead to increased mortality and nursing home placement with significant costs to our society. Although in clinical trials drug and hormone therapies have shown an important decrease in fracture risk there is a significant role of surgical implantation treatments to further reduce the risk in specific subpopulations. Strength testing was completed on four pairs of osteoporotic, two pairs of osteopenic, and two pairs of normal cadaver femurs. The fracturing was recorded with a video camera at 4000 frames per second. The specially designed test fixture was instrumented with three load cells

to measure the femoral forces. Force and moment data were recorded simultaneously and correlated with the frames. The fracture force at the greater trochanter was used to characterize the strength of implanted/nonimplanted osteoporotic femurs. All femurs began fracturing within about 60 ms at a test speed of 100 mm/s. During the first 20 ms, the relationship between force and displacement was nonlinear, but linear thereafter until the fracture occurs. The fracture events resolved completely within 10–20 ms. The average strength increase of the implanted femurs was 79% compared to the nonimplanted controls. The simultaneous acquisition of fracture images and load data is a powerful tool to understand and characterize numerically the femoral fracture. This methodology allows the researcher to define the best metrics to compare competing reinforcement materials, implant designs and surgical procedures.