

Appendix

To assess the adequacy of the current model in simulating osteoporotic purchase, we conducted a small pilot study involving third-generation Sawbones humeri (model 3304) to evaluate the pullout strength of cortical screws. Screws were inserted into holes that were drilled to 0.3 mm less than the screw diameter, as described in the manuscript. The constructs were then attached to a Bionix MTS axial servohydraulic testing machine. Pullout was performed at a rate of 0.1 mm/sec of axial displacement³⁵. The resulting load-displacement curves were constructed and analyzed. The peak load achieved prior to pullout and a drop in load was determined.

One screw pulled out at 1270 N, and one screw pulled out at 1123 N (average, 1197 N). Although limited conclusions can be made from so few specimens, with the standard technique of hole preparation and screw insertion as well as the homogeneous nature of the synthetic material, it is unlikely that significant variations would have occurred with additional specimens.

These data are within the range of osteoporotic cadaveric bone pullout strength as reported in the literature. Stromsoe et al. conducted pullout tests with use of 4.5-mm cortical screws in cadaveric diaphyseal bone³⁶. The average age of the donors at the time of death had been seventy-four years, and all bone densities were $<1.0 \text{ g/cm}^2$ (average, 0.77 g/cm^2), indicating osteopenia or osteoporosis. The median pullout force was 4180 N (range, 600 to 6440 N). The pullout strength of about 1200N in this pilot study is well within this range. The great variability seen in that study underscores the difficulties of conducting standardized tests in osteoporotic human bone.

A full-scale validation study with more specimens, repeat testing, and comparisons with human osteoporotic bone is necessary and is currently being conducted. However, our pilot data indicate that this method adequately simulates the reduced screw-holding power of osteoporotic bone and allows for the use of a homogeneous synthetic material to study screw purchase in osteoporotic bone.