Biomechanics of Osteoporotic Fracture Fixation

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Osteoporotic fracture is now a challenging problem in orthopaedic practice.The major technical problem facing the surgeon is the difficulty in obtaining secure fixation of an implant to osteoporotic bone. There is less cortical and cancellous bone for the screw threads to gain purchase, so that the pull-out strength of implants is significantly reduced. The load transmitted at the bone-implant interface can often exceed the reduced strain tolerance of osteoporotic bone. This may result in micro-fracture and loosening of the implant, with secondary failure of fixation. Consequently, the common mode of failure of internal fixation in osteoporotic bone is bone failure rather than implant breakage. Fixations of osteoporotic bone require some changes in surgical technique in order to decrease the risk of failure at the bone-implant interface. These include the use of relative stability techniques such as intramedullary nails, fixed-angle devices, bone augmentation. Relative stability techniques are the most efficient at reducing strain at the bone-implant interface, as the implant is within the load-bearing axis of the bone. Locking plate fixation of metaphyseal fractures is effective in osteoporotic bone as it avoids high strain at a single screw while the implant provides a large contact area at the bone-implant interface. Locking plates are very useful as they resist angular deformation and torsion. The holding power of an implant can be increased further by having locked screws at multiple fixed angles. Bone augmentation can be achieved by using bone autograft or allograft, bone cement or bone substitutes. Understanding mechanic behavior of fixation methods will help surgeon choose and perform the fixation of osteoporotic fractures properly for more expected positive result.