

OSTEOSCOOP

News on current events in osteoporosis and rheumatology

Fracture healing: micro-computed tomography tells more

N°107 – November 2009

Noninvasive characterization of fracture callus structure and composition may facilitate development of surrogate measures of the regain of mechanical function. As such, quantitative computed tomography- (CT-) based analyses of fracture calluses could enable more reliable clinical assessments of bone healing. Although previous studies have used CT to quantify and predict fracture healing, it is unclear which of the many CT-derived metrics of callus structure and composition are the most predictive of callus mechanical properties.

The goal of this study [1] was to identify the changes in fracture callus structure and composition that occur over time and that are most closely related to the regain of mechanical function. Micro-computed tomography (μ CT) imaging and torsion testing were performed on murine fracture calluses ($n=188$) at multiple postfracture timepoints and under different experimental conditions that alter fracture healing. Total callus volume (TV), mineralized callus volume (BV), callus mineralized volume fraction (BV/TV), bone mineral content (BMC), tissue mineral density (TMD), standard deviation of mineral density (σ TMD), effective polar moment of inertia (Jeff), torsional strength, and torsional rigidity were quantified. Multivariate statistical analyses were used to identify differences in callus structure and composition among experimental groups, and to determine which of the μ CT outcome measures were the strongest predictors of mechanical properties.

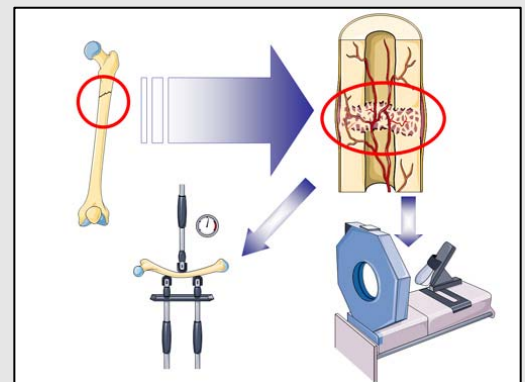
Although calluses varied greatly in the absolute and relative amounts of mineralized tissue (BV, BMC, and BV/TV), differences among timepoints were most strongly associated with changes in tissue mineral density. Torsional strength and rigidity were dependent on mineral density as well as the amount of mineralized tissue: TMD, BV, and σ TMD explained 62% of the variation in torsional strength ($P<0.001$); and TMD, BMC, BV/TV, and σ TMD explained 70% of the variation in torsional rigidity ($P<0.001$).

These results indicate that fracture callus mechanical properties can be predicted by several μ CT-derived measures of callus structure and composition. These findings form the basis for developing noninvasive assessments of fracture healing and for identifying biological and biomechanical mechanisms that lead to impaired or enhanced healing.

1. Morgan EF et al. Bone. 2009;44:335–344.

Fracture healing: micro-computed tomography tells more

Noninvasive characterization of fracture callus structure and composition may facilitate development of surrogate measures of the regain of mechanical function. Comparison of fracture callus mechanical properties with micro-CT-derived measures show that callus strength can be predicted by several μ CT-derived measures of callus structure and composition. These findings form the basis for developing noninvasive assessments of fracture healing and for identifying biological and biomechanical mechanisms that lead to impaired or enhanced healing.



PROTELOS[®]

Treatment of postmenopausal osteoporosis to reduce the risk of hip and vertebral fractures

