Xu W, Ganz C, Weber U, Adam M, Holzhüter G, Wolter D, Frerich B, Vollmar B, Gerber T
Evaluation of injectable silica-embedded nanohydroxyapatite bone substitute in a rat tibia defect model
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Abstract: In clinical practice, vertebral compression fractures occur after trauma and osteoporosis.
Kyphoplasty is a minimally invasive procedure using bone filler material for the treatment of such fractures. A full synthetic injectable bone substitute (SIBS) was manufactured by means of spray drying. The aim of this study was to characterize the SIBS and to analyze the remodelling process during degradation of the biomaterial and new bone formation after implantation. SIBS is an aqueous suspension of donut-like microparticles. These microparticles consist of nanocrystallites of synthetic hydroxyapatite embedded in amorphous silica gel. After implantation of SIBS in a proximal tibial diaphyseal defect in 52 rats, grafts were harvested for subsequent analysis on different days. Newly formed bone originating from endosteum was observed on day 6. Hematomas in the medullary space and cortical wounds disappeared on day 12. The wound region was completely replaced by a composite of newly formed cancellous bone, extracellular matrix, and SIBS. At day 63 the cortical defect was fully healed by bone, while newly formed bone in the medullary space almost disappeared and was replaced with bone marrow. In conclusion, SIBS demonstrated a unique structure with osteoinductive and bioresorbable properties, which induced fast bone regeneration. Therefore, a clinical application of SIBS for kyphoplasty is promising.