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Early matrix change of a nanostructured bone grafting substitute in the rat.

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A nanocrystalline bone substitute embedded in a highly porous silica gel matrix (NanoBone) has previously been shown to bridge bone defects by an organic matrix. As the initial host response on the bone graft substitute might be a determinant for subsequent bone formation, our present purpose was to characterize the early tissue reaction on this biomaterial. After implantation of 80 mg of NanoBone into the adipose neck tissue of a total of 35 rats, grafts were harvested for subsequent analysis at days 3, 6, 9, 12, and 21. The biomaterial was found encapsulated by granulation tissue which partly penetrated the implant at day 3 and completely pervaded the graft at day 12 on implantation. Histology revealed tartrate-resistant acid phosphatase (TRAP)-positive giant cells covering the biomaterial. ED1 (CD68) immunopositivity of these cells further indicated their osteoclast-like phenotype. Scanning electron microscopy revealed organic tissue components within the periphery of the graft already at day 9, whereas the central hematoma region still presented the silica-surface of the biomaterial. Energy dispersive X-ray spectroscopy further demonstrated that the silica gel was degraded faster in the peripheral granulation tissue than in the central hematoma and was replaced by organic host components by day 12. In conclusion, the silica gel matrix is rapidly replaced by carbohydrate macromolecules. This might represent a key step in the process of graft degradation on its way toward induction of bone formation. The unique composition and structure of this nanoscaled biomaterial seem to support its degradation by host osteoclast-like giant cells