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Bone regeneration enhanced by using a gold nanoparticle–hydrogel complex

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Introduction: Gold nanoparticles (GNPs) are widely used in diagnostics, drug delivery, biomedical imaging and photothermal therapy due to their surface plasmon resonance, fluorescence, and easy-surface functionalization. According to recent studies, GNPs display a positive effect on the osteogenic differentiation of mesenchymal stem cells (MSCs) and MC3T3-E1 osteoblast-like cells. The aim of this study was to develop a new approach for bone tissue regeneration based on the utilization of a biodegradable hydrogel loaded with GNPs.

Methods & Materials: We used photo-curable gelatin hydrogels (Gel) to provide a proof of principle of GNPs in regeneration strategies for bone tissue repair. We investigated the effects of these Gel–GNP composite hydrogels both *in-vitro* and *in- vivo*. The hybrid hydrogel was formed by irradiating a mixture of a photo-initiator, methacrylated gelatin (GelMA) and GNPs with ultraviolet (UV) light. The content and distribution of GNPs in the GelMA solution and hydrogel were determined by UV-Vis spectroscopy, differential scanning calorimetry (DSC) and thermo-gravimetric analysis (TGA). The GNPs embedded in a gelatin hydrogel were evaluated for their capacity to induce osteogenic differentiation of human adipose-derived stem cells (ADSCs).

Results: The *in-vitro* results showed that the hydrogels loaded with GNPs promote proliferation, differentiation and alkaline phosphate (ALP) activities of human adipose-derived stem cells (ADSCs) as they differentiate towards osteoblast cells in a dose-dependent manner. Moreover, the in-vivo results showed that these hydrogels loaded with high concentrations of GNPs had a significant influence on new bone formation.

Conclusion: The Gel–GNP displayed significantly higher new bone formation in animal tests. Through these *in-vitro* and *in-vivo* tests, we found that the Gel–GNP can be a useful material for bone tissue engineering.

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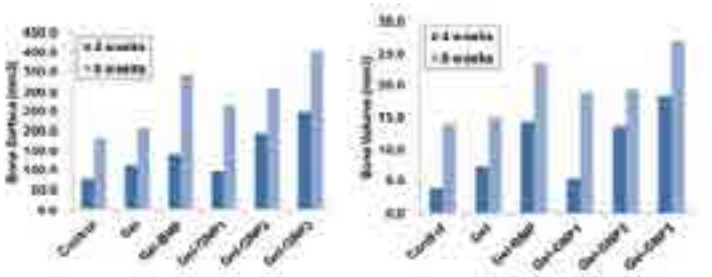

Fig.3 3-Dimensional scan images of rabbit calvaria after 4 and 8 weeks of implantation, and recovered bone area of the defected sites.

Biography

Deok-Won Lee is an Oral and Maxillofacial Surgery Specialist and Associate Professor of Kyung Hee University College of Dentistry. His expertise is in treating and improving the oral and maxillofacial health and wellbeing of people. His research on dental implant materials creates new pathways for improving healthcare. He is continually building and investigating on adequate material for implantation through in-vivo and in-vitro models based on years of experience in research, evaluation, teaching and administration both in hospital and education institutions.

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