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Introducing a poly dopamine-laced hydroxyapatite-gelatin nanocomposite for customized scaffolding in bone tissue engineering

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Poly dopamine has recently been reported to improve osteoblast adhesion and proliferation *in vitro*. We also found that pre-osteoblasts express functional dopamine receptors that could regulate cell proliferation and mineralization via the dopamine monomer released from the polydopamine-laced hydroxyapatite-gelatin nanocomposite (PDHG). Thus, PDHG not only possesses enhanced physical properties of hydroxyapatite-gelatin bioceramics but also can facilitate bone tissue engineering. The interconnection of polydopamine network within PDHG increases both compressive and tensile strength approaching to that of natural cortical bone. The present study determined dose ranges for dopaminergic effect in osteogenesis which will be used to optimize the composition of PDHG. *In vitro* tests of MC3T3-E1 culture used soluble dopamine drops and the real-time polymerase chain reaction (qPCR). At the end of culture, the expression of osteogenic genes was quantified with and without addition of dopamine antagonists. In a pilot *in vivo* test, a thermo differential process in conjunction with the indirect scaffolding technique was applied to fabricate a customize PDHG prosthesis for jaw bone regeneration in rats. The 3 mm resection of rat mandible was created at the premolar and molar region. The PDHG porous prosthesis was used to fix the osteotomized mandible. The result showed that osteogenic gene expression was significantly greater in the dopamine-treated than control group ($p<0.05$) but inhibited by dopamine receptor antagonists. The rats underwent PDHG reconstruction behavior normal chewing and life activities; histological retrieval is currently underway.

Biography

Ching-Chang Ko is Professor of Orthodontics in the School of Dentistry at the University of North Carolina (UNC). He received his PhD in Bioengineering and Biomaterials from the University of Michigan. Since 2014, he has served as Program Director and Vice Chair of the Department of Orthodontics at UNC and in 2014 was named Hale Distinguished Professor. He has contributed more than 100 publications to the scientific literature. He is a member of AADR, AAO, ORS, ASME, ASCER and Biomaterials.

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