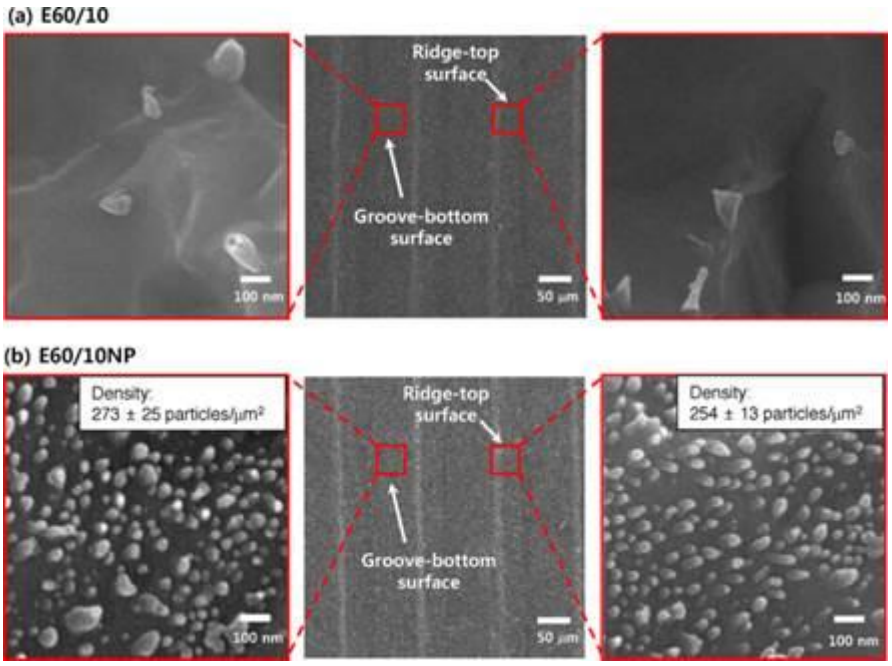
Controlled dual release of bone morphogenic protein-2 and insulin-like growth factor-1 using catecholfunctionalized adhesive polymer nano-particles on microgrooved tatanium enhances the osteogenic activity of human mesenchymal stem cells

Kim, K.H.[1]

[1] Department of Biomaterials & Prosthodontics, Kyung Hee University Hospital at Gangdong, School of Dentistry, Kyung Hee University, Seoul, Republic of Korea

Introduction & Methods: We aimed to demonstrate that controlled dual release of bone morphogenic protein-2 (BMP-2) and insulin-like growth factor-1 (IGF-1) by catechol-functionalized adhesive polymer nanoparticles on microgrooved titanium (Ti) surface enhances *in vitro* osteoblastic differentiation of human mesenchymal stem cells (MSCs). Photolithography was used to fabricate the microgrooved Ti, and catechol-functionalized adhesive nanoparticles were immobilized onto Ti surfaces. The nanoparticles consisted of the surface Ti-adhesive catechol groups, anionic poly (L-aspartic acid) (PAsp) shells, and hydrophobic poly (L-phenylalanine) (PPhe) cores. The immobilization of the adhesive nanoparticles was verified using the imaging methods field-emission scanning electron microscopy (Fe-SEM) and confocal laser scanning microscopy (CLSM) After characterizing the controlled dual release profiles of BMP-2 and IGF-1 from the nanoparticle-immobilized Ti substrata, we assessed the alkaline phoshpatase activity and osteoblastic differentiation and confirmed the result by determining the expression of major osteoblast marker genes and proteins.



Results & Discussion: We demonstrate that surface microgrooves and dual growth factor releasing system synergistically promote the osteoblastic differentiation of MSCs. Also, combined microgrooves and controlled release of BMP-2 and/or IGF-1 significantly promote the relative expression of major osteoblast marker genes and proteins. The overall significant correlations between the experimental results determined by the Pearson's correlation analysis verify the validity of our study. The proposed combined surface of microgrooves and growth factor release system can be used as a strong osteogenic promoter on biomaterial surfaces.

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