CHAPTER 12

Bio-Functionalization of Dental Implants with Binding Pharmaceuticals to Titanium Surfaces

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Summary

Since dental implants contact many different tissues, those materials must have optimum surface compatibility with the host bone tissue and soft tissue, as well as anti-microbial properties on an exposed region of the mucosa. Such materials can be created under well-controlled conditions by modifying the surfaces of materials that contact those tissues. This paper is focused on the surface modification of biomaterials for developing "Bio-functional dental implants", which are compatible with all host tissues, using a cold-plasma technique.

At the bone tissue/implant interface, a thin calcium phosphate coating and rapid heating with infrared radiation was effective in controlling the dissolution without cracking the coating. These thin calcium phosphate coatings may directly promote osteogenisis, but also enable immobilization of bisphosphonate. Simvastatin is also effective candidate that is reported to increase the expression of BMP-2. Thin-film of hexamethyldisiloxane (HMDSO) was plasma-polymerized onto titanium, and then HMDSO surface was activated by O2-plasma treatment. QCM-D analysis demonstrated that simvastatin was immobilized on the plasma-treated surfaces due to introduction of O2-functional groups. At the soft tissue/implant interface, multi-grooved surface topographies and utilizing the adhesive proteins such as fibronectin or laminin-5 may help in providing a biological seal around the implant. At the oral fluid/implant interface, an alumina coating, F+-implantation and immobilization of anti-microbial peptides were responsible for inhibiting the biofilm accumulation.

KEY WORDS: Surface modification, Cold plasma, Dental implant, Titanium, Calcium phosphate, Bisphosphonate, Simvastatin, Osteogenesis, Biological sealing, Anti-biofilm

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