Antimicrobial effects of Ag incorporated calcium phosphate film

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Statement of Purpose: Most researches on dental implants were focused on implant-bone interface. Although the success rate of dental implant is high today, post-operative implant failures have been often reported. When bone healings are associated with infection, the healing process becomes more complicates and the implant failure is expected since the implant becomes loosened due to the formation of bacteria colony on the implant surfaces. In this study, various amounts of Ag were introduced into ion beam assisted deposit thin calcium phosphate films, and antimicrobial effects were evaluated with *Escherichia Coli ATCC 8739* and *Streptococcus mutans OMZ 65*.

Methods: Evaporants of hydroxyapatite were synthesized by sintering a commercial $Ca_{10}(PO_4)_6(OH)_2$ powder. Samples of silicon wafer and polished commercially pure Ti were used as substrates. Ar ion beam was generated from the end-hall type ion gun and used for precleaning substrates for 20 minutes. Whilst vapor fluxes of evaporants were generated and deposited on rotating substrates, the Ar ion beam was bombarded simultaneously with the fixed voltage of 120 V and the current of 0.2A. For the introduction of silver ion through ion-exchange process, calcium phosphate deposited samples were immersed in $AgNO_3$, and the amount of doped silver was controlled by using different $AgNO_3$ concentration. The amounts of silver ions introduced were measured with Rutherford backscattering technique using He ions accelerated to 2MeV. A shake flask method was employed to evaluate the antimicrobial effect of Ag doped calcium phosphate coating layer. Each specimen was placed in well plate containing 1 ml of saline solution, and each well contains either 6.4×10^8 of *Escherichia Coli ATCC 8739* or 2.0×10^8 of *Streptococcus mutans OMZ 65*. Colony number was counted both at 4-hour and 24-hour after incubation at 37oC.

Results/Discussion: Present authors reported silver ion was easily introduced through immersion of ion beam assisted deposit calcium phosphate film in $AgNO_3$ aqueous solution. Enhanced antimicrobial effect is expected with the higher amounts of incorporated silver ions into calcium phosphate film. However, osteoconduction ability of calcium phosphate film could be reduced due to the depletion of calcium ions. Thus, controlling the amounts of silver ions and the determination of Ag/Ca ratio are very important. Figure 1 shows antimicrobial effects of different amounts of silver doped calcium phosphate thin films for *Streptococcus Mutans OMZ 65* (in where positive means bacteria in medium without sample, and control means no Ag doped sample). Since small amounts of Ag remarkably reduced the colony forming unit by the order of 10^6, infection by *Streptococcus Mutans OMZ 65* could be effectively prohibited without sacrificing bone-forming ability of thin calcium phosphate film.

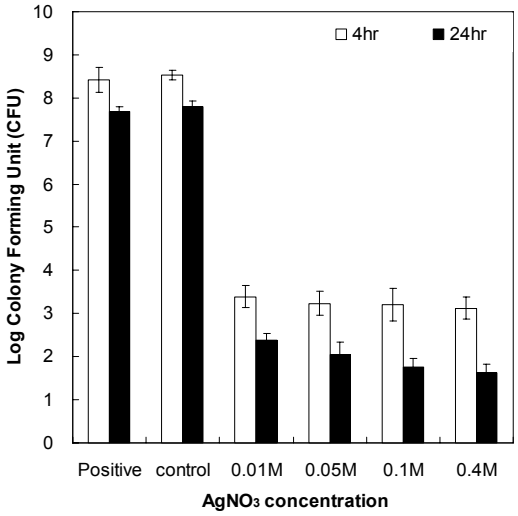

Figure 1. Antibacterial activity effect of Ag incorporated CaP film for *S Mutans OMZ 65*.

Conclusions: Doped silver amounts were effectively controlled by using different concentration of $AgNO_3$. The Ag doped calcium phosphate coating layer was effective in reducing both Escherichia Coli ATCC 8739 and Streptococcus Mutans OMZ 65 on contact with respect to control.

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