Abstract

Effects of chemomechanical decontamination methods and biological growth factors for bone differentiation on rough titanium surfaces

2023
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Introduction

Peri-implantitis is a plaque-associated pathological condition occurring peri-implant soft and hard tissues (Berglundh et al., 2018). As the primary etiological factor has been identified as bacterial biofilm, its removal is prerequisite to resolve inflammation and to arrest further loss of supporting bone. There is a need to identify the effective method of decontamination in terms of not only for bacterial removal but also post-cleaning cytocompatibility.

Ichioka et al. (2019) indicated that air-abrasive debridement followed by alkaline electrolyzed water (AEW) may be beneficial to restore cytocompatibility of previously bacterial contaminated smooth titanium surfaces. Since currently available implants are made of rough surface, it is also interests to evaluate the potential effects of the proposed method on the rough surface. In addition, the present in-vitro study assessed the effects of biological growth factors on the osseogenic cells when cultivated on the decontaminated titanium rough surfaces.

Methods

Acid etched titanium discs (Ra=1.73 μm) were prepared and used in the present study. The discs were contaminated with *Streptococcus gordonii* biofilm for 24 hours. All contaminated discs were mechanically cleaned using air-abrasive debridement with erythritol powder. The discs were then immersed either in 0.9% NaCl, 0.05% AEW, or 3% H_2O_2 for 1 minute. X-ray photoelectron spectroscopy (XPS) was used to evaluate the chemical surface properties of the treated titanium discs. In addition, osteoblast-like cells (MC3T3-E1) were cultured on the treated titanium discs in cell medium in adjunct to either enamel matrix derivative (EMD) or basic fibroblast growth factor (FGF-2). The cytocompatibility was evaluated by counting the number of attached cells and measuring cell spread area. The bone differentiation was evaluated by ALP expression of the cells.

Results

XPS analysis demonstrated that AEW group showed significantly lower organic contamination than the NaCl and H_2O_2 groups. The number of attached cell and its spread in AEW group were significantly greater compared to those in the other groups. ALP expression was also significantly enhanced in the AEW compared with the NaCl. No additional effects of EMD or FGF-2 in ALP expression were observed.

Conclusion

Air-abrasive debridement followed by AEW may be beneficial to restore cytocompatibility and bone differentiation of previously bacterial contaminated rough titanium surfaces. FGF-2 and EMD may not have additional efficacy in MC3T3-E1 differentiation.