Dentin collagen stabilization with dopamine treatment

Po-Chun Tseng (曾柏鈞)[1], Shu-Fen Chuang (莊淑芬)[2], and Dar-Bin Shieh (謝達斌)[3*]

[1]Institute of oral medicine, National Cheng Kung University, Tainan, Taiwan
[2] Institute of Oral Medicine and Department of Stomatology, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan, Taiwan
[3] Institute of Basic Medical Science, Institute of Oral Medicine and Department of Stomatology, National Cheng Kung University Hospital, College of Medicine, National Cheng Kung University, Tainan 704, Taiwan;
dbshieh@mail.ncku.edu.tw

Abstract

Objectives: The inherent instability of collagen remains a major challenge to dentin adhesion. Treatments with certain polyphenolic collagen cross-linkers have been reported to enhance the biostability and mechanical strength of dentin collagen. The objective of this study was to explore the effects of dopamine, a phenolic compound with catechol functional group, on dentin collagen stabilization.

Methods: Human dentin specimens were treated with dopamine HCl (10^-1/-2/-3 M, pH = 8.5) for 24 hours while those treated with Tris buffer or 5% glutaraldehyde were served as negative or positive controls. All specimens were then rinsed extensively for 3 times and immersed in de-ionized water for 24 hours to remove unbound agents. Afterwards, the specimens were analyzed with ATR-FTIR and synchrotron-based DRIFT-FTIR to evaluate the adsorption of dopamine onto surface-demineralized dentin. Regarding the effect of dopamine treatment on biostability of dentin collagen matrix, cross-sectional SEM images of the demineralized dentin surface were captured after challenged by collagenase from Clostridium histolyticum (1 mg/ml in HEPES buffer with 0.36 mM CaCl2). Furthermore, biodegradation of fully-demineralized dentin slabs was measured as the percentage of weight loss after collagenase (100 ug/ml) degradation for 48 hours.

Results: The ATR-FTIR spectra confirmed the adsorption of dopamine onto dentin matrix as the increase in the absorbance at 1500 & 1600 cm-1 (aromatic C=C stretching) after treatment with 10^-1~10^-2 M dopamine. SEM images and FTIR analysis suggested that all dopamine treatments could help the demineralized dentin matrix to maintain their structural integrity upon collagenase challenge. The results of biodegradation assay suggested dopamine treatment could dose-dependently reduce the collagenase-induced degradation of dentin collagen compared with the negative control.

Conclusions: This study demonstrated the potential of dopamine as a novel dentin collagen stabilizer. The findings will bring us more mechanistic insights into dentin collagen stabilization with possible clinical applications in the future.

Keywords – Collagen, Dentin, SR-based FTIR, ATR-FTIR

---For poster session and poster contest, please stop here. The above content should not exceed 1 page.---