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Raman Spectroscopy and OCT Analysis of Dentin Remineralization Using Riboflavin

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Objectives Biochemical alterations within the lesion have the potential to discriminate the lesion zones. The aim of this study is to investigate the effects of calcium phosphate-containing toothpastes and 2% Riboflavin on dentin remineralization with Spectral-Domain Optical Coherence Tomography (SD-OCT) and Raman Spectroscopy.

Methods Ninety dentin disc specimens were obtained from caries-free extracted human molars and divided in 9 groups (n = 10). Group I: Universal bonding agent(Kerr Optibond, CA, USA) Group II: Universal bonding agent and 2% Riboflavin (RF), Group III: Functional Tricalcium Phosphate(fTCP) containing toothpaste(3M Clinpro 5000, USA), Group IV: fTCP based toothpaste + 2% RF, Group V: Calcium glycerophosphate(CaGP) containing toothpaste (R.O.C.S. Repair and Protect, Moscow) Group VI: CaGP based toothpaste + 2% RF Group VII: positive control(remineralization solution), Group VIII: negative control(deionized water) Group IX: 2% Riboflavin. The optical depth of backscattered light and calcium phosphate peak values were measured using a High Definition SD-OCT(Carl Zeiss, USA) and a Renishaw in via Raman spectroscopy(Renishaw, UK). All samples were scanned using the Anterior Segment Five-Line Raster mode of SD-OCT and mineralization depth was measured by Raman probing the symmetric valence vibration near 956 cm^{-1} as a marker for crystallinity. Statistical analyses were performed by using One-way ANOVA, Tamhane, LSD tests. The level of significance was set at $p < 0.05$.

Results Raman analyses demonstrated that there was a statistically significant difference between the study group surfaces subjected to the pH cycling process and remineralization agents and the control group surfaces only subjected to pH cycling($p < 0.05$). The mean value of Group IV that has the highest R^2 is 23326.2 ± 4562.11 . All study groups except Group I and Group VIII were significantly efficient in reducing optical lesion depth on dentin ($p=0.001$).

Conclusions Remineralizing agents with %2 RF have positive effects on the remineralization potential of artificial caries of dentin surfaces.