Evaluation of the Caries Inhibition Effect of Fluoride-releasing Resin Composites Using pH-cycling

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Abstract: Objectives: Previous studies showed that fluorine can enhance enamel remineralization. This effect is expected and many fluoride-releasing materials are developed in resin systems. However, the clinical evaluation of resin systems is not certain. The automatic pH-cycling system used from the former study can simulate daily changes in pH that occur in the oral cavity. Therefore, the aim of this study was to evaluate the caries inhibition effect of fluoride-releasing resin composites using this pH-cycling system.

Materials and Methods: BS groups consisted of Beautifil II (F+) and Fluoro Bond Shake One (F+), AMF groups consisted of Clearfil AP-X and Clearfil Mega Bond FA (F+), UM groups consisted of Unifil-Flow (F+) and Clearfil Mega Bond, and SM groups consisted of Solare and Clearfil Mega Bond. The buccal surface of human premolars was filled up with each material, and a 150 µm thick single-section specimen was prepared and the polished surface was coated with wax. The examination condition was 6 cycles/day for five weeks, and a demineralizing solution (lactic acid solution, pH 4.5) and remineralizing solution (HEPES solution, pH 7.0) were used to reproduce the same pH changes that typically occur in the oral cavity. For all groups, the Transverse Micro Radiography (TMR) image of each specimen was examined to evaluate the progression of caries with respect to integrated mineral loss and lesion depth.

Results: Evaluation of the results of integrated mineral loss showed that, at 1w, the BS group was the significantly lowest, followed by the SM group, AMF group, and UM group, respectively. At 3w, the BS group was the lowest, followed by the AMF group, UM group, and SM group, respectively. At 5w, the order was the same as that for 3w. The results for lesion depth showed that, at 1w, the UM group was the lowest, followed by the AMF group, BS group, and SM group, respectively. At 3w, the BS group was the lowest, followed by the AMF group, SM group, and UM group, respectively. At 5w, the BS group was the lowest, followed by the AMF group, UM group, and SM group, respectively. With respect to fluoride release, the inclusion of Beautifil II and Unifil-Flow in lactic acid solutions was significantly high compared with inclusion in de-ionized-water. In terms of bonding materials, there was no statistically significant difference between the use of Fluoro Bond Shake One and Clearfil Mega Bond FA.

Conclusion: In this study, it turned out that the caries inhibition effect was high in the BS group, and the effect of fluorine was low in the UM group. From this result, caries inhibition effect differs depending on the type of fluoride-releasing resin composites used. It is thought that clarifying the differences among these fluoride-releasing materials can lead to the development of new, more effective materials.

Key words: Fluoride-releasing materials, Caries inhibition effect, Automatic pH-cycling system, Fluoride release