Development of New Monomer Inducing Dentin Remineralization

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Abstract: In recent years, the development of adhesive restorative materials has progressed remarkably with the spread of the concept of minimal intervention (MI) in operative dentistry. Although people had conventionally regarded permeability and adhesive ability as important in the development of adhesive materials, material development has recently been shifting toward functionality which is represented by anti-cariogenicity. However, problems such as loss of fillings and recurrent caries still occur after the restoration. The nanospace into which the bonding agent does not infiltrate in the decalcified dentin collagen etched with acids or self-etching primers is known to exist underneath the hybrid layer. It has been reported that hydrolysis of the remaining decalcified dentin collagen and the bonding agent contacting it occurs over time, eventually causing the adhesion interface between resin and dentin to collapse. To solve this issue, we suggest a blockade of the nanospace, achieved by remineralization of the remaining decalcified dentin collagen using adhesive restorative materials containing resin monomers that possess mineral induction ability, may improve the durability of the adhesion interface between resin and dentin. In this study, we examined in vitro the mineral induction ability of newly developed monomers, compared with that of a model decalcified dentin matrix. We also examined the adhesion ability of 4-META/MMA-TBB resin containing the newly developed monomers to a dentin specimen by means of a micro-tensile bond test. Moreover, we observed the adhesion interface between resin and dentin with a scanning electron microscope (SEM).

From these experiments, the following results were obtained:

1. In mineral induction experiments in vitro, the newly developed monomer, CMET, induced hydroxyapatite formation more rapidly than the model decalcified dentin matrix (PV).

2. In the micro-tensile bond test, 4-META/MMA-TBB resin containing the newly developed monomers, CMET and CMET, at a concentration of 5 and 10% showed a high adhesive ability, equal to that of 4-META/MMA-TBB resin alone as a control. However, bond strength decreased significantly with the increase of concentration.

3. In the SEM observation of the adhesion interface between resin and dentin, a defect with a porous structure and imperfect formation of the resin tag were observed at the adhesion interface in 4-META/MMA-TBB resin containing CMET at concentrations of 30%, 50% and 70% CMET.

In conclusion, it was suggested that the newly developed monomer, CMET, promotes remineralization of the remaining decalcified dentin collagen at the adhesion interface. Furthermore, the optimal concentration of CMET to be added to 4-META/MMA-TBB resin may be 10% considering the mechanical properties of the resin.

Key words: Mineral-inductive monomer, Dentin remineralization, Durability of adhesive interface