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Solvent-induced Expansion & Shrinkage of Demineralized Dentin Matrix

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Before resin composites can serve as durable substitutes for amalgam restorations, the adhesive system used to retain them and add to seal dentin must be improved. The recent observations, using the newly developed LVDT (linear variable differential transformer) probe, that all commerical bonding systems cause a collapse of the demineralized dentin matrix, simulated a re-evaluation of the effects of these formulations on the matrix. The experiment was begun by examining solvents such as water-HEMA mixtures. These produced the same shrinkages as did the complete formulations. As the matrix collapsed, the interfibrillar spaces, which are diffusion channels for monomer uptake, disappeared. The effect was so large that the purpose of this study is focused to pursue studies of polar solvents rather than monomers. The goal of this work is to understand the mechanisms responsible for determining the expansion of the matrix. The pervious work indicated that the matrix can be made so stiff that it doesn' t collapse when air-dried, but that approach is not clinically practical. However, recent preliminary work has compelled us to conclude that we have under-estimated the effects that polar solvents have on the dentin matrix. Acetone, ethanol, and HEMA are used to solubilize adhesive comonomers, but they induce a shrinkage or collapes of the wet matrix that we believe is detrimental to bonding. We have discovered that more polar solvents, such as formamide and ethylene glycol, while causing a transient, small shrinkage, re-expand the matrix to the height that it had in water. The pioneering work of Kuznatsova et al.(1997) taught us that polar solvents with 2 or more groups can form hydrogen bonds with themselves and with collagen. These compounds are more capable of expanding collagen peptides than are monofunctional H-bonding molecules, such as primary alcohols(i.e. ethanol, HEMA). We propose to utilize glycerol(propanetriol) as a model primer solvent because it has three such polar alcohol groups. Even after derivatizing one glycerol with methacrylate to produce a polymerizable maintain the matrix in an expanded condition with large interfibrillar spaces. We believe that this situation will lead to more durable resin-dentin bonds, and perhaps to higher bond strengths. The proposed specific aims are designed to evaluate the interactions of various polar solvents with the dentin matrix and to provide new insight into the influence of solvents on the dimensions of the dentin matrix and thus its potential for resin impregnation and bonding.