Ultramorphology and Bond Strength of Self-Etching Bonding Agents to Demineralized and Remineralized Enamel

Thesis

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بسم الله الرحمن الرحيم

"قالوا سبحانك لا علم لنا إلا ما علمتنا انك أنت العليم الحكيم"

صدق الله العظيم

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Dedication

TO MY PRECIOUS PARENTS, SUPPORTIVE WIFE AND BELOVED SON, YOUSOF

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Remineralizing agents are used as a preventive method, or as a treatment method for incipient enamel carious lesions. The conservative dental approach for treatment of lost dental structures, and the usage of tooth colored restorations led to the evolution of adhesive dentistry, and subsequent self-etch adhesives. In this study, the effect of different remineralization regimens, aggressiveness of the self-etch adhesives, and the acid etch pretreatment on bond strength to enamel was evaluated.

Bovine teeth were used in the present study. Mineral distribution in the carious lesions in bovine teeth were similar to that found in human teeth, and structural changes in human and bovine teeth were similar (**Edmunds el al, in 1988)**.

Penetration of a resin might be mainly influenced by two components: 1) material properties such as filler particle size and viscosity; 2) substrate properties such as wetting behavior and mineral content of enamel (**Irinoda et al, in 2000)**. Traditionally 30%–40% phosphoric acids have generally been used in etching enamel (**Van Meerbeek, in 2003)**. Scotchbond Etchant is used as an acidic gel for enamel etching.

Self-etching systems simplify the bonding procedures in practice by removing the acid-etching step. The mild aggressiveness of self-etch acidic monomers could result in minor modifications and less enamel loss, which, in turn, could affect resin adaptation (**Breschi, in 2003)**. In a morphological study evaluating the surface of etched enamel (**Perdigão et al, in 1997)**, reported that the application of self-etching adhesive primer did not result in as deep an enamel etching pattern as did the application of phosphoric acid. While self-etching adhesives show shallow etching patterns, in most

studies, their bond strengths to enamel were found to be similar to total-etch adhesive systems (**Kelsey et al, in 2005)**.

The development of self-etch adhesives has brought some promising opportunities. The self-etch adhesives used in the current study were chosen according to their aggressiveness **(Van Meerbeek et al, in 2003)**. G-Bond was used as a representative of mild self-etch adhesive, with pH about 2 **(Peumans et al, in 2005)**. Adper Prompt L-Pop was used as a representative of aggressive self-etch adhesive, with pH 1 or below **(Van Meerbeek et al, in 2003)**. Both materials were chosen as all-in-one self-etch adhesives rather than two-step self-etch adhesives; in order to eliminate any effect that might occur from adding a step in the self-etch adhesive system used **(Foong et al, in 2006).** G-Bond is the first HEMA-free self-etch adhesive introduced into the market; in order to avoid allergic effects of HEMA on the practitioner and the patient, as well as to improve the hydrolytic resistance and thus long term stability of the resultant bond **(De Munck et al, in 2005)**. Although, G-Bond is a HEMA-free and Adper Prompt L-Pop is a HEMA-containing self-etch adhesives, yet the effect is considered negligible because bonding to enamel does not require hydrophilic components found in HEMA to assure wettability as compared to bonding to dentin. In addition, in G-Bond and Adper Prompt L-Pop, phosphoric ester is the main component that affects enamel in means of etching and adhesion, as being mentioned by the manufacturers of both self-etch adhesive systems.

Fluorides are documented to be one of the oldest and most successful remineralizing agents in dentistry. It was considered by many authorities the gold standard in assessment of the efficacy of newly introduced

materials. Remineralization of enamel is enhanced by the presence of fluoride ions (**Ten Cate, in 2004)**. In the present study, Fluocal Mouth Wash was used as it is a commercially used mouth wash present in the Egyptian market; it was selected due to its relative high concentration of fluoride; 0.2% NaF (900 ppm F) (**Zero, in 2006)**.

The role of casein phosphopeptide amorphous calcium phosphate nanocomplexes (CPP–ACP) has been described as localization of amorphous calcium phosphate (ACP) at the tooth surface which buffers the free calcium and phosphate ion activities, helping to maintain a state of supersaturation with respect to enamel depressing demineralization and enhancing remineralization (**Reynolds et al, 2003)**. Accordingly, Tooth Mousse was tested in this study as a representative of these formulations.

Recent studies have demonstrated the remineralisability of etched or softened enamel surface by natural saliva. It is speculated that with calcium, phosphate and fluoride content, saliva may possess a reparative effect on early enamel erosion, which is characterized by surface softening and slight subsurface mineral loss **(Imfeld, in 1996)**. In this study, it was considered appropriate to use stimulated natural saliva **(Amaechi et al, in 2001)**. Artificial saliva was used as a storage medium between different applications (**Yamaguchi et al, 2006)**. This was in order to mimic the oral cavity conditions. The used formula was fluoride free to eliminate the effect of its fluoride content.

Lactic acid was used as a demineralizing solution **(Tanaka and Iijima, in 2001)**, to cause enamel demineralization. In the current study demineralization/remineralization cycles was done to mimic clinical caries