Self-etching primers and adhesives: aspects of microtensile bond strength, ultrastructure and nanoleakage

A thesis submitted to the University of Hong Kong in partial fulfillment of the requirements for the degree of

Master of Dental Surgery

By

CHAN Kar Mun

2002

Paediatric Dentistry and Orthodontics
Faculty of Dentistry
University of Hong Kong
Hong Kong Special Administrative Region
Thesis supervisors: Prof. Nigel King and Dr. Franklin Tay
Abstract

Self-etching dentin bonding systems are attractive in that removal of the smear layer and smear plug is not required. It was suggested that less aggressive versions of self-etching primers failed to etch through clinically relevant thick smear layers, resulting in decrease in tensile bond strength. On the other hand, self-etching dentin bonding systems are claimed to be able to etch and prime simultaneously, and that are not rinsed, which should not exhibit areas of incomplete infiltration (nanoleakage) within hybrid layers produced in sound dentin. The *in vitro* studies in this thesis compared the microtensile bond strength and the ultrastructure of resin-dentin interfaces of four self-etching systems applied to dentin with a thick smear layer. The extent of silver-staining in these self-etching systems bonded to dentin was also studied.

In paper I, twenty-four human third molars were ground with 180-grit silicon carbide papers to expose deep coronal dentin. A 3 mm vertical slit was made along the diameter of each tooth to fit a glass cover slip, dividing each tooth into two bonding surfaces. Two two-step, self-etching primers (ABF experimental system, Kuraray and Imperva Fluoro Bond, Shofu) and two single-step, self-etching adhesives (One-Up Bond F, Tokuyama and AQ Bond, Sun Medical) were examined. Adhesives were applied to one side of the teeth passively, and to the other side with continuous agitation for the same self-etching period. Incremental composite buildups were performed and beams with cross-sectional areas of 0.81 mm² were prepared for microtensile bond strength (µTBS) evaluation. Demineralized, bonded specimens were processed for transmission electron microscopy (TEM) examination.

In experiment 2, flat dentine surfaces were bonded with the same adhesives, except for One-Up Bond F being replaced by UniFil Bond (GC) and a lining composite
was used to create a composite buildup. For each adhesive, 0.8 mm thick slabs from the
same tooth were coated with nail varnish applied 1 mm from the bonded interfaces and
immersed in 50 wt% AgNO₃ for 24 hours (h). Four types of polyhydroxyethyl
methacrylate (HEMA) resins were made: 100% HEMA; 90 mass% HEMA-10% water;
75% HEMA-10% water, all polymerized with tri-N-butylborane (TBBO) at 50°C for 6 h;
100% HEMA polymerized at 25°C for 30 minutes (min). After developing,
undemineralized, unstained, epoxy resin-embedded sections were prepared for
transmission electron microscopy (TEM).

In experiment 1, it was found that agitation produced significantly higher µTBS
than passive application. Smear layers were completely dispersed and thicker hybrid
layers with upstanding collagen fibrils were observed with continuous agitation. In
experiment 2, nanoleakage patterns were observed in all specimens. Increasing amounts
of silver uptake were observed in specimens containing more water.

This study suggests that bonding of self-etching systems to dentin with thick
smear layers may be improved by continuous agitation during the self-etching process.
Silver staining observations suggest microporous zones in hybrid layers formed by self-
etching systems are not nanoleakage in the strictest sense, they represent regions of
incomplete polymerization caused by incomplete removal of water from primed dentin.