Factors affecting the longevity of tooth-colored restorations.

Enamel and Dentin considerations
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Enamel and Dentin considerations

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PhD dissertation
Submitted in partial fulfilment of the requirements to obtain
the degree of Doctor in Philosophy
Siena, 2006
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List of publications resulted from the PhD thesis

Bortolotto T, Ferrari M, Onisor I, Tay FR, Krejci I. Marginal adaptation of contemporary bonding agents in enamel and dentin under the simulation of dentinal fluid.
**Dentistry South Africa, 2005; 7: 46-58.**

**American Journal of Dentistry. In press.**

**Dental Materials. Submitted.**

Bortolotto T, Ferrari M, Krejci I. Wetting ability of single-component self-etching adhesives on enamel and dentin.
**American Journal of Dentistry, accepted for publication.**

**American Journal of Dentistry. Submitted.**

**Journal of Adhesive Dentistry. Submitted.**

Awards

* Award to the best scientific poster, *Academy of Operative Dentistry* European Sections’ meeting, February 2006, Rome, Italy

Title: “Marginal adaptation of contemporary dentin bonding agents on enamel and dentin under the simulation of dentinal fluid”

Bortolotto T, Onisor I, Tay FR, Ferrari M, Krejci I
Preface

Patients’ demands for esthetic fillings and a need to seek alternatives to amalgam were the determinant reasons for the increasing use of composite resin materials in the restoration of posterior teeth. Due to their improved esthetic qualities, strength and wear resistance, long-lasting direct composite restorations can be achieved with today’s materials and restorative techniques.

However, the clinical performance of adhesive composite restorations is influenced by the patient’s risk of developing recurrent caries and by many technical and material related factors. Even if the literature does not support a strong positive correlation between marginal deterioration (or marginal gap width) and recurrent caries, both clinical parameters have been reported as the major reasons given by the practitioners for restoration replacement. Moreover, replacement of old or defective fillings represents a major part of the restorative work performed in a dental office. This is traduced in billions of dollars in re-treatment cost per year worldwide, which might be of especial concern in public oral health programs. Keeping this in mind, marginal integrity might be an important clinically relevant parameter to consider when predicting the long-term behaviour of any restoration in the mouth.

It is generally accepted that polymerisation shrinkage and microleakage of resin-based restorative materials are still unsolved problems in clinical dentistry. This is especially of concern when evaluating the restorations’ marginal adaptation since it depends, among other factors, on the capability of the bonding agent and tooth structure to withstand the stresses resulting from the polymerisation contraction of the composite and from deformation during functional stressing. It is in this context where adhesive systems become crucial contributors to the restorations’ success.
Consistent results in terms of bonding performance have been reported in several studies with multi-bottle etch & rinse and self-etching adhesives. However, with simplified adhesives fewer data is available on their durability, especially when evaluating their bonding potential to enamel. These formulations were introduced to the market to answer the needs of practitioners seeking for more user-friendly and less technique-sensitive adhesives. From a clinician’s standpoint, it is important to place adhesive restorations and warrant a durable and efficient bond to enamel and dentin substrates, as both tissues are present in most cavity preparations. The question to be answered is whether currently available adhesive systems equally bond to enamel and dentin and if not, attempt at least to identify some of the main issues of concern in enamel and dentin adhesion with these formulations.

The general purpose of this PhD thesis is to define some of the factors influencing the bond of tooth-colored adhesive restorations, considering both enamel and dentin substrate and focusing in particular on simplified self-etching adhesives. The reasons for failure of the low performing systems will be sought with the aid of micro morphological evaluation methods of the adhesive interface. Finally, the long-term performance of a self-etching adhesive with specific antibacterial additives will be evaluated, and its contribution to the durability of the resin-dentin/enamel joint will be discussed.

In the first study the marginal adaptation of the most recent restorative systems (adhesive system & composite resin from the same manufacturer) will be evaluated on both enamel and dentin margins. Quantitative replica evaluation in a Scanning Electron Microscope will be performed immediately after placement of the restorations and after fatigue testing (thermal and mechanical loading) that simulates
5 years of clinical service, under the simulation of dentinal fluid (Chapter 1). Restorative systems that resist and that fail under this in vitro simulation of oral conditions will be defined by this evaluation and serve as a reference frame for the subsequent studies.

All the restored teeth of the first study will be stored in the dark in chloramine-containing water at 37°C for 1.5 years and then another set of replicas will be produced for the SEM evaluation of the marginal adaptation after this period of time. By doing this, additional information will be provided on the long term hydrolytic stability of the current adhesive systems on enamel and dentin (Chapter 2).

The effect of different factors such as enzymatic activity and artificial aging by thermal and mechanical load on the bond strength of two simplified adhesive systems will provide some information on the biomechanical behaviour of the resin-dentin joint (Chapter 3). The purpose of this evaluation is to elucidate additional problems associated with the fatigue resistance of the resin-dentin interface that can not be determined with margin analysis alone. Both short-term (micro tensile bond strength (μTBS) of non-loaded specimens) and long-term (μTBS of loaded specimens) results will provide some evidence on the degradation mechanisms of this interface.

Owing to the fact that with self-etching adhesives the smear layer is no longer removed from the tooth-surface but incorporated into the hybrid layer, in the next two studies (Chapters 4 and 5), a morphological evaluation of both enamel and dentin surfaces will be performed. Differences in wetting ability of one simplified adhesive system (with no HEMA content) compared to some experimental adhesives with different concentrations of hydrophilic monomer (HEMA) should provide some evidence in respect to their penetration ability on smear layer covered enamel and
dentin. The effect of all-in-one self-etching adhesives on the thickness of the smear layer remaining over the surface after different bur preparation methods will be assessed in the fifth study. The objective of this evaluation is to identify the smear layer (if present), to measure its thickness on enamel and dentin and to try to define how simplified adhesives deal with this smear layer: Do they modify it? Do they expand the smear layer if the adhesive is too hydrophilic? Do the different bur preparation methods produce the same thickness of smear layer?

The problems associated with physical sealing (Chapters 1 and 2) together with the presence of a potentially bacteria-contaminated smear layer covered surface introduce the importance of ensuring a biological sealing of the restoration. Thus, the contribution of an antibacterial monomer-containing self-etching adhesive on the improvement of the restorations long-term stability is discussed in the last chapter.

It is the final goal of this research project to contribute to a better understanding of enamel and dentin adhesion with simplified self-etching adhesive systems. Additionally, to provide scientific evidence that may be of help in the improvement of these formulations, from which will depend, among other factors, restorations’ longevity.
Marginal adaptation of contemporary dentin bonding agents in enamel and dentin under the simulation of dentinal fluid.

Abstract

**Purpose**: To compare the *in vitro* marginal adaptation of contemporary adhesive and restorative systems in mixed Class V restorations. Both etch & rinse and self-etch adhesives were evaluated before and after long-term thermal and mechanical loading under the simulation of dentinal fluid.

**Materials and Methods**