COMPOSITIONAL CHANGES OF BLEACHED ENAMEL SUBSTRATE AND ITS MICRO-TENSILE BOND STRENGTH TO NANO-FILLED RESTORATIVES

Thesis Submitted to the Faculty of Oral and Dental Medicine, Cairo University, for Partial Fulfillment of the Requirements for Doctor Degree in Operative Dentistry

BY

Nermeen Kamal Hamza

B. D. S 1996, M. D. S. 2004

Faculty of Oral and Dental Medicine

Cairo University

2011

Supervisors

Dr. Mohsen Abi El-Hassan

Professor of Operative Dentistry

Faculty of Oral and Dental Medicine

Cairo University

Dr. Heba Allah Mohamed Taher

Lecturer of Operative Dentistry

Faculty of Oral and Dental Medicine

Cairo University

List of contents

List of tables

List of figures

INTRODUCTION

In the decades, dentistry has undergone many changes, especially in the area of esthetic dentistry. Influenced by the media that emphasize health and beauty, patients commonly desire white teeth. Although, discolored teeth may not be related to disease, they nonetheless may compromise the esthetics of a smile. As a solution, bleaching is the best conservative treatment to lighten teeth in order to improve the appearance of the smile. Bleaching techniques using hydrogen peroxide have been used in-office since the beginning of the 20th century to whiten non-vital and discolored vital teeth. However the earlier techniques were slow, and used highly acidic solutions of hydrogen peroxide. Heat also often was employed to expedite the bleaching process and side effects such as increased sensitivity in the teeth were frequently observed **(Goldstein et al, 1995; Smidt et al, 1998; Hegedus et al, 1999; Climilli et al, 2001).**

Tooth enamel is the hardest mineralized tissue in the human body. It's composed almost exclusively of apatite crystals that are biologically unique in terms of their crystalline and highly organized ultrastructure. Extensive researches have thought to understand the process of enamel formation which is important for advance in biomineralization. Dental enamel contains over 96 wt% inorganic mineral, and the main consistent is a single calcium phosphate phase, hydroxyapatite HAP crystallites, which are bundled together by organic molecules into organized large-scale structures **(Dong et al 2010).** Caries process is a continuum of many cycles of demineralization and remineralization. Remineralization is the body's natural process for repairing subsurface non-cavitated carious lesions caused by organic acids created by bacterial metabolism of fermentable carbohydrates. Fluoride ions in the presence of calcium and phosphate promote remineralization by building a new surface on existing crystal remnants in subsurface demineralized lesions.

This environment also favors the formation of the more favored fluoroapatite crystals in the enamel. Remineralization of incipient carious lesions is a conservative alternative to conventional caries removal and dental restoration. Nowadays the bleaching agents could facilitate this action by the presence of amorphous calcium phosphate and fluoride in many available bleaching gels **(Michael et al 2009).**

Amorphous calcium phosphate (ACP) is a reactive and soluble calcium-phosphate compound that releases calcium and phosphate ions to convert to apatite and remineralize when it comes in contact with saliva. ACP provides a reservoir of calcium and phosphate ions in the saliva **(Chow et al 1998).**

Since that vital bleaching involves direct contact with tooth enamel so it is possible to use of dental bleaching as an attempt for remineralization of white spot lesions. **In 1989, Haywood and Heymann,** introduced the night guard vital bleaching technique that has become widely popular among clinicians and patients. Clinically there are two techniques for bleaching vital teeth in-office and at-home bleaching. Night guard bleaching typically uses a relatively low level of whitening agent applied to teeth via a custom fabricated mouth guard and is worn at night for at least two weeks. While vital bleaching with a peroxide gel generally is recognized as both safe and effective transient dentinal hypersensitivity is a common, unpleasant side effect of the treatment.

The etiology of bleaching related tooth sensitivity is neither well-understood nor easily measured, however, the hydrodynamic theory is a mechanism frequently cited to explain it. Accordingly, peroxide solutions introduced in the oral environment contact available dentinal surfaces and cause retraction of the odontoblastic processes resulting in rapid fluid movement inside the dentinal tubules. This ultimately manifests in stimulation of a mechanoreceptors at the pulp periphery. As a result, patients can feel clinically evident painful sensations when such teeth are exposed to cold or pressure or even when they are at rest.

Bleaching of vital teeth involves direct contact of the whitening agent with the outer enamel surface for extended periods of time. Many in vitro studies have evaluated possibly adverse effects of carbamide peroxide or hydrogen peroxide agents on enamel micro-morphology. Consequently, it has been shown that bleaching with carbamide peroxide may result in a change in calcium, phosphate and fluoride content in enamel **(Ernst et al, 1996; Crews et al, 1997; Frietas et al, 2002).** In an attempt to decrease tooth sensitivity, to re-establish surface hardness and to support remineralization of initial white spot lesions, some manufacturers have incorporated fluorides into their bleaching gel formulas **(Attin et al, 2009; Tanizawa, 2005).** More recently amorphous calcium phosphate (ACP) has become available in tooth whitening products; however, up to now the effects of ACP on enamel remineralization have rarely been scrutinized **(Milnar, 2007).**

Another side effect of the bleaching materials on the tooth structure, the most which has been confirmed is the interaction between the bleaching agent and the bond strength of composite materials to enamel. The desire to investigate the bonding performance, of enamel and dentin adhesive systems in details, has opened the way for novel methods of bond strengths testing. Microtensile bond strength testing was first introduced by **Sano et**

al in 1994. The bond area tested is much smaller compared to that of the macro tests being about 1mm or less.

Therefore the present study was aimed to investigate the remineralizing potential of mineralizing agents within the bleaching material, as well as the effect of these agents on microtensile bond strength of nano-filled resin composite and nano-filled glass ionomer to bleach

REVIEW OF LITERATURE

Bleaching techniques: (Historical background)

External tooth bleaching is a popular method of whitening teeth. The home vital bleaching technique is the most popular bleaching method and involves the fabrication of a custom bleaching tray in which carbamide peroxide or hydrogen peroxide is placed and worn over the teeth, usually overnight, to obtain the desired esthetic effect **(Haywood, 1990, Albers 1991).** Carbamide peroxide dissociates into hydrogen peroxide and urea when in contact with soft tissues or saliva at oral temperatures. Peroxide can diffuse through enamel and dentin due to its low molecular weight. While hydrogen peroxide further degrades into oxygen and water, urea degrades into ammonia and carbon dioxide **(Haywood and Haymann 1991).** The mechanism of the action of bleaching agents is thought to be due to the ability of hydrogen peroxide to form oxygen free radicals that interact with adsorbed colored organic molecules and oxidize these macromolecules and pigment stains, producing dental discoloration into smaller and lighter molecules. The shift of the visible absorption spectrum from a longer to a shorter wave length results in colorless or less dark compounds, producing color changes and a whiten action **(Seghi and Denry 1992)**.

Murchison and Charlton in 1992 studied the effect of three 10% carbamide peroxide home bleaching agents on tensile bond strength of resin to enamel. Eighty extracted bicuspid crowns were divided into four groups (three bleaching agents and control), and treated with the bleaching agents for five consecutive days. A bonding site on the buccal surface of each crown was etched with phosphoric acid and an orthodontic bracket was boded in place. The specimens were thermocycled and loaded to failure in