THE EFFECT OF CURING TECHNIQUES AND BONDING PROCEDURES OF COMPOSITE RESTORATIONS, ON THE PHYSICO-CHEMICAL STRUCTURES OF HYBRIDIZED NORMAL AND EROSIVE DENTINE

Thesis

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By

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بسم الله الرحمن الرحيم

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

صدق الله العظيم

"آية 32 سورة البقرة"

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DEDICATION

This work is Dedicated to:

My Parents for their endless love

My Husband who gave me support and love

And

For my children for their patience

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INTRODUCTION

The increased esthetic demands and patients’ interest have resulted in the development of new tooth-coloured restorative materials and techniques. Composite resin materials and adhesive techniques have become the foundation of modern dentistry. Now, they are used in cases ranging from the restoration of initial decay and cosmetic correction to veneering in complex prothodontic rehabilitation. However, polymerization shrinkage of composite resins remains a challenge and still imposes limitations in the application of techniques. (1)

During the pre-gel polymerization, composite resin is able to flow, which relieves stress within the structure. (2) After gelation, flow ceases and cannot compensate for shrinkage stresses. Therefore, post gel contraction, results in clinically significant stresses in composite – tooth bond and surrounding structure. (3) These stresses may produce defects in composite tooth bond, leading to bond failure, microlcakage with associated postoperative sensitivity, (4) recurrent caries and could also cause deformation of the surrounding tooth structure. (5) This coronal deformation may result in enamel microcracks in the cervical region and postoperative hypersensitivity. (6)

The control of contractions stresses may be accomplished by different methods. (7) One approach is the technique or the manipulation of the composite resin during filling. This can be achieved by controlling the technique of insertion, (8) or modulating the curing technique. The concept is to prolong the time required for the material to approach the post-get phase. The longer the pre-gel phase the more the restoration can adapt to shrinkage.(9) One way to prolong the pre-gel time is through controlling the. curing light by using “soft-start” or two-step polymerization. (10) Pulse-delay curing mode, have been recently proposed to allow relaxation of stresses of composite resin materials during polymerization. (11)

Bonding to dentin is affected by many variables some of them are related primarily to the dentin structure perse. [12] Dentin is a dynamic substrate, [13] with regional differences in dentinal tubule density, dentin permeability, calcium concentration, presence of abnormal dentin and varying thickness of smear layer. This results in non-uniform etching of dentin, and hence a non uniform bond strength. [14] Van Meerbeek et at, in 1994[15] suggested that demineralization is more difficult in both the peritubular and intergobular regions of sclerotic dentin and they showed that, the hybrid resin layer formed in dentin bonding is much thinner and exhibited fewer or no resin tags as compared to normal dentin.

It’s worthy to mention that adherence depends on adhesive technology, material application, taken into consideration its time, the surrounding tooth structure and within the immediate vicinity of the hybridized dentin. All are factors inducing a change which mereostates its investigation.

REVIEW OF LITERATURE

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Erosion describes the process of gradual destruction of the surface of something, usually electrolytic or chemical process. It describe the physical result of a pathologic, chronic, localized, painless loss of dental hard tissue chemically etched away from the tooth surface by acid and/or chelation without bacterial involvement. The acids responsible for erosion are not products of the intraoral flora they stem from dietary, occupational or intrinsic sources. [(16-18)] Erosion affects dental enamel causing dissolution of the appetite crystals. Depending on the histological structure of enamel, erosion proceeds either by dissolving enamel prisms or by chemically wearing off the aprismatic surfaces. Once the erosion reaches dentin the process continues via dentinal tubules and eventually involves the pulp tissue. A characteristic increase in tooth sensitivity to any outer stimuli is seen as a main symptom of erosion. However if the process is slow an increased sensitivity may be delayed because of accumulation of tertiary dentin in the pulp.

Acid producing tooth destruction may be exogenous, endogenous or of unknown origin. Extrinsic erosion is the result of exogenous acids. These can be airborne acidic contaminates of the working environment, acidic water of swimming pools, or a side effect of chlorination using chlorine gas that react with water forming hydrochloric acid [(19-24)]. Sever cases of extrinsic erosion was also owing to the use of medication as iron tonics.

Also dietary acids are undoubtedly causative factor for extrinsic tooth erosion. The most frequently consumed erosive acids are fruit acids fruit juices and soft drinks [(25-34)]. More recently ascorbic acid (Vit C) contained in all sorts of drinks.

Intrinsic erosion which is the result of endogenous acid occur when gastric acid contacting the teeth during vomiting or regurgitation. Erosion is characterized by being localized predominantly palatal and occlusal surface of upper arch buccal and occlusal surfaces of lower premolars and molars. SEM studies showed that enamel of erosive lesions showed as honeycomb appearance similar to that seen in acid etched enamel. While latent or inactive erosions which occur through a change in the etiologic factor have prominent thick enamel borders and do not show a honeycomb enamel prism structure in the SEM [(25)]. Owing to these specific features of an erosive lesion the presence of a substrate that is different than normal dictates the use of specific bonding systems. these latter have to be compatible with the nature of such substrates. However, different generations of bonding systems were suggested throughout the last four decades.

Protective Factors Against Erosion

Saliva and its components protect the dentition against erosion by various mechanisms. [(35-36)] Increasing salivary flow helps to dilute acids in the mouth, which also leads to their rapid removal by swallowing. Also, salivary buffers partly neutralize the acids in the oral fluids, the calcium and phosphate levels in the saliva act as common ions to the minerals in enamel and dentin, resulting, in a slower dissolution rate of mineral.

Restorative Treatment

Restorative treatment may be necessary if the structural integrity of the tooth is threatened the tooth (dentin) is hypersensitive the defect is esthetically unacceptable to the patient or pulpal exposure is likely.

The restoration of erosion defects has been a major area of controversy for many years. In the past such lesions were often disregarded or left untreated. It was normally argued that restoration of such lesions would be temporary and that regardless of the cause of the original lesion, the anomaly would only return. Moreover, conventional cavity preparations that are described in most operative textbooks would involve extensive loss of tooth structure [37].

Research directed towards developing adhesion between restorative materials and mineralized tooth surfaces has been advancing for over 40 years. The main goal in this process has been to obtain an intimate adaptation with cavity interfaces to resist microleakage and the influx of oral irritants, which may lead to post-operative sensitivity, interfacial staining, and recurrent caries[38].

While perminent success has been achieved with respect to enamel surface, adhesion to cementum and dentin substrates has been more challenging. Conditioning of enamel with acidic solutions, such as phosphoric acid (37%), predictably creates microporosities into which resinous materials can penetrate, thereby achieving mechanical retention and sealing [39]. Initially, similar strategies employed for dentin surfaces have been discouraged due to inadequate adhesive bond strength and concerns for pulpal injury [40-41].

In order to increase the surface area for micro retention on enamel, it is important to place a long bevel along the enamel margin using a flame shaped diamond. This enamel surfacing procedure or beveling is quite substantial. The bevel visually decreases the boundary between the restoration and tooth structure. Additionally, it amplifies the bond to the underlying enamel. If the restoration is extended onto unetched enamel surface, this will result in discolored margins because the overlying unbonded composite gradually lifts from the surface. Finally, many of the modern dentin all-etch bonding agents use a phosphoric or other organic acid etching agent with only a 10% concentration to condition enamel and dentin simultaneously. Matured enamel in older patients and uncut enamel surfaces commonly require a much higher acid concentration (approximately 30-37%) for effective etching. Failure to bevel and