"Marginal Adaptation and Fracture Resistance of Two CAD/CAM Occlusal Veneers"

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Dedication

I would like to dedicate this work to

my dear parents,

my sisters and brother and

George

for their continuous support and encoragement

Acknowledgment

First of all I would like to thank GOD for blessing me through this work.

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Introduction

The excessive loss of coronal tooth substance due to causes other than dental caries has been one of the common situations in dental practice.[1, 2]

Tooth surface loss in general is multifactorial. It happens physiologically as a consequence of the ageing process, other pathological causes include attrition, abrasion and erosion. Para functions such as clenching and bruxism are among the causes that lead to severe loss of tooth material. There is always a need to evaluate each individual case where generalized loss of coronal tooth substance is present. This is crucial for the identification of the problem and finding a suitable treatment.[3]

The detrimental effects of tooth surface loss include: affection of the Vertical Occlusal Dimension (VDO), change in appearance, pain and/or sensitivity due to tooth dentin exposure. In addition, loss of posterior occlusal stability affects the harmony of the musculoskeletal system of the orofacial region; these all result in affection of function, comfort and appearance of dental patient.[4]

The appropriate management of the problems of severely worn dentition has been for long a controversial issue. The treatment plan has to be individually placed after thorough diagnosis. The number and condition of the remaining teeth also affect the decision in treatment. The restorative options may include multiple full-coverage restorations, crown lengthening and elective tooth de-vitalization. Unfortunately, these procedures result in removal of healthy tooth tissues to

accommodate the preparation design. The introduction of the idea of using all ceramic occlusal veneers offered a very suitable treatment option for the worn dentition.[5]

During the past few years, there was much interest in the hybrid materials, where the resin matrix component offered preferable fracture pattern upon loading. New developments in the fields of nano-dentistry and high strength ceramics also lead to materials with superior characteristics regarding strength, marginal adaptation and esthetics Also, advances in adhesion protocols and materials as well as the introduction of the CAD/CAM technology (Computer Aided Design /Computer Aided Manufacturing) in dental field have allowed much modifications in treatment options with special concerns to more and more conservation for the remaining tooth structure and the fabrication of thin restorations when the available space is limited. In addition, more flexibility regarding material choice and restoration design was thus achieved giving ability to expand the range of their dental applications.[6-8]

Bonded posterior occlusal veneers have been introduced as a conservative alternative for the treatment of severe tooth wear. The combination of CAD/CAM technologies and a state of the art bonding protocol seems to be the right approach to achieve predictable results. There is no definite material that proved to be solely the ultimate material to be used as occlusal veneer.[7, 9]

The marginal adaptation and fracture resistance of occlusal veneer are of the most important technical factors to assess long term clinical success of the restoration. Clinical evaluations of marginal adaptation and fracture resistance of restorations are generally complicated

procedures because of time, cost and ethical reasons .In vitro studies are therefore performed to predict the performance.[10]

Review of Literature

Occlusal Tooth Structure loss Prevalence and Management strategies:

Tooth wear or non-carious tooth surface loss is a clinical problem that is becoming increasingly prevalent. Many researches were concerned specifically with erosive tooth wear. Tooth structure loss was shown in various age groups.[2,11]

Oral rehabilitation of patients with non-carious tooth loss requires strategies that address all the factors relevant to the etiology and pathogenesis of the condition. The multifactorial nature of tooth wear and the variability in its clinical presentation provides challenges for the clinician and successful management must be more than just restoration. Management must include preventive and restorative strategies keeping in mind that long-term restorative success is influenced largely by the patient's oral environment, and how diet, lifestyle and medical status can modify this environment. The stability of the oral environment and the condition of the remaining tooth structure will eventually determine the success of any restorative intervention.[3,12,13]

Conservative approach, Biomimetic concept:

Biomimetic dentistry means to copy what is life-like. Nature has

provided the most successful and ideal properties to our natural teeth. When restoring damaged, broken, and decayed teeth, the goal is to return the tooth to its original strength, function, and esthetics.

Preservation of tooth structure is nowadays the main concern in restorative dentistry. From a biomimetic perspective, the conservation of tooth structure is paramount in maintaining the equilibrium between biologic, mechanical, functional, and esthetic needs. It is clearly beneficial to maintain the pulp vitality and avoid endodontic treatment and the need for posts and cores, because these more invasive approaches violate the biomechanical balance and compromise the longevity of restored teeth.[14, 15]

In order to achieve optimal restoration of teeth, it is important to avoid approaches concentrating solely on characteristics of restorative materials – such as strength, hardness etc. The key to successful and simple (not primitive) restorative technique is to use the intact tooth as a guide to biomechanical and esthetic reconstruction and utilize those principles through hard tissue bonding. [16]

The backbone of tooth strength is its internal stress distribution mechanism. It is provided via dentino-enamel junction (DEJ) that constitutes a lesson from nature on how to achieve strong, durable bonding between dissimilar materials: the hard, brittle outer layer of enamel and the softer, but tougher dentin. In primitive biomimetic model, DEJ is often compared to adhesive layer in terms of stress absorption. However, it is not completely correct. Adhesive layer poorly imitates DEJ. The reason is that biomechanically DEJ should be seen as a graded band or interphase rather than a discrete interfacial line. Gradual change in mechanical properties is the most important

feature of the DEJ. Such graded transition from enamel to dentin may sustain higher loads than a direct bond between two distinct adhesive layers and thus it stands in contrast to the adhesive interfaces between artificial dental restorative materials and dentin.[17]

Occlusal Veneers

Minimally invasive approaches for the management of occlusal tooth surface loss are of great interest in modern dentistry. An Occlusal veneer is defined as a monolithic thin indirect extra coronal overlay restoration that is adhesively bonded to tooth. Occlusal veneers are conservative alternative to traditional onlays and complete coverage crowns for the treatment of worn dentition. This is due to the fact that they utilization of additive adhesive techniques with no or minimal need of tooth preparation. [18, 19]

Occlusal Veneer Preparation Design:

The conventional preparation all ceramic restorations required removal of significant amount of sound tooth structure in order to achieve 1.5 to 2 mm occlusal clearance to provide bulk of material for strength. [20]

However, the rapidly growing advances in fields of adhesion dentistry and CAD/CAM materials eliminated the need for aggressive tooth preparations. A study to compare different thicknesses of different materials 0.5 mm, 1.0 mm, 1.5 mm, 2.0 mm, and 3.0 mm was performed. A simplified tri-layer onlay model was designed to mimic the restoration for posterior tooth. A conclusion was drawn on the linear