بسم الله الرحمن الرحيم

قال ربي اشرح لي صدري ويسر لي أمري
واحلل عقدةً من لساني يفقهوا قولي

صدق الله العظيم

سورة طه الآيه (٢٤-٢٨)

A Newly Developed Composite Material As An Anterior Crown Restoration- In vitro Assessment

Master Thesis submitted to the
Faculty of Oral and Dental Medicine
Cairo University

For partial fulfillment of Requirements for the
Master Degree in Fixed Prosthodontics

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B.D.S (2001)

Faculty of Oral and Dental Medicine
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2009

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Dedication

To my mother and father, whose care and devotion have strengthened me throughout my life and brought me to where I am today.

To my beloved husband Mohab, who supported me throughout this research work.

Finally, to my lovely kids Ali and Zeina for the joy they brought into my life.

Acknowledgement

It is a great pleasure to express my special appreciation and gratitude to ***Prof. Dr. Hany Halim Nasr,*** Professor and Former Chairman of Fixed Prosthodontics Department, Faculty of Oral and Dental Medicine, Cairo University for his great support and valuable supervision. His deep knowledge and contributions had influenced this work and made it be fulfilled. I deeply thank him for such a penetrating guidance.

I would like to express my deepest appreciation to ***Dr. Iman Salah El-Din Hamdy,*** Assistant Professor of Fixed Prosthodontics, Faculty of Oral and Dental Medicine, Cairo University for her continuous encouragement, support and sincere care. I am so grateful to her for offering such a valuable supervision and great help.

I would like to thank ***Prof. Dr. Ashraf Hassan Mokhtar,*** Professor and Chairman of Fixed Prosthodontics Department, Faculty of Oral and Dental Medicine, Cairo University.

I would like to express my appreciation and gratitude to ***Prof. Dr. Mohamed Mahmoud Al-Kateb,*** Professor and Former Chairman of Conservative Dentistry Department, Faculty of Oral and Dental Medicine, Alexandria University, for his great help during laboratory work of this study.

A lot of thanks and gratitude to my colleague, ***Dr. Haitham Amr*** and to all staff members of Fixed Prosthodontics Department, Faculty of Oral and Dental Medicine, Cairo University.

LIST OF CONTENTS

Page

List of tables

List of Figures

INTRODUCTION

One of the prime goals of fixed prosthetic treatment is to substitute the lost tooth structure by a material capable of restoring function, esthetic and comfort. Over the past decade, increased demand for esthetically pleasing restorations has led to the development of tooth-colored materials, with ever-improving clinical properties.

Most experienced dental practitioners would agree that the literal standard for long-term full-crown survival is the cast gold restoration. Although the durability of this type of crown has stood the test of time it has not met ever-increasing patient demands for esthetics. This demand has led to the development and use of various ceramo-metal and all-ceramic types of dental materials and techniques from which to choose.

Although few persons would challenge the fact that ceramo-metal crowns have a proven record of strength, long-term durability, and improved esthetics, the metallic component fails to allow for a natural esthetic rendition in all instances. The fact that all-ceramic crowns have no structural metallic phase, which may interfere with the natural transmittance of light or need to be opaqued, makes them a logical restorative consideration. Aside from the “metallic smile line” produced by some ceramo-metal crowns, the metallic substructure may present with oxidation and sag resistance problems during porcelain firing.

Ceramo-metal restorations lacked the natural appearance of adjacent dentition due to metal backing, so they can’t provide translucency needed in

certain clinical situations. The required translucency could only be achieved with metal-free restorations such as all ceramic or the newly introduced composites.

During the last two decades, the prominence of esthetic in dentistry, changes in the socio-economic conditions, reduction in caries prevalence, advancement in adhesive technology, and the controversies surrounding potential toxicity and biocompatibility of metal-based restorations resulted in great revolution of treatment concepts and have prompted the development of metal free tooth colored restorations.

Restorative dentists frequently are introduced to new restorative systems and treatment modalities. While patients are primarily concerned with improved esthetics, dentists are interested in marginal accuracy and strength of the restoration due to their great influence on the long- term success of the final restoration. However, it should be fully recognized that, without the ingenuity of technicians and dentists many advances would have been wasted.

Review of Literature

The aesthetics of anterior maxillary restorations and health of the surrounding tissues are primary determinants of the successful outcome of a clinical procedure. Various restorative material and application techniques have been developed to achieve optimal aesthetics. While early porcelain-fused-to-metal restorations exhibited metal margins, the development of shoulder porcelain margins in the 1980s resulted in a significant aesthetic improvement. In the 1990s, all-porcelain restorations finally achieved the strength and complete range of optical characteristics exhibited by the natural dentition. Three decades ago, porcelain-fused-to-metal (PFM) crowns were considered to be an exotic treatment, and 'restraint' was advised for their use. [1,2]

In the early developments, several decades ago attempts were made to improve aesthetics with PFM crown restorations, beginning with beveled metal margins, shoulder metal margins, and chamfer metal margins. [3,4] On most occasions, however, only the labial aspect of the crown was veneered with porcelain. This design allowed improved stability, and occlusal contacts could be placed on the metal palatal aspect of anterior maxillary restorations for reduced wear of the opposing dentition.

The development of enhanced ceramic formulations and improved techniques to bond the ceramics to the metal substructure resulted in wide spread clinical success of this treatment modality. Several researches discovered an oxidation layer on the metal coping surface, demonstrated that firing of the first layer in an oxidizing atmosphere enhanced the bond strength of porcelain to metal. [5,6]

An optimally aesthetic result could now be achieved by adding three layers of porcelain – opaquer, body porcelain, and incisal porcelain. [1]

The 1980s were characterized by a variety of enhancements to satisfy the increasing aesthetic demands of the patients. Achieving depth of translucency in anterior crown restorations was expected to overcome previous weaknesses in the vitality of porcelain, which rendered the restorations discernible and out of harmony with the adjacent dentition.

High- and low-gold alloys were used primarily for the metal frame- work, whereas base- metal alloys demonstrated technique sensitivity when utilized for porcelain veneering. While the flexural strength of traditional feldspathic porcelains remained at approximately 70 MPa, their formulations were enhanced for improved color, translucency, and correlation with the coefficient of thermal expansion of the supporting metal substructures. The high firing temperatures for dental porcelains carried the risk of micro-crack induction in precious metal alloys and the formation of excessive oxide layers in Chromium-containing alloys.

Although not hydrolytically stable at the time, leucite- reinforced low-fusing porcelains were introduced in an attempt to overcome these complications. In addition, replacement of the metal coping by a higher strength ceramic or a non-shrinking ceramic, for restorations that were designated for porcelain veneering was discussed. [7] The "controlled crystallization" of glass resulting in castable glass-ceramics was a third alternative presented. [8]

At the beginning of the 1990s, the aesthetic result that could be achieved with anterior maxillary restorations seemed to approach perfection. Although restorations with shoulder or chamfer metal margins offered more options for an aesthetic result, [9,10] they could be surpassed only by aesthetic results attained utilizing all ceramic restorations. [11,12]

The first and primary advantage of all ceramic restorations is the increase in depth of translucency and light transmission that provide the patient with a natural and vital-looking restoration. [13] Second, esthetics at the cervical area can be enhanced through the superior blending between the restoration and the surrounding tissues. [14] Third, all ceramic restoration allows supra-gingival margin placement without compromising the esthetic result. [15,16] Moreover, reducing biologic width violation or iatrogenic periodontal disease resulting from accumulation of bacteria and plaque around sub-gingival margins. [17] Also, fabrication of an accurate definitive impression will be achieved. Forth, the likelihood of over contouring the restoration is reduced; thus, the risk of iatrogenic periodontal disease is minimized. [18,19] Fifth, ceramic systems have a reduced thermal conductivity, resulting in less thermal sensitivity and potential pulpal irritation. [20] Finally, the problem of hypersensitivity of some patients to dental alloys is eliminated with all ceramic systems. [21]

Despite of all the previous advantages, no sufficient clinical data are available regarding the safety and efficacy of commercially available ceramic systems under heavy occlusal loads. [19] Also, **Groten et al,** [22] mentioned that feldspathic porcelains generally provide excellent esthetics, biocompatibility, and compressive strength. However, they lack tensile strength and frequently fracture when subjected to shear forces and due to the inherent weakness of