بسم الله الرحمن الرحيم(١)

الحمد لله رب العالمين(٢)

الرحمن الرحيم(٣)ملك يوم

الدين(٤)إياك نعبد وإياك

نستعين (٥)اهدنا الصراط

المستقيم(٦)صراط الذين

أنعمت عليهم غير المغضوب

عليهم ولا الضالين(٧)

سورة الفاتحة

صدق الله العظيم

Optical properties and surface roughness of lithium disilicate ceramics using two different techniques

Thesis

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By

Asmaa Saber Mohamed Wahba Elnashar

B.D.S

Alexandria University

٢٠٠٠

Faculty of dentistry

Ain shams universiy

٢٠١٣

Supervisors

Dr.Jihan Farouk M Younis

Assistant professor, Crown and Bridge department,

Faculty of Dentistry, Ain shams university

Dr.Tarek Salah Morsy

Assistant professor, Crown and Bridge department,

Faculty of Dentistry, Ain shams university

To my husband and to the members of my family for their time concern, love, devotion and support throughout the study time and to sole of my father

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INTRODUCTION

The dental profession has long been concerned with the problem of matching the appearance of the ceramic restorations with a patient's natural dentition.[١] Since the introduction of the earliest all-ceramic reinforced crown system by McLean and Hughes (١٩٦٥) [٢], several generations of newer all-ceramic systems compete with the traditional porcelain fused to metal crown.

The first all-ceramic system consisted of a porcelain core material reinforced by ٥٠% aluminum oxide ($AL_٢O_٣$) and veneered with feldspathic porcelain [٣]

This was followed by the introduction of several types of ceramics as the castable ceramic Dicor in ١٩٨٤ [٤] and the pressable ceramic cerestore. Attempts have been made to enhance physical properties of all-ceramic materials; however the clinical appearance has been affected [٥]

In all dental ceramic material, there are two categories depending on the nature of supporting structur.The first category is the reinforced ceramic core systems which could be further divided into ;(Alumina- or zirconia) reinforced ceramics which are opaque in nature glass-infiltrated High Strength Ceramic Core Systems. The second category is the Glass Ceramics [٤] which either moderately filled glass (Dicor-Empress) or highly filled glass (e-max).

The ability to blend a porcelain crown with its natural counterpart involves consideration of size, shape, surface texture, translucency, and

color [٧] Furthermore, Kelly et al identified core translucency as one of the primary factors in controlling esthetics and a critical consideration in the selection of materials. [٦]

The next generation of glass ceramics was the Empress II with a crystalline phase of lithium disilicate ($Li_٢Si_٢O_٥$) that makes up around ٧٠% of the volume of the glass ceramic. [٤] Empress II was claimed to be highly translucent due to the optical compatibility between the glass matrix and the crystalline phase, yet, an optimal result was not yet feasible in all conditions because the optical behavior and final esthetic results of all-ceramic restorations constructed from glass ceramics is dependent partially on the luting agent and the underlying tooth structure which might be discolored or restored with metal post and core. [٨, ٩]

REVIEW OF LITERATURE

The word ceramic can be traced back to the Greek term “keramos”, meaning "a potter" or "pottery". Keramos in turn is related to an older Sanskrit root meaning "to burn". According to Gilman in ١٩٦٧, a ceramic is an earthy material usually of silicate nature and may be defined as a combination of one or more metals with a non-metallic element usually oxygen. The American Ceramic Society defines ceramics as inorganic, non-metallic materials. They are typically crystalline in nature, and are compounds formed between metallic and nonmetallic elements such as aluminum + oxygen (alumina-Al_2O_3), calcium + oxygen (calcia- CaO), and silicon + nitrogen (nitride-Si_3N_4). [١٠]

Traditional porcelain is a blend of three minerals: quartz, feldspar and pure white clay ($Al_2O_3.SiO_2.xH_2O$). In order to produce various shades and translucencies, pigments and opacifying agents were added to porcelain. After baking, the material contains small leucite crystals and/or alumina-silicate crystals embedded in a silicate glass (a non-crystalline, amorphous matrix). Leucite, a reaction product of potassium feldspar and glass, is responsible for the optical properties, thermal expansion, strength and hardness of porcelain. [١١]

The structure of ceramic materials is dictated by the type of atoms present, the type of bonding between the atoms, and the way the atoms are packed together. The atoms in ceramic materials are held together by a chemical bond, the two most common chemical bonds for ceramic materials being covalent and ionic. For metals, the chemical bond is called

metallic bond. The bonding of atoms together is much stronger in covalent and ionic than in metallic bonding. That is why, generally speaking, metals are ductile and ceramics are brittle. [١٠]

Dental ceramics

Ceramics can be classified into two main groups according to their composition.

A- Oxide ceramics:

The oxide ceramics comprise both simple oxides such as aluminum oxide, zirconium dioxide and titanium dioxide, as well as complex oxides such as spinelle, ferrite. They are indicated for cases with high functional loading in both the mandibular static position and during excursive movements which requires the use of a material with great resistance to fracture.[١٢]

B- Glass ceramics:

Glass-ceramics are polycrystalline solids consisting of a glassy matrix and one or more crystal phases produced by the controlled nucleation and growth of crystals in the glass (controlled crystallization).[١٣]

The term "controlled crystallization" was described as the separation of a crystalline phase in the form of minute crystals; the number of crystals, their growth rate, and final crystal size being controlled by an optimized heat treatment. The process of controlled crystallization is termed "ceramming". [١٢]

The crystals in glass-ceramics are not the same as those contained in the raw material. Rather, they have been "artificially" created by controlled crystallization. This process allows tailor-made materials to be produced, which exhibit a high strength, homogeneous structure, good thermocycling properties, as well as good optical properties. [١٤]

The feldspathic porcelain material is a conventional, silica-based ceramics which is usually used in the fabrication of inlays, onlays and laminate veneer restorations. The advantages of using feldspathic porcelain include; ١) reproducibility of tooth color with a thin layer of the material, ٢) low laboratory cost compared to other ceramic restorative systems, ٣) excellent mechanical retentive characteristics after etching with hydrofluoric acid, and ٤) excellent bonding characteristics with the use of appropriate silane bonding agents. [١٥] So, there is certainly a strong indication for the use of feldspathic porcelain in the fabrication of porcelain veneers. [١٦]

The major drawback with feldspathic porcelains is its low flexural strength, predisposing to fracture, with poor longevity. This is due to its brittleness and micro porosities formed between porcelain particles.[١٧,١٨]

So stronger and tougher materials were developed and commercialized along with novel processing technologies to overcome those drawbacks.[١٩]