

Mona Maghraby



بسم الله الرحمن الرحيم

مركز الشبكات وتكنولوجيا المعلومات

قسم التوثيق الإلكتروني



Mona Maghraby



جامعة عين شمس

التوثيق الإلكتروني والميكروفيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
على هذه الأقراص المدمجة قد أعدت دون أية تغييرات



Effect of multiple firing cycles and temperatures on lithium silicate color stability and translucency

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Riham Magdi Abdelwahed Saleh

B.D.S, Faculty of Dentistry
Ain-Shams University
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Faculty of Dentistry
Ain-Shams University
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Supervisors

Prof. Dr\ Tarek Salah El Din Morsi

Professor of Fixed Prosthodontics Department

Faculty of Dentistry

Ain-Shams University

Dr\ Ahmed Ezzat Sabet

Associate Professor and Head of Fixed Prosthodontics Department

Faculty of Dentistry

Ain-Shams University

British University in Egypt (BUE)

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Dedication

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Introduction

Dental esthetics is a challenge and influenced by many factors like the wishes of the patient, experience of the clinician and the artistic and technical skills of the ceramist. It is art and science. Art is not enough to create life like restorations, while science alone is inadequate for pleasing results. In the patient's perception of dental attractiveness one of the most important considerations in judging the finished restoration is the shade of the restoration¹.

Esthetic became one of the main demands at dental field and continuous enhancement of ceramic materials are done to fulfill this demand.

Ceramic materials are the material of choice due to their natural appearance, fluorescence, biocompatibility, durability, stability, high compressive resistance as well as their coefficient of thermal expansion is similar to natural tooth also success of a ceramic restoration is mainly based on a high adhesive between the ceramic, resin cement and dental hard tissues^{2,3}.

All ceramic restorations are highly demanded by patients because they are esthetically pleasant and their use eliminates the need for sub-gingival placement of restoration margins for esthetic purposes. Moreover, these restorations provide precision of fit, which is important for long-term success⁴.

Glass ceramics containing lithium silicate had been introduced in the dental market in the past few years. Obsidian is a lithium silicate glass ceramic indicated for crowns, inlays, onlays and veneers. It exhibits excellent translucency resulting in superior esthetics. It possesses above average flexural strength and is recommended mainly for anterior and premolar crowns⁵.

Patient satisfaction is important with shade matching and reproduction. Fabricating restorations of shades compatible with adjacent teeth has two aspects 1- Shade matching 2- Shade duplication.

Despite careful shade selection the color of restoration may be affected by fabrication procedures, thickness of the ceramics, cement color and multiple firing⁶.

As the tooth is made up of enamel and dentin which have different colors and inherited translucency. For this reason, ceramic restorations might require multiple applications of intrinsic and extrinsic stains to achieve an acceptable result. Several factors of ceramics as translucency, florescence, opalescence, shade, condensation technique, brand and number of firings affect the final color of the restoration. Moreover, depending on the esthetic requirement of the restoration, it may be fired up seven to ten times⁶.

Multiple firings may affect color and translucency of all ceramic material. Therefore, the following study accessed the effect of multiple firings on the color stability, and translucency of a lithium silicate ceramic.

Review of Literature

Esthetic aspects of dental treatment are becoming increasingly important to patients, thus increasing the demand for all ceramic restorations. Since the introduction of the reinforced feldspathic porcelain in (1965), new materials and processing technology for all ceramic restorations with significantly improved physical and mechanical properties are available at present ⁷.

Porcelain is a ceramic that consists of a glass matrix phase and crystal phase(s). The glass phase is responsible for esthetics and the crystalline phase is responsible for mechanical strength ⁸.

Dental ceramics materials are classified according to whether a glass-matrix phase is present (glass-matrix ceramics) or absent (polycrystalline ceramics) or whether the material contains an organic matrix highly filled with ceramic particles (resin-matrix ceramics)⁹.

Glass ceramics are composed of glass and crystals and according to their ratios; their esthetic and physical properties are determined. Lithium disilicate, ($\text{Li}_2\text{Si}_2\text{O}_5$) was the first glass ceramic developed by Stooky in 1959 and gained popularity since then. Various methods of chemical synthesis and controlled crystallization determine lithium silicate's final properties^{10,11}. Lithium disilicate ceramic restoration was recently used for anterior and posterior single crowns, and partial coverage restorations¹².

Classifications of Dental Ceramics

Dental ceramics can be classified in a number of different ways, including by their processing method, fusing temperature, translucency, fracture resistance, abrasiveness, composition and microstructure^{13,14}.

Classifying ceramics according to their composition and microstructure is a logical step in the right direction, because understanding of it by both technician and clinician is essential for optimal results^{9,13}.

At a microstructural level, ceramics can be defined by their composition of glass-to-crystalline ratio. There can be infinite variability of the microstructures of materials; however, they can be divided into five basic compositional categories with a few subgroups¹⁰:

- Composition Category 1: Glass-based systems (mainly silica)
- Composition Category 2: Glass-based systems (mainly silica) with fillers, usually crystalline (typically leucite or a different high-fusing glass)
- Composition Category 3: Crystalline-based systems with glass fillers (mainly alumina)
- Composition Category 4: Polycrystalline solids (alumina and zirconia)
- Composition category 5: Resin matrix ceramics

Category 2: Glass Based System with fillers

In this category, ceramics have large variety of glass-crystalline matrix and crystals with different ratios. Consequently, they can be subdivided into three groups. The difference between the subgroups is the amount of different types of crystals added or grown in the glass matrix. The main types of crystals are leucite, lithium disilicate and fluoroapatite. The glass-based system is made from materials that contain silica or silicon dioxide with different amounts of alumina.

Subgroup 2.1: Low to moderate leucite containing feldspathic glass.

This material has leucite crystals that are of random size and distribution with the average particle size being around several hundred microns. Leucite inhibits crack propagation and raises the coefficient of thermal expansion of the material which improves the strength of the material¹⁵. The randomization of distribution and large particle size gives the material low fracture resistance and abrasive properties relative to enamel^{16,17}. Recently, much finer leucite crystals (10–20 µm) have been developed with even particle distribution throughout the glass. Therefore, they are less abrasive and have higher flexural strengths^{18,19}. Via electron micrograph, it reveals a glass matrix surrounding leucite crystals. This material is available as powder/liquid and is used for veneering cores of restorations.

Subgroup 2.2: High leucite-containing (approximately 50 %) glass.

They are glass ceramics which have a crystalline phase grown within the glass matrix by a process called “controlled crystallization of glass”. They have higher resistance to fracture, erosion and thermal shock. They are available in both powder/liquids, machinable, and

pressable forms. The most famous glass ceramic is the original IPS Empress. CEREC and E4D are pressable and machinable and have performed excellently clinically when used for posterior onlays and inlays, anterior veneers and crown restorations²⁰.

Subgroup 2.3: Lithium disilicate glass-ceramic

They consist of a glass matrix of a lithium silicate with micron-size lithium disilicate crystals in between submicronlithium orthophosphate which creates a highly filled glass matrix with crystal content about 70 %¹⁷. The lithium disilicate crystals are needle-like in shape²¹. The volume and shape of the crystals increase the flexural strength to about 360 MPa, or about three times that of IPS Empress²²⁻²⁵. Even with its high crystalline content the material is very translucent due to the low refractive index of lithium disilicate crystals. Thus, they can be used as full contour restorations.

They can also be veneered by veneering porcelain which consists of fluorapatite crystals in an aluminosilicate glass to create the final morphology and shade of the restoration. Fluorapatite is a fluoride containing calcium phosphate which contribute to the veneering porcelain's optical properties and CTE so that it matches the lithium disilicate pressable or machinable material. They were originally introduced by Ivoclar Vivadent as IPS Empress II and a new form named IPS e.max pressable and CAD/CAM²¹.

Recently in the past few years, a new lithium silicate-based glass ceramic was introduced under the name of 'Obsidian' designed for construction of monolithic all ceramic restorations. Obsidian can be