Comparison of the bond strengths of resin cement to new esthetic CAD/CAM materials and their durability

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By

Ahmed Mohsen Mohamed Foad

B.D.S

Faculty of Dentistry,

Ain Shams University,

2010

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<u>Supervisors</u>

Dr. Tarek Salah Morsi

Assistant Professor and Head of Crown and Bridge Department,

Faculty of Dentistry, Ain Shams University

Dr. Ahmad Khaled Abo El-Fadl

Lecturer, Crown and Bridge Department,

Faculty of Dentistry, Ain Shams University

Faculty of Dentistry,

Ain Shams University

2015

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Dedication

This work is dedicated to

My dear parents,

Precious sister and brother and

My Beloved fiancé

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MBE&P: MonoBond Etch and Prime

MBP: MonoBond Plus

SEM: Scanning Electron Microscope

PCIN: polymer infiltrated ceramic network

INTRODUCTION

Throughout the years, dental treatment had an enormous evolution from just emergency treatment relieving pain till it reached preventive treatment ending by esthetic rehabilitation.[1]

Nowadays, esthetic correction became one of the patient's main demands raising their expectations to a very high level and being reflected in their self-esteem and confidence.[1]

With the introduction of the all ceramic restorations by **McLean** in 1967 fabricating Fixed Partial Denture (FPD) pontic using high alumina ceramics,[2] all ceramic restorations has been used widely since then fulfilling the patients requests. Moreover, the methods of fabricating those restorations changed from just ordinary manual lab work to sophisticated CAD/CAM systems.[3]

Usually techniques for ceramic bonding in addition to intraoral repair utilize hydrofluoric acid for etching in spite of its various harmful effects it has concerning the patient and the dentist that **Ozcan et al in 2012** summarized in their study.[4] As a consequence many repair systems were fabricated using less harmful acids as phosphoric acid but reliable bond strength is still debatable.

Nowadays, there are increasing cases where the retention of restorations is reliant on bonding, *e.g.* resin-bonded bridges. Hence, the quality of bonding is of increasing importance, and is a dominant factor required for the long-term success of glass ceramic restorations. In addition, the ceramic and resin cement bond is subjected to a complex environment in the oral cavity being influenced by several extrinsic factors such as temperature change, saliva, daily food and drink intake, biting force and other habits. Consequently, laboratory testing should simulate these variables to enable the development of superior materials and surface preparation methods that provide long-term durable bond strengths in the oral environment.[5]

Summarizing the above points of view, trying to use different etching solutions instead of hydrofluoric acid and having an efficient bond strength for a reliable long term retention has been a goal for both: having a successful durable restoration and performing a fast and safe intraoral repair.

Although newly introduced CAD/CAM Hybrid ceramics feature a diversity of superior esthetic & mechanical properties, yet, little is known regarding the bond strength of these materials. Moreover, recently introduced bonding systems assume a high bonding performance without the harmful effects of the HF acid.

REVIEW OF LITERATURE

As dentistry continues to evolve, new technologies and materials are continually being offered to the dental profession. Throughout the years, restorative trends and techniques have come and gone. Some material developments have transformed the face of aesthetic dentistry, while other initial concepts have phased out and died. Today all ceramic restorations continue to grow in the area of restorative dentistry, from pressed ceramic techniques and materials to the growing use of zirconia, and new materials that can be created from CAD/CAM technology.(6)

Ceramics are formally defined as compounds of metallic and non-metallic elements consisting of oxides, nitrides, carbides, and silicates. Typical silicates are formed of Si-tetrahedrons, SiO4.(7) The structure of ceramics exists in the form of crystalline solid or glasses.(8) Ceramics used in dentistry predominantly contain non-metallic and metallic elements(9) and are mostly based on silicon that is usually found in the form of silica (silicon dioxide), SiO2, due to silicon's high affinity for oxygen. A vast array of Si-O compounds and silicate minerals exists in the Earth's crust.(10) When silica occurs as a crystalline material, it can be in the form of quartz, crystobalite, and tridymite. Silica in dental ceramics is usually in the form of quartz.(8) Because of the black appearance of nitrides and carbides, they are not used as biomaterials in dentistry.(9)

The traditional type of dental ceramics are feldsparbased materials containing silica fired at temperatures above 870°C and composed of a tectosilicate mineral feldspar ($KAlSi_3O_8$), quartz (SiO_2), and kaolin ($Al_2O_3 \cdot 2SiO_2 \cdot 2\ H_2O$).(11) Because feldspar-based ceramics were prone to failure owing to their inherent brittle nature, ceramics with higher crystalline content such as alumina (aluminum trioxide) Al_2O_3 and zirconia (zirconium dioxide) ZrO2, were developed in order to improve the mechanical properties.[7]

The so-called glass-ceramics are different from traditional feldspar-based ceramics because of the larger crystalline phase that helps stop crack growth. The presence of these crystals improves mechanical properties by reducing crack formation. The glassy phase fills the grain boundary to help create a pore-free structure.[7] The crystalline phase grows during ceraming, i.e. conversion from a glass to a partially crystalline glass, and may occupy 50–100% of material.[8, 11, 12] The advantages of glass ceramics include great durability and the ability to bond to the tooth through the use of a resin luting composite.[5] The properties of glass-ceramics depend on the crystal size, the density of crystals, and the interaction between the crystals and the matrix. Glass-ceramics are easier to fabricate than traditional ceramics and do not shrink much after firing. They are also highly translucent because the glassy matrix and the crystalline phase reduce internal light scattering [11]

Innovative CAD/CAM ceramics

The earliest CAD/CAM ceramic inlay was fabricated in 1985 using a ceramic block of fine grain feldspathic ceramic (Vita™ Mark I).[13] In 2002, it was concluded by **Otto and De Nisco** that the survival probability rate of Cerec-1 CAD/CAM restorations made of Vita Mark I feldspathic ceramic appears to be acceptable to 90.4% after 10 years of clinical service.[14]

Lithium disilicate(Li_2SiO_5) glasses have their flexure strength between 350 MPa and 450 MPa. A lithium disilicate CAD/CAM ceramic IPS™ e.max CAD (Ivoclar Vivadent, Liechtenstein) was introduced in 2006 and is a chair-side monolithic restorative material. The blocks are manufactured in a process based on the so-called "pressure-casting" procedure used in the glass industry. They are