

**Evaluation of Bond Strength of Two
Different Bioactive Resin Cements versus
Conventional Resin Cement to Lithium
Silicate Ceramic and Tooth Enamel
- An in Vitro Study -**

Thesis

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بِسْمِ اللّٰهِ الرَّحْمٰنِ الرَّحِیْمِ

وَقُلْ اَعْمَلُوا فِیْ سَبِیْلِ اللّٰهِ
عَمَلَكُمْ وَرَسُوْلَهُ وَالْمُؤْمِنُوْنَ



صدق الله العظيم

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INTRODUCTION

Nowadays dentists are starting to use bioactive materials that are strong, esthetic and long lasting to traditional composites and glass ionomers. Composites are strong and esthetic but are passive without releasing bioactive potential materials. On the other hand, Glass ionomers are bioactive but have poor esthetics and unfavorable physical properties.

Bioactive materials introduce a specific biologic response at tissue surface interface. Once bioglass particles attach to dentine surface they form a surface hydroxycarboappetiate layer sealing the tubules, decreasing dentine hypersensitivity and dissolve ions that initiate the cell growth factors that cause cell regenerative and reconstructive capacity which is commonly known as regenerative dentistry.

Calcium silicate-based cements (CSC) are self-setting hydraulic cements ^[1].

The composition of calcium silicate cements is composed of dicalcium and tricalcium silicate. Calcium hydroxide and calcium silicate hydrate are produced after mixing the powder with water, then a sticky colloidal gel is formed (calcium silicate hydrate gel) that finally solidifies and hardens. ^[2,3]

A number of recent studies demonstrated that calcium-silicate cements may possess bioactivity properties when immersed in phosphate-based solutions, such as simulated body fluid, and are able to induce the formation of apatite precipitates.

Bioactivity properties may be possessed by calcium silicate cements and that was demonstrated by a number of recent studies, as when calcium silicate cements are immersed in phosphate-based solutions such as stimulated body fluid, they are able to induce apatite precipitates. [4-7]

Conventional resin cements are not bioactive, release a small amount of fluoride, and do not bond chemically to teeth. They have high strength and high esthetics but poor adapted to tooth structure and have high rate of failure lasting an average of 5.7 years. [8-12]

From the bioactive cements that are gaining attention nowadays are Activa bioactive resin cement and Theracem bioactive resin cement. We are going to discuss their importance in bonding to enamel and e.max and compare their bond strength in comparison to conventional resin cements.

Durable bonding between ceramic materials and the underlying cement is very important as it improves retention, fracture resistance, marginal adaptation and prevents any leakage or decay. Activa and Theracem have different mechanisms for bonding than conventional cements. This has to be assessed and investigated by a number of physical and mechanical tests to conclude its properties as there are no enough studies about it.

Our aim in this study was to evaluate the shear bond strength of bioactive resin cements like Activa and Theracem with enamel and e.max in comparison to the conventional resin cements such as G-cem after thermocycling.

REVIEW OF LITERATURE

Glass ceramics

Dental ceramics are materials that are part of systems designed with the purpose of producing dental prostheses that in turn are used to replace missing or damaged dental structures. The literature on this topic defines ceramics as inorganic, non-metallic materials made by man by the heating of raw minerals at high temperatures. ^[13]

Ceramics and glasses are brittle, which means that they display a high compressive strength but low tensile strength and may be fractured under very low strain (0.1%, 0.2%).

As restorative materials, dental ceramics have disadvantages mostly due to their inability to withstand functional forces that are present in the oral cavity. Hence, initially, they found limited application in the premolar and molar areas, although further development in these materials has enabled their use as a posterior long-span fixed partial prosthetic restorations and structures over dental implants. ^[14] All dental ceramics display low fracture toughness when compared with other dental materials, such as metals. ^[15]

Metal ceramic systems combine both the exceptional esthetic properties of ceramics and the extraordinary mechanical properties of metals. ^[16] Some metals used as restorative materials in dentistry may constitute a problem for some patients. These problems may reveal themselves as allergies, ^[17] gum staining ^{[18],[19]} and release of metallic ions into the gingival tissue ^[20] and the gingival fluid. ^[21] These

drawbacks, as well as the search for more esthetic materials by patients and dentists, have stimulated research and development of metal-free ceramic systems.

The main objective of this work is to review ceramic dental materials, including their most relevant physical and mechanical properties.

Classification

Ceramics can be classified by their microstructure (i.e., amount and type of crystalline phase and glass composition).^[22]

They can also be classified by the processing technique (power-liquid, pressed or machined).

Microstructural Classification

At the microstructural level, we can define ceramics by the nature of their composition of glass-to-crystalline ratio. There can be infinite variability of the microstructures of materials, but they can be broken down into four basic compositional categories, with a few subgroups:

- 1- Glass-based systems (mainly silica),
- 2- Glass-based systems (mainly silica) with fillers, usually crystalline (typically leucite or, more recently, lithium disilicate),
- 3- Crystalline- based systems with glass fillers (mainly alumina) and
- 4- Polycrystalline solids (alumina and zirconia).

1- Glass-Based Systems

Glass-based systems are made from materials that contain mainly silicon dioxide (also known as silica or quartz), which contains various amounts of alumina.

Aluminosilicates found in nature, which contain various amounts of potassium and sodium, are known as feldspars. Feldspars are modified in various ways to create the glass used in dentistry. Synthetic forms of aluminasilicate glasses are also manufactured for dental ceramics.

2- Glass-based systems with fillers

This category of materials has a very large range of glass-crystalline ratios and crystal types, so much so that this category can be subdivided into three groups. The glass composition is basically the same as the pure glass category.

The difference is that varying amounts of different types of crystals have either been added or grown in the glassy matrix. The primary crystal types today are leucite, lithium disilicate or fluoroapatite.

Low-to-moderate leucite-containing feldspathic glass - these materials have been called "feldspathic porcelains" by default. Even though other categories have a feldspathic-like glass, this category is what most people mean when they say "feldspathic porcelain."

High-leucite-containing (approximately 50%) glass. Again, the glassy phase is based on an aluminosilicate glass. These materials have been developed in both powder/liquid, machinable and pressable forms.