# Microtensile Bond Strength of Resin Bonded Translucent Zirconia Using Different Surface Treatments

### **THESIS**

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### **INTRODUCTION**

The increase of patient's desire for esthetics has resulted in the use of all – ceramic restorations in the posterior region as well as the anterior region. The acceptance of all ceramic restorations has increased because of their inherent esthetics, excellent biocompatibility, and improved physical properties. Today's, many framework structures for prosthetic restorations are fabricated using CAD/CAM procedures which means that a major part in the working sequence is carried out by industrial machines. On the other hand, it is possible to achieve more accurate design than hand drawn design, reduce the human errors and gain higher productivity which is particularly important for ceramic materials.

Zirconia based ceramics have become one of the most popular types of all ceramic restorations available today. Zirconia based ceramics utilize CAD /CAM technology for fabrication of copings for crowns, bridges and implant abutments. To gain the strength benefits of the core material, the core—veneer bond strength must be of adequate strength and toughness to transmit functional stresses from the esthetic veneer to the underlying framework.

The zirconia-veneer bond strength was inferior compared to other all-ceramic systems, which suggests that the layered zirconia frameworks are more susceptible to delamination and chipping under function, so the development of translucent zirconia will allow the use of monolithic restorations thereby making crowns with high aesthetic, translucency and at the same time avoid delamination of the veneering ceramics.

Different cement types (conventional cements, glass ionomer cements and adhesive resin cements) have been proposed for luting zirconia.

Establishing a strong and stable bond with zirconia has proven to be difficult, as the material is acid resistant and does not respond to the common etching and silanation procedures used with other glass containing ceramic materials. Other alternative techniques have been used to establish rough surface of zirconia such as, sandblasting, silica coating, selective infiltration etching, laser induced roughening, heat treatment and hot etching.

No agreement has been found in the literature regarding the best surface treatment to be used for enhancing the bond strength of zirconia to cement, that's why this study was carried out to investigate new techniques of surface treatment for enhancing zirconia / resin bond strength.

## **REVIEW OF LITERATURE**

In the search for the ultimate esthetic restorative materials, many new all-ceramic systems have been introduced to the market; the use of all-ceramic materials is increasing at almost an exponential rate. Ceramics offer the potential for excellent esthetics, biocompatibility and long-term stability. (1, 2)

All ceramic materials are classified according to composition into: silica –based (feldspathic porcelain, leucite-reinforced ceramics, and lithium disilicate ceramics) and non- silica-based (Y-TZP zirconia or alumina). (3,4)

### Feldspathic Porcelain

Feldspathic porcelain is a silica-based ceramic available in sintered, pressed and milled forms. Feldspathic porcelain is composed of Leucite (potassium aluminosilicate) and glass. It has low to medium values of flexural strength (65-120 MPa). Esthetics is the number one priority for ceramic restorations and feldspathic porcelain is arguably the most esthetic porcelain, since it has superior translucency. It is technique sensitive and due to its low strength, it is not recommended for bruxers or in high wear areas and it is rarely used for full coverage. (3)

#### **Leucite-reinforced Ceramics:**

Leucite-reinforced ceramic is a silica-based ceramic available in sintered, pressed and milled forms. It is composed of Leucite-reinforced ceramics and contains up to 45% by volume of leucite. Leucite is a reinforcing phase that results in medium values of flexural strength (120-140 MPa) and compressive strength. Leucite

crystals can act as crack deflectors and contribute to increase resistance to crack propagation. Leucite-reinforced ceramics are recommended when esthetics is the primary objective. These ceramics are less technique sensitive than feldspathic porcelains. They are not recommended for posterior areas and it is rarely used for full coverage crowns because of their low strength; however, they can be used for inlays and onlays.<sup>(3)</sup>

#### Lithium disilicate ceramics:

Lithium disilicate ceramic is a silica-based ceramic available in sintered, pressed and milled forms. Lithium disilicate ceramics consist of about 65% by volume of highly interlocking lithium disilicate crystals dispersed in a glassy matrix. These ceramics have high flexural strength (300-400MPa) and high fracture toughness. Lithium disilicate restorations combine strength with good esthetics. (3,4)

#### **Zirconia-based Ceramics:**

Zirconia is used as a biomaterial because of superior mechanical properties, chemical inertness and biocompatibility. Normally, zirconia is doped with a small amount of yttria (Y2O3) to form yttria tetragonal zirconia polycrystals (TZP) which increases the fracture toughness, flexural strength and wear resistance. Yttria tetragonal zirconia polycrystals are widely used in dentistry as root canal posts, orthodontic brackets, dental implant abutments and all-ceramic restorations. Zirconia-based ceramics utilize CAD/CAM technology for fabrication of copings for crowns, bridges and implant abutments. Zirconia (zirconium oxide, TZP) is milled in the "green" or presintered state and then sintered, during which the material shrinks about 20%. After the copings are fabricated, a ceramic veneer

compatible with the properties of the zirconia coping is pressed, stacked or milled, creating a uniquely strong and esthetic restoration. Values of flexural strength range from 800 to 1500 MPa. (3-6)

### **Biological characteristics of zirconia:**

### 1 Biocompatibility:

In vitro and in vivo studies have confirmed a high biocompatibility of zirconia, especially when it is completely purified of its radioactive contents <sup>(7,8)</sup>. Generally, ceramics are inert materials, which have no adverse local or general tissue reactions. <sup>(9,10)</sup>

### 2 Degree of toxicity

In vitro tests have shown that zirconia has a lower toxicity than titanium oxide and similar to alumina. Cytotoxicity, carcinogenicity, mutagenic or chromosomal alterations in fibroblasts or blood cells has not been observed. (11)

#### Mechanical characteristics of zirconia:

### 1. Flexural strength

It can be defined as the final force required to cause fracture and is strongly affected by the size of flaws and defects on the surface of the material tested. Microcracks and defects that inherently grow during the thermal and mechanical