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# Comparative Evaluation of Micro Shear bond Strength of Self-Adhesive Resin Cement to Two Commercially Available Zirconia-Reinforced Lithium Silicate Ceramics

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**Abstract:** ***Aim: To Compare and evaluate micro shear bond Strength of Self-adhesive resin cement to two commercially available Zirconia-reinforced lithium silicate ceramic. Settings and Design: In vitro evaluative and comparative study. Methods and Material: VITA Suprinity (VS) and Celtra duo (CD) blocks were sectioned into 10 each microbars. Each microbar was cemented to each flat dentin surface of a human premolar with self-adhesive resin cement. micro shear bond strength at 24 hours and after a week was then determined and the data was analysed by using t-test. Statistical analysis used: t-test. Results: The analysis revealed that the type of Zirconia-reinforced lithium silicate ceramic used did not reveal any significant difference in msbs. Conclusions: Within the limitations of this study, the two commercially available ZLS ceramics achieved comparable msbs when they were bonded to dentin by using self adhesive resin cement.***

**Keywords:** ZLS, Micro-shear bond strength, self-adhesive resin cement

## 1. Introduction

Metal-free restorations have emerged as a viable treatment option in fixed prosthodontics showing increased aesthetic properties over metal ceramic restorations, with adequate mechanical behaviour. Although in the last year's new high translucency stabilized zirconia have been introduced for monolithic full contour restorations, they remain predominantly opaque. This aspect limits their use as monolithic restorations in the posterior region only.

The lithium disilicate (LS2) glass ceramic is the most popular material used for all ceramic restoration. These ceramics exhibit a translucency and aesthetic appearance superior to those high strength polycrystalline alternatives. However, the mechanical properties limit their use in the molar area. [(1).] Research focuses on the development of materials that offer a combination of adequate translucency, improved mechanical strength, and optimized timesaving machining.

A new group of machinable ceramics has recently been introduced for CAD/CAM techniques: zirconia-reinforced lithium silicate (ZLS) ceramics (Celtra Duo, Dentsply DeTrey, Konstanz, Germany; Suprinity, Vita Zahnfabrik, Bad Sackingen, Germany). According to the manufacturers, these materials offer mechanical properties ranging from 370 to 420 MPa. The values for mechanical properties are approximately three times higher than those determined for traditional leucite-reinforced glass ceramics (IPS Empress, IvoclarVivadent, Schaan, Liechtenstein) [(2)]

The ceramics provide adequate strength yet they are prone to fracture under chewing loads and tensile strain. Thereby making the cementation process very important for the clinical success of these restorations. [3] A strong resin bond between a ceramic restoration and the tooth structure provides good support for the restoration and transmits functional loads through the bonded interface.

The resin cements were first developed in 1950s and by Dr. Rafael Brown in 1963 and according to the conditioning of tooth before cementation, resin cements are divided into three groups, i.e., total etch and rinse resin cements, self-etch resin cement system, and self-adhesive resin cement system/all-in-one resin cements. [(4)] The conventional technique for cementation, i.e., total-etch adhesive system, is technique sensitive and involves various steps before cementation. [6] To reduce the number of operative steps and simplify the clinical procedures self-etch resin cement systems were introduced, which includes the application of self-etching acidic primer followed by the application of resin cement. [5]

In 2002, self-adhesive resin cements were introduced those incorporate etchant, primer, and bonding resin in a single solution. Therefore, no treatment of the prepared tooth before cementation is required. [5] They possess no postoperative sensitivity, reduce chair side time, are moisture tolerant, dimensionally stable, and easy to apply, release fluoride ions, offer good esthetics, have optimal mechanical properties, and adhere micromechanically. The adhesion between the cement and tooth is obtained by the chemical interaction between the multifunctional monomer with phosphoric acid groups and hydroxyapatite. [7] However, reports on the effectiveness of this cementation systems with newly introduced glass-ceramic formulation like ZLS ceramics are sparse. Hence, this study aimed at comparing the micro-shear bond strength of self adhesive resin cements to two commercially available zirconia-reinforced lithium silicate ceramics. The null hypothesis stated that there is no significance difference in the shear bond strength of Zirconia reinforced lithium silicate samples bonded using self-adhesive resin cement.

**Subjects and Methods:**

**Study Design:** In vitro evaluative and comparative study.

## 2. Materials and Methods

For this study, 10 disk-shaped Zirconia-reinforced lithium silicate ceramic specimens of VITA Suprinity and 10 specimens of Celtra Duo were fabricated by using CAD-CAM Technology and luted to the tooth substrate using Self-adhesive resin cement (U 200, 3M) following which they were divided into two groups based on the type Zirconia-reinforced lithium silicate ceramic: Group VS (VITA Suprinity); Group CD (Celtra Duo). All the bonded specimens were stored and tested for their MSBS.

**Preparation of tooth surface:**
Twenty freshly extracted human premolars were taken and evaluated thoroughly for any visible cracks and/or carious lesions. The teeth were then mounted up to 1mm below the cementoenamel junction in autopolymerising acrylic resin (DPI RR Cold Cure, India) in a prefabricated metallic mould. The teeth were cut with a diamond bur under constant coolant about 1-2 mm below the central fossa to expose the deep dentin surface taking care not to expose the pulp. The tooth surfaces were examined under stereomicroscope to ensure uniform exposure of dentinal surface. (Figure 1)

**Cementation of zirconia-reinforced lithium silicate discs to the tooth surface:**
The surfaces of all discs were etched with 5% HF acid (IPS Ceramic etching gel, IvoclarVivadent) for 20s and then washed thoroughly followed by drying. The self-adhesive resin cement was applied on the tooth surface and the ZLS discs were cemented on it under constant load. The resin cement was then cured according to the manufacturer's instructions. (Figure 2)

All the samples were stored in distilled water for 24 hours at room temperature. The MSBS was measured for each sample with a universal testing machine (UTM) (Figure 3). The samples were loaded at 90degree to the long axis of the tooth at ceramic tooth interface at crosshead speed of 1mm/min. The samples were loaded until the ceramic disc debonded from the tooth surface, and the maximum load was measured. The MSBS was calculated in MPa by dividing this obtained value by the area of the discs for each specimen. Following this, the mode of failure was checked for all the samples using stereomicroscope. The data was statistically analysed using appropriate tests.

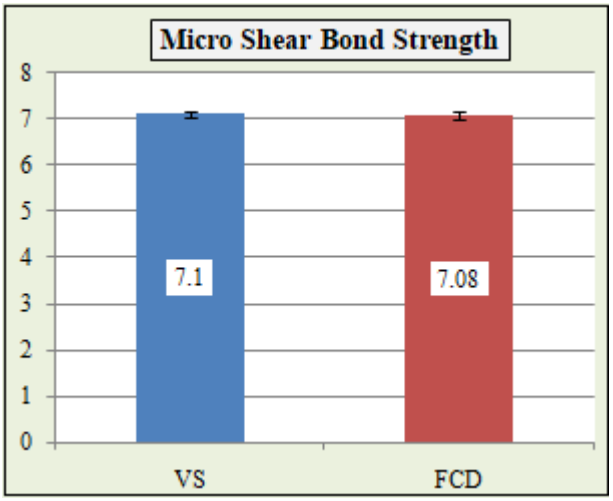
## 3. Results

Statistical analysis was performed using Statistical Product and service solution (SPSS) version 16 for windows (SPSS Inc, Chicago, IL). Intergroup comparison of means between the groups was done with the help of t-test which revealed that there was no significant difference in the MSBS of self-adhesive resin cement to two commercially available zirconia-reinforced lithium silicate ceramics. The mode of failure was mostly adhesive i.e. between dentin and resin cement. (Table 1, 2, 3) reinforced lithium silicate ceramics. The mode of failure was mostly adhesive i.e. between dentin and resin cement. (Table 1, 2, 3)

**Table 1:** Descriptive statistics of Micro shear bond strength of Self Adhesive Resin Cements to Two Commercially Available Zirconia-reinforced Lithium Silicate Ceramics

| | Mean | SD | SE | Minimum | Maximum |
|---|---|---|---|---|---|
| VS | 7.10 | 0.084 | 0.026 | 7.01 | 7.32 |
| FCD | 7.08 | 0.071 | 0.022 | 7.01 | 7.20 |

**Table 2:** Descriptive statistics of Micro shear bond strength of Self Adhesive Resin Cements tto Two Commercially Available Zirconia-reinforced Lithium Silicate Ceramics




## 4. Discussion

In recent years, various CAD/CAM-machinable ceramic materials have been developed in order to enable the esthetic demands of prosthetic restorations to be accomplished. (8). All-ceramic restorations currently available are highly aesthetic restorative materials that can simulate the appearance of natural dentition. Their evolution has been a battle for ideal strength-aesthetic combinations. (9)

Recently, a zirconia reinforced lithium silicate glass ceramic (Vita Suprinity; Vita Zahnfabrick, Bad Säckingen, Germany) for dental CAD/CAM applications for the fabrication of inlays, onlays, partial crowns, veneers, anterior and posterior crowns and anterior and posterior single tooth restorations on implant abutments has been introduced to the dental field/market. This new glass ceramic is enriched with zirconia (≈10% by weight). It is the first zirconia reinforced lithium silicate ceramic. The manufacturer has claimed that this newly developed generation of glass ceramic materials combines the positive material characteristics of zirconia (ZrO2) and glass ceramic. The zirconia particles are incorporated in order to reinforce the ceramic structure by crack interruption. It has been supposed that the structure which is obtained after crystallization, exhibits enhanced mechanical properties and fulfills the highest esthetic requirements. It is anatomically contoured as monolithic restoration due to enhanced translucency and different shades. [9-11]

Self-adhesive resin cements were introduced to dentistry within the past decade but have gained rapidly in popularity, with more than a dozen commercial brands now available. They are based on filled polymers designed to adhere to tooth structure without the requirement of a separate

adhesive or etchant. The major benefit of these materials would appear to be simplicity of application. [12]

The purpose of the study was to evaluate and compare the shear bond strengths of the two commercially available ZLS using self-adhesive resin cement and to evaluate the mode of bond failure by stereomicroscope.

In the present study the micro-discs of the two commercially available ZLS were luted on human premolars using self adhesive resin cement. In group VS, VITA Suprinity micro discs were used and in group FCD, Celtra Duo micro discs were used. The luting protocol for both the groups was same. The samples were luted using constant finger pressure and kept in distilled water for 24 hours following which the sample underwent 10, 000 cycles of thermocycling.

The samples then underwent the MSBS Test using Universal Testing Machine and under the limitations of these study, there was no significant difference found in the Micro Shear bond strength of the self adhesive resin cement to two commercially available zirconia-reinforced lithium silicate ceramics.

In a study conducted by N A Preethy et all similar results were seen when three commercially available restorative composites were tested.

The null hypothesis was proven to be correct in this study. The probable reason for obtaining comparable values for both the groups may be attributed to similarity in the structural composition of both the materials i.e. VS and FCD. Within the limitations of this study it can be concluded that both commonly available Zirconia-reinforced lithium silicate ceramic exhibited comparable MSBS with self-adhesive resin cement. However, before drawing definitive conclusions, further studies can be envisioned using other types of resin cements and clinical configurations.

## 5. Conclusion

The results obtained from this current study reveal that both the commercially available Zirconia-reinforced lithium silicate ceramics, VITA Suprinity (VS) and Celtra Duo (CD) exhibit comparable shear bond strengths with self adhesive resin cements. The statistical data analysis revealed that there was no significant difference in the MSBS of self-adhesive resin cement to two commercially available zirconia-reinforced lithium silicate ceramics. However since ZLS is a new material very sparse data is available regarding its machinability, its ideal acid concentration and etching times and moreover its adequate luting protocols. Hence, further clinical investigations are requested to decide the reliability and clinical performance of Zirconia-reinforced lithium silicate ceramics.

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**Conflicts of interest:** There are no conflicts of interest

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List of Abbreviations:

| Abbreviation | Definition |
|---|---|
| ZLS | Zirconia-reinforced lithium silicate ceramic |
| msbs | Micro-shear bond strength |