Effect of Different Resin Luting Materials on the Marginal Fit of Lithium Disilicate CAD/CAM Crowns (A Comparative Study)

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Abstract

Aim of the study: To recognize the effect of using different resin luting materials on the vertical marginal discrepancy of Lithium Disilicate CAD/CAM crowns.

Material and method: A total of 36 intact maxillary first premolars extracted for orthodontic purpose were disinfected in a solution of 1% Thymol for 1 day which utilized to receive a ceramic crown after tooth preperation. Digital impression was made with Omnicam Scanner (Dentsply Sirona) using Cerec Premium Software. Lithium disilicate CAD/CAM crowns made via In-Lab MC XL milling device (Dentsply Sirona) and cemented with different resin luting materials. The marginal discrepancy was measured at three locations on each tooth surface, with optical microscope at 200x magnifications before and after cementation. Statistical analysis was performed with one way ANOVA test to know statistical significance and Turkey's test (HSD) to compare the mean marginal increase among the three groups (P=0.05).

Statistical analysis: The least amount of marginal increase after cementation was with Gaenial universal flo (flowable composite); with a mean marginal increase of 38.53 ±0.63 mm. Choice2 cement (resin cement) increased the margins by mean 40.55 ±0.95 mm. The highest marginal increase was detected in the Ceramx one sphere TEC (preheated composite) resin group (87.82±1.26 mm).

Conclusion: Cementation of CAD/CAM crowns with preheated composite resin (Ceramx sphere TEC one) cause a marginal increase surpassed the clinically acceptable range of marginal discrepancy.

Keywords*: resin cement, flowable, preheated, Lithium Disilicate, Marginal discrepancy, CADlCAM.*

Introduction

The vertical marginal discrepancy considered as an integral part of indirect restoration and this discrepancy increased after cementation and poor marginal fit can lead to microleakage, marginal discoloration, dissolution of cement and secondary caries. Type of cement used can govern the amount of augmentation in discrepancy after cementation, but to which degree computer aided design/ computer assisted manufacture (CAD/CAM) Lithium Disilicate crown affected by different resin cement is unclear. Marginal discrepancy is a perpendicular distances from the margin of a restoration to the-finish-line-of the tooth preparation [1] . Although-horizontall discrepancies such as crown overhangs intraorally can be adjusted to some degree; but the vertical marginal-discrepancy can be closed only by the luting cement,-which-is-prone-to-degradation. Therefore, the-vertical marginal-discrepancy- has the-most-clinical significance-and-should-be considered-the more-critical-element in-crown margin-evaluation [2]. Marginal fit considered as a basic factor in the success of indirect restoration. Poor marginal fit may cause cement dissolution which lead microleakage or secondary caries [3]. Therefore; to-decrease the-incidence-of above mentioned complications minimal marginal discrepancy is-an essential element for long term restoration success. Conflicting studies proposed regarding the clinical acceptable marginal-discrepancy. Some studies recommend a marginal discrepancy of less than 120 µm [4] and others less than 100 µm [5]. Different brands of luting

cements have-been used for-the adhesive luting of-ceramic crowns, and attitudes vary as to which is the best [6] . Dual-polymerized resin cements has been designated when the ceramic material is too thick or too-opaque to allow satisfactory polymerizing light transmission[6, 7]. Furthermore, flowable composite resins have been advised for adhesive luting [8]. **Barceleiro et al** [9] found similar results when bonding feldspathic porcelain to bovine enamel by using dual polymerized resin cement and a light polymerized flowable composite resin. Their study has been advised clinicians to use flowable composite resins as an appropriate substitute luting agent when bonding porcelain laminate veneers-less than 2 mm in thickness.

In addition preheated composite resins have also been used to bond restorations. Preheating composite resin-decreases-its viscosity and-ultimate film thickness, offering-the clinician an-improved controlling and superior composite resin adaptation to preparation margins, together- with an-increased degree of polymerization and depth of-polymerization [10] .

There is no specific cementation-protocol for lithium-disilicate restorations can be considered ideal[9] . Moreover, researches regarding the influence of luting cement on marginal discrepancy after cementation provide different results [10] .

This in vitro study to recognize the effect of using different resin luting materials on the vertical marginal discrepancy of Lithium Disilicate CAD/CAM crowns is proposed.

Material and Method

Thirty-six sound human maxillary first premolar teeth of equivalent size and shape extracted for orthodontic purpose from patients with age range17-222 years had been selected to be used in this in vitro study. Cleaning of teeth has been done carefully from any calculus and soft tissue deposits with air Scalerr then disinfected in a solution of 1% Thymol for 1 day.

To avoid Dehydration of the specimens during all stages of the study samples has been stored in distilled water at room temperature [11].All teeth samples has been, implanted individually in cold cure acrylic resin block up to 2 mm apical to the CEJ to approximate the support of alveolar bone in a healthy tooth then the teeth prepared with high-speed turbine mounted on dental surveyor (Dentaurum, Germany) (Fig. 1), with copious water spray under ×4 magni-fication (Carl Zeiss dental loupe) to receive a ceramic crown according to the following criteria: a planar occlusal surface reduction, 1.0 mm deep chamfer finishing line depth, 6 degree convergence angle and 5 mm height from the occlusal level to the intended finish line both buccally, and palatally (Fig.2).

Figure (1): high-speed turbine mounted on dental surveyor

Direct scanning was-done by powder-free Omnicam intraoral scaner (Dentsply Sirona Dental System, Bensheim, Germany) by using CEREC premium software (version 4.5), then In Lab MCXL (Dentsply Sirona Dental Systems, Bens-heim, Germany) was used to produce the full ceramic crown using-CEREC in-Lab (version 18.0) software

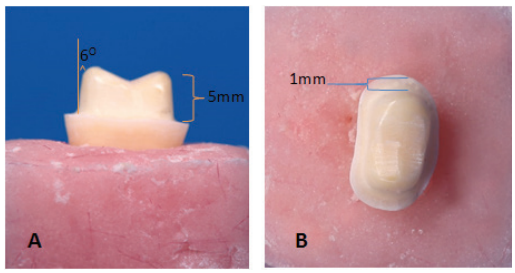

Figure (2): Finished prepared tooth

A: Lateral view, B: Occlusal view

The crowns where divided into, three. Groups (twelve cro-wns in each group) according, to the luting cement to be used

A-flowable composite group **(G-ænial Universal Flo, GC** Japane)

B-light cure, resin cement, group (Choice 2 cement;

Bisco, USA)

C-pre-heated composite, group (ceramx sphere TEC one, Dentsply, Germany)

The inner surface of the crowns for all groups has been treated similarly before cementation (table1) also all teeth of all groups has been treated similarly (table 2). Measurments where performed with a dino-lightdigital microscope at magnification of 200X [11].

Table1. Treatment of internal surfaces of crowns

1	Etching with 9% hydrofluoric acid for 20 sec.
2	Water rinse for 20 sec. then air drying
3	Silane application with micro-brush for 20 sec. then air dry

The measurements were performed at three locations on each tooth surface therefore; a total of 12 marginal adaptation evaluation sites for each tooth were performed[12].

After that measurements performed before and after adhesive cementation and the difference between the above mentioned tow measurements will considered as a marginal discrepancy. Statistical analysis was performed with one way ANOVA test to know statistical significance and Tukey test (HSD) has been performed to compare the mean marginal increase among the three groups. (P=.05)

Table2. Treatment of teeth

1	Etching enamel with phosphoric acid 37% (Total etch) for 15 sec.
2	Rinsing with water for 15 sec. before air drying
3	Bond (universal bond, bisco, USA) on enamel and dentin with microbrush
4	Flowable composite resin (Gaenial universal flo,GC), resin cement (choice2,bisco) application inside crown In case of preheated composite resin (ceramx sphere TEC one) Using Micerium heater (ENA heat,Micerium) for 55min. at temperature 55oC) then applied inside the crown (ENA)
5	Cleaning access with composite modeling brush
6	Light polymerization for 20 sec. for each surface

Results

Statistical analysis was performed with one way ANOVA test to know statistical significance and significant differences were found among the groups (P=.000) and tukey test (HSD) has been performed to compare the mean marginal increase among the three groups. The mean marginal increase after cementation for Gaenial univer-sal flo (flowable composite) was 38.53±0.63 mm. For Choice2 cement (resin cement) was 40.55±0.95 mm and for Ceramx sphere TEC one (preheated composite) group 87.82±1.26 mm (table 3). Representative digital image of the crowns before and after cementation --are shown in Figure 3.

Discussion

The Results of this study has been revealed that significant differences among the groups (P=.000). The increase in the marginal discrepancy after adhesive luting of restorations was constant with that of other studies [13].

Outcomes of the present study demonstrated an increase in marginal discrepancies of 38.53±0.63 μm with flowable composite (Gaenial universal flo), 40.55±0.95 μm with resin cement (choice 2), and 87.82 ±1.26 μm with preheated composite (ceramx sphere TEC one).

Results have been demonstrated that preheated composite-(ceramx sphere TEC) had a meaningfully higher value of marginal increase than flowable composite (Gaenial universal flo) and resin cement (choice 2). These results agree with those of the study by **Sampaio et al [14]** who stated that preheated restorative composite resin (68_C) had a higher film thickness (300 μm) than flowable resins (150 μm). Results of the current study also agree with those findings by **Blalock et al [15]** who acknowledged an average film thickness of flowable composite resin (35 μm) and preheated composite resin at 54_C (140 μm). The reported marginal increases after adhesive luting have ranged between 13 and 50 μm [16] . Flowable composite (Gaenial universal flo) and resin cement (choice 2) used in this investigation seemed to meet the International Organization for Standardization requirement which is 50 μm maximum film thickness, because the increase in marginal gaps after cementation was within the recommended limit ,where is preheated (ceramx sphere TEC) much higher than recommended and this agree with **Stappert et al [17]** who found that 20 to 50 μm marginal increase for e.max restorations

cemented with resin luting cement (Variolink II; Ivoclar Vivadent AG).

In **2013 Sakrana** [18] examined the fit of two types of ceramic single crowns and indirect composite resin complete coverage crowns before and after cementation with self-adhesive resin cement an found an increase in the marginal discrepancy after cementation ranging from 24 to 40 mm.

Results of the present study revealed that preheated composite (ceramx sphere TEC) resin caused a large marginal increase (87.82 ±1.26) which is above the required limit, placing results out of the range of marginal increase of previous studies. Therefore, it is not recommended for crown cementation; instead, flowable composite (Gaenial universal flo) are recommended beside the resin cement (choice 2).

The above mentioned facts agree with **Mounajjed et al** [19] who identified that the marginal increase of pressed lithium disilicate crowns cemented with preheated composite resin exceeded the clinically acceptable range of marginal discrepancy. Beside that manufacture literature stated that Gænial Universal Flo represents a simple and efficient solution for the cementation of veneers. This versatile, injectable restorative composite unites easy handling, high physical properties and excellent aesthetics. Generally used as a restorative and liner material, it can also be used for the bonding of veneers and some inlays and onlays where light-curing is possible and considered as good alternative to preheated composit ,Thanks to a low film thickness [25]

Some studies reported a mean increase of the margins of approximately 17 μm [11] ,other study by **Pascale et al.,**[20] stated that luting of inlay , onlay and overlay with preheated restoration composite doesn't prevent seating accuracy , these results disagree with our findings.

According to **Shinkai et al.,** [21] the rate of flow of luting agent depends largely on the amount and configuration of the filler particles. this is explain that why flowable composite (Gaenial universal flo) has highest flow as it contain 69 % fillers by weight compared to resin cement (choice2) 75 % fillers by weight and preheated composite (ceramx sphere TEC) 77-79% fillers by weight and regarding to configuration Gaenial universal flo has an ultra-fine spherical particles (strontium glass) which tend to improve fracture strength and increase flow rate [22] .

Masouras et al.,[23] stated that in addition to the amount, size, and type of filler material, the coupling of the resin matrix to the filler particles played an important role in the material's performance, according to manufactured Gaenial universal flo has a new silane surface treatment which is called full coverage silane coating (FSC) technology which makes it possible to homogeneously and densely disperse ultrafine 200 nm fillers. Flextural strength considered as the most important physical properties of luting agent[24], according to manufactured Gaenial universal flo has very high flextural strength (167 MPa) compared to choice 2 resin cement (124 MPa) and ceramx sphere TEC (146 MPa) thanks to the new filler filler technology which allowed to develop an injectable material that is stronger than most conventional composite.

On the topic of the manufactured, one of exclusive advantages of Gaenial universal flo its viscosity which is carefully balanced in order to provide material that has a thixotropic property which provides easy placement and flow smoothly under pressure.

According to the above mentioned properties and findings, Gaenial universal flo can be considered as a suitable alternative luting agent when bonding lithium disilicate crowns that were less than two millimeter in thickness [9].

Conclusions

Within the limitations of this in vitro study, the following conclusions:

1. The cementation process increased the marginal discrepancy for the 3 luting cements evaluated.

2. Preheated composite resin (ceramx sphere TEC one) had produced significantly higher marginal discrepancies than flowable composite resin (Gaenial universal flo) or resin cement (Choice2).

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Conflict of Interest: None to declare.

Ethical Clearance: All experimental protocols were approved under the College of Dentistry and all experiments were carried out in accordance with approved guidelines.

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