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Comparison between marginal adaptation of monolithic ceramic restorations before and after cementation: Effectof different resin cements

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Abstract
Objective: *The aim of this study was comparethe marginal adaptation of lithium disilicate and zirconia restorations before and after cementation under the effect of different resin cement.*
Materials and methods: *Eighty intact human maxillary premolars were selected for this study, prepared using computer aided design/computer aided manufacturing technique. Teeth were divided into two main groups according to the restorative materials used (n=40). Group restored withmonolithic**Lithium disilicate**andthe other restored with **Zirconia**. Each main group was subdivided into two subgroups according to type of resin cements; one type of**self-adhesive resin cement** and one type of **adhesive resin cement**(n=20). Beforecementation, vertical marginal discrepancies (µm) were measured at the margin of each crown at (mid-buccal, mid-palatal, mid-mesial and mid-distal) and three measurementswere recorded at each of the four position for 12 measurements per restoration using stereomicroscope at 45x magnification. After cementation, all samples are subjected to 10000 thermocycles for artificial aging. After 24 hours, marginal discrepancies (µm) were evaluated at the same points taken before cementation. The data were tabulated, compared andstatistically analysed*
Results:*After cementation, significantly higher marginal gaps were noted in comparison with before cementation.Cement types have significant effect on marginal adaptation.*
Conclusion:*Vertical marginal gap increased after cementation.*
Key words:*Marginal adaptation, Lithium disilicate, zirconia, resin cement.*

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I. Introduction

Dental cement is a luting agent that is important tobind indirect restoration to the prepared tooth.[1] Resin cements have ability to bind to the structure of the tooth to the inner surface of the restoration.[2] Resin cements made of the same main components like composite concrete but with filler particle lower concentrations.[3] Resin cements fall intothe adhesive cements category. Adhesive cements should bind to many substrates, such as enamel and dentin, many metal alloys and gold, porcelain, ceramics and indirect resin composites.[4]

Recently,increasing interest of patients in highly natural restorations has led to the production of recent all ceramic materials.[5,6]Owing to the excellent esthetic properties and superior biocompatibility, ceramics have been used for esthetic restorations.[7] Although ceramicsystems are growing, many becomeredundantbecause of the distinct advantages of zirconia and lithium disilicate.[8]Precise adaptation appears to be very important factor for restoration longevity.[9,10]Restoration adaptation is determined by marginal and internal gap measurements, which are very important for the longevity of the restorations. Marginal misfit can result in plaque retention, bacterial contamination, and periodontal problems, also insufficient or delayed healing of traumatized soft tissues.[11]Open margins can produce micro-leakage, that result in de-cementation due to cement dissolution.[12]**Suliman et al**,[13] have reported that 100µm is an accepted gap for the clinical use. **Moldovon et al**,[14]suggested that a gap of 200-300µm is evenly accepted. **McLean and Von Fraunhoferetal**,[15] believe that 120µm is the acceptable range for the clinical use. There are various methods for determining the fit of the prostheses and each has its own advantages and disadvantages. It is divided into four groups: direct view technique with external microscope, impression technique,cross-sectioning, and visual examination using an explorer.[16]

The vertical thickness of the cement line has becomean important item in determining beneficial marginal adaptation characteristics, science the indirect restorationsprovides an interface between the dental

structure and the restoration.[17,18] A largeexposed line of the cement agent to the oral environment can lead to periodontal problems and staining of the margins.[19]

The most commonly used reproducible resulting technique is the direct view method or external microscope examination. Itevaluate the gap between the die and the crown at the margin under a microscope at many magnifications not internally. Compared to other techniques, It is asimpler, economic and less time consuming method with less riskof error arising from multiple steps. This technique maybe used only in vitro as it needs direct examination of the marginal gap using a high-power microscopy for more technique accuracy.[20]

II. Materials and methods

Eighty intact human maxillary premolars were collected for this in-vitro study. The root was embedded vertically within self-cured acrylic resin (Acrostone cold cure, England), mounted in upright position using a specially centralizing metal device.Before tooth preparations, an additional silicone impression was made of each tooth that could represent the original tooth. The silicone impressions were vertically sectioned and used a guide forthe preparation and evaluate the amount of occlusal and axial tooth reductions. The selected teeth were divided into 2 main groups (n=40) according to the restoration type.The first group restored withmonolithic **lithium disilicate**ceramicrestorations andthe otherwas restored withmonolithic **Zirconia** ceramic restorations.Eachmain group was subdivided into two subgroups regarding to the type of resin cements (n=20); one subgroup restored with self-adhesive resin cement and the other subgroup restored with adhesive resin cement **(Table1)**.

Fabrication of lithiumdisilicate crowns: Scanning and designing was done using ceramil mind system. Wax pattern, spruing and investing were done first. Ceramic press furnace (Programat EP3010) was used for pressing e.max ingot. Crowns were crystallized and glazed using a digital furnace (Programat P500/G2).

Fabrication of zirconia crowns: Scanning and designing of restoration was done using ceramil map 400 scanner. Milling was done using (ceramil motion 2), complete sintering of crowns using (ceramiltherm 3).

Vertical marginal gap detection before cementation: Before cementation, vertical marginal gap detection was done using stereomicroscope (Olympus stereomicroscope)at 45X at (mid-buccal, mid-palatal, mid-distal and mid-mesial) each measurement was recorded three times.

Crown cementation: Before cementation,the fitting surface of lithium disilicate crowns were subjected to surface treatment with hydrofluoric acid 9% for 20 seconds , whereas the inner surface of the zirconia crowns were air abraded using dental sandblaster (Renfert GmbH, Al_2O_3 cobra, Germany) with aluminium oxide particles with 50µm for 10 seconds.Tubes or resin cements were used for crown cementations.the corresponding resin cement was dispensed in the fitting surface of crowns. Each crown was thenseated on its corresponding tooth and held under constant load of 10 N during polymerization then light curing for 3 seconds to allow removal of excess cement. The final curing was performed for 20 seconds for each side according to manufacturer's recommendations.

Thermo-cycling: All samples were subjected to 10000 thermo-cycles with altering temperature between 5ºC, 55ºC simulating one year of the temperature changes inside the oral cavity. Each cycle include insertion in cold water 5ºC for 30 seconds, resting time for 10 seconds and then insertion into hot water for 30 seconds.

Vertical marginal gap detection after cementation: After cementation, vertical marginal gap detection was done using stereomicroscope (Olympus stereo microscope) at 45X at same points measured before cementation (mid-buccal, mid-palatal, mid-distal and mid-mesial) each measurement was recorded three times. Then the data was tabulated, compared and statistically analyzed.

III. Results

There were significant differences between lithium disilicateand zirconia crowns in marginal gap values. Resin cement types have no significant effect on marginal adaptation.According to restorative material (with neglecting the effect of resin cement type) using stereomicroscope, Wilcoxon signed rank test compare between restoration type before and after cementation showed that, there was significance difference at *p* value $p \leq 0.05$.

According to resin cement type (with neglecting the effect of restorative material) using stereomicroscope, there was differences between adhesive resin cement and self adhesive resin cements. Wilcoxon signed rank test showed that there was significant difference at *P* value $p \leq 0.05$.

IV. Discussion

In this study, natural teeth were selected to resemble the clinical condition by Appling luting cement with a microstructure that is almost similar to the clinical situation. Collection of teeth with comparable sizes was followed, in which the teeth were chosen to be of average size and shape of the first maxillary premolars.[21]

To ensure the centralization and alignment of the tooth to the mold, a special centralizing device was used. It has been stated that marginal integrity and bonding effectiveness are the most important factors influencing the longevity of the restoration, science a large marginal opening permitfurther accumulation of plaque, gingival sulcular fluid flow, and loss of bone, lead to micro-leakage, recurrent caries, periodontal disease and decrease prosthetics restorations longevity.

In this study two types of resin cement were used, self-adhesive resin cement and adhesive resin cement, for cementation procedures as resin cements have ability to bond to the tooth structure and the inner surface of the restoration.[22]In a study by **Behr et al, (2009)**[23] reported that the marginal adaptation of three self-adhesive resin cements (Multilink Sprint and Rely X Unicem and Maxcem) after aging is less than (Panavia F 2.0) clinically well-tried adhesive cement.

Lithium disilicate based ceramic was selected for this study as it is a glass ceramic ingots that are heat-pressed within a porcelain furnace to mold the ceramic material into the desired shape. This methoddecrease processing errors which mayrelated to the conventional sintering and has been chosen for superiormechanical stability. IPS e.max Press showed better vertical marginal gap than IPS e.max CAD as reported with **Baig[24],Anaditoi[25]** and **Neves[26]**, that compared the marginal fit of those constructed with CAD/CAM technique and stated that the pressed restorations improve superior marginal fit in comparison to the CAD/CAM restorations.

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[27]. Legends

Table 1: sample grouping.

Total number of teeth n=80			
Lithium disilicate monolithic restorations n=40		**Zirconia monolithic restorations** n=40	
Self adhesive resin cement n=20	**Adhesive resin cement** n=20	**Self adhesive resin cement** n=20	**Adhesive resin cement** n=20

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