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A COMPARATIVE STUDY ON THE EFFECT OF DIFFERENT PREPARATION DESIGNS AND TYPE OF MATERIALS ON THE MARGINAL FIT OF OCCLUSAL VENEER

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ABSTRACT

Purpose: to evaluate the effect of two occlusal preparation designs and three different types of ceramic materials on the marginal fit of bonded posterior occlusal veneers. **Statement of the problem**: Thin bonded posterior occlusal veneers constitute a conservative alternative to traditional more retentive complete coverage crowns in treatment of severely worn dentition. **Materials and Methods**: Sixty extracted human maxillary first molars were randomly distributed into two equal groups, 30 teeth for each according to the preparation design as following: **Non-ferrule** and **Ferrule (F)**. Each of group (NF and F) were subdivided into three subgroups according to the type of ceramic materials: **IPS e.max CAD (E)**, **Lava™ Ultimate CAD/CAM (L) and VITA SUPRINITY® PC (S)**. The occlusal veneers were cemented over their respective teeth with resin cement Total Cem automix. The marginal fit was determined by using stereomicroscope with digital camera using computer software for taking four points on each axial surface of the restoration so; there are sixteen readings per each sample. **Results**: the mean value of vertical marginal gap of Lava Ultimate recorded lower value in no ferule and ferule group (28.4 ± 3.9 / 34.95 ± 4.02) respectively which considered statically significant difference from than the other two materials, followed by IPS E max Cad in ferule group (49.7±5.6) then VITA SUPRINITY in ferule and no ferule (50.8 ± 7.43/ 51.9 ± 3.70) respectively, then finally IPS E max Cad in no ferule group (52.4 ± 5.5). **Conclusion**: Within the limitation of this study, it concluded that, Lava Ultimate occlusal veneers represent the more adequate material to achieve better marginal adaptability however, the marginal gap of the three materials were within the clinical acceptance range

INTRODUCTION

The progressive reduction of enamel thickness is a biological condition resulting from the aging process or pathological condition as bruxism [(1)]. However, the premature and accelerated loss of enamel by gastroesophageal reflux disease (GERD) or bulimia nervosa may occur in adolescence or childhood, with destructive consequences [(2,3)].

Preservation of tooth structure is a major driving force in restorative dentistry [(4,5)]. From a biomimetic perspective, the conservation of tooth structure is paramount in maintaining the suitable equilibrium between biologic, mechanical, functional, and esthetic parameters [(6)]. It is clearly beneficial to keep the pulp vitality and prevent endodontic treatment and the need for posts and cores, because these more invasive approaches violate the biomechanical balance and compromise the performance of restored teeth over time [(6, 7)].

Occlusal veneers are extra coronal restorations requiring a simpler and more intuitive preparation driven by interocclusal clearance and anatomical considerations. The usual recommendation for porcelain restoration thickness is 1.5 to 2.0 mm. The occlusal veneers have many advantages such as, it need minimal reduction, optimum access for the marginal finishing and hygiene, adequate retention and far from periodontal affection. On the other

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hand, the main disadvantages of occlusal veneers are alignment can prove difficult, technically demanding, less retentive than complete coverage and not suitable for non-vital teeth [8].

The glass ceramics were introduced and be used in this study as IPS e.max lithium disilicate was introduced in 2005, as an improved hot pressed ceramic material, in order to expand the range of indications of the previously used IPS Empress 2 [9]. On the other hand, the machinable lithium disilicate (IPS e.max CAD) consists of 40% platelet shaped lithium metasilicate crystals embedded in a glassy phase which is produced after an "intermediate" crystallization process (blue, translucent state) [10].

A zirconia reinforced lithium silicate glass ceramic (Vita Suprinity) for dental CAD/CAM applications for the fabrication of inlays, onlays, partial crowns, veneers, anterior and posterior crowns and on implant abutments have been introduced to the dental market. This new glass ceramic is enriched with zirconia (≈10% by weight)[11].

Resin nano ceramic (Lava Ultimate) It is a resin nano ceramic and a blend of nano ceramic particles embedded in a highly cured resin matrix composite. This combination increases their ability to withstand loading by undergoing more elastic deformation before failure. In contrast, ceramic materials exhibit relatively high flexural strength and flexural modulus making them less flexible and more brittle [12].

There are several studies describe how to measure the accuracy of the marginal in all ceramic restoration, Baig et al approved six point only for evaluation of the marginal fit of a zirconia ceramic (CAD) crown system using stereomicroscope [13,14] Abdel-Azim et al concluded that, marginal gap was measured for each restoration under 45×magnification with a stereomicroscope at 4 points: midfacial, midlingual, middistal, and midmesial. Each measurement location was marked on the prepared tooth to standardize the measurement location for each substructure with direct visualization[15]. There is still controversy over the clinically acceptable marginal fit standard. However, most authors are considered to agree upon the fact that the marginal discrepancy should be less than 120 μm [16-23].

METHODOLOGY

Thirty teeth were prepared to a flat occlusal surface with no ferrule preparation and other thirty teeth were prepared to a flat occlusal surface with circumferential chamfer finish line or ferrule preparation. Each (NF) and (F) groups were subdivided into three subgroups according to the ceramic materials (10 for each): IPS e.max CAD (E)Lava™ Ultimate CAD/CAM (L)VITA SUPRINITY® PC (ZLS).

The Dentiform cast model was used in this study for the use of its present typodont teeth as biogeneric copy to restore the prepared natural teeth during CAD/ CAM fabrication. After taking the optical impression of the model teeth, the model was adjusted to accommodate the size of natural prepared teeth by slightly widening the internal surface of the maxillary first molar sockets.

The restoration design was accomplished by Ceric® in Lab® 3D software version 4.2 (Sirona dental system GmbH. D-64625 Bensheiu, German). The main screen of the software has five sections; Administration, Scan, Model, Design and Mill. Once the first section is completed the next one is activated.

All teeth were mounted in self-cure acrylic resin (Acrostone, Acrostone Dentsl Manufacture, Egypt). Using a plastic ring of 19 mm in diameter. All occlusal veneers were cleaned in ultrasonic cleaning device and 70% ethyl alcohol for 10 minutes to ensure a proper clean surface for the cementation. For IPS e.max and ZLS occlusal veneers; the internal surface of the restoration was etched with Dentobond Porcelain etch (hydrofluoric acid 9%) for 20 secs, then rinsed with water and dried with

oil free moisture free air. Then the DentoBond Porcelain Silane was brushed on the etched ceramic surface and dried well after one minute with moisture free oil free compressed air according to the manufacturer instructions. The restoration was seated gently on the preparation allowing the cement to flow from all sides after cementation then curing with light cure.

The cemented occlusal veneers were subjected to measure the vertical marginal gap distance which represented by the vertical distance between the edge of the restoration and the finish line of the tooth. The marginal gap was measured by stereomicroscope (Leica EZ4 ND Germany using a fixed magnification of 35X at four points of each surface.

RESULT

Quantitative data were described using range minimum (Min) and maximum (Max), Mean, Standard Deviation (±SD) and Median. Significance of the obtained results was judged at the 5% level. Two way (ANOVA) Was assessed to showing the effect of each factor and the interaction between the groups. F-test (ANOVA) For normally quantitative variables, to compare between more than two groups. Post Hoc test (Tukey) for pair-wise comparisons between the groups.

The mean values and standard deviation of the marginal gap (μm) as function of preparation design and type of the material are summarized graphically drawn in figure (1)**.**

TABLE (1) Two Way ANOVA Test for Comparison of marginal gap results showing interaction between the preparation design and the materials used.

Marginal Fit	F	p
Design	0.477	0.493
Material	94.046*	<0.001*
Design vs Material	4.461*	0.016*

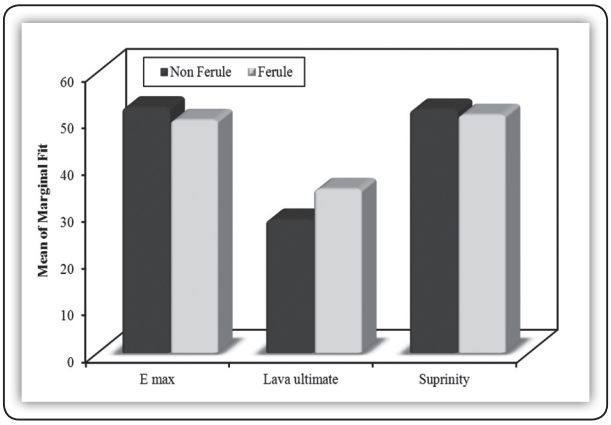

Fig (1) Diagrammatic chart representing the measurements of the marginal fit in μm of the studied groups according to material used and preparation design.

Effect of preparation design and type of material on the marginal gap

According to **Post Hoc Test (Tukey)** regarding the preparation design used, there was statistical significant difference ($p \leq 0.05$) between Lava Ultimate occlusal veneer recording lower marginal gap mean value than VITA SUPRINITY occlusal veneer recoding and IPS e.max CAD occlusal veneer recording in no ferule and ferrule preparation.

There was no statistical significant difference ($P > 0.05$) between no ferule and no ferrule IPS e.max and VITA SUPRINITY occlusal veneers according to preparation design (figure 2).

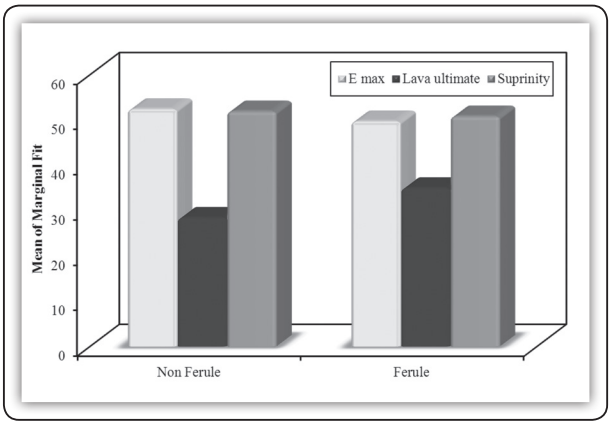

Fig (2) Diagrammatic chart representing the comparison of the marginal fit in μm between the studied groups according to preparation design and materials used.

DISCUSSION

Occlusal veneers are extra coronal restorations requiring a simpler and more intuitive preparation driven by interocclusal clearance and anatomical considerations. The selection of maxillary human first molar of comparable size and dimension for allowing similar occlusal veneer restoration during construction by CAD/ CAM technology. The decision of natural teeth selection not epoxy resin or metal dies to represent better the clinical situation[24].

The teeth preparation has been achieved standardization by using the micro saw for occlusal flat surface preparation and milling survivor with the same size of bur for chamfer finish line or ferrule preparation. The selection of these two designs (no ferrule and ferrule) to evaluate a possible influence of the marginal preparation design on the marginal fit of the restoration.

For standardization for all samples, biogeneric copy mode was used in the Cerec software 4.2 so, each restoration is design and mill as an exact replica of the prepared anatomy. CAD/CAM technology was chosen due to its ability to control thickness and anatomy of restorations during the fabrication process. It also allowed the standardization of the internal fit of the restoration as well as the mechanical properties of the restorative materials[25].

The hypothesis of this study was " partially accepted " because there is statistically significant deference between materials used in this study whenever, the main vertical marginal gap value of resin nano ceramic is lower than that of lithium disilicate and ZLS. When there is no statically significant difference between two preparation designs used.

The resulted obtained in this study showed that the vertical marginal gap mean value of occlusal veneer made from Lava Ultimate is lower than that of lithium disilicate and ZLS either no ferrule or ferrule preparation design. The higher value of both IPS e.max CAD and VITA SUPRINITY may be due to milling of these materials in a partially crystalline stage which need further firing for the completion of their crystallization which may cause liner shrinkage of these materials and so affect its margin[26]. On the other hand, Lava Ultimate doesn't need any heat treatment after milling and doesn't suffer from shrinkage which may lead to better marginal adaptation[27]. These result can also be explained by the fact that Lava Ultimate CAD/CAM restorative materials have modulus of elasticity 12.77 GPa Which cut smooth edges causing intimate contact with the preparation and better marginal fit [27]. While the IPS e.max CAD and ZLS have modulus of elasticity 95 GPa and 70GP, respectively and they are a brittle material which may lead to their chipping when milled in small sections at the margins causing higher value of the vertical marginal gap [28,29].

CONCLUSION

Fabrication of occlusal veneers with resin nano ceramics produces superior marginal fit than occlusal veneers fabricated from lithium disilicate and zirconium reinforced lithium silicate (ZLS). Occlusal veneers fabricated from lithium disilicate have marginal fit close to that of ZLS. The three materials used in this study have marginal fit of clinical acceptance range.

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