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Influence of Restoration Thickness and Auxillary Retentive Means on Marginal Gap of Occlusal Ceramic Veneers

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ABSTRACT

Objectives: To assess the influence of restoration thickness and auxillary retentive means on marginal gap of occlusal ceramic veneers.

Materials and Methods: Forty sound molars were chosen which are free from caries, the teeth were restored with ceramic occlusal veneers of CAD /CAM lithium disilicate material and divided to two groups. Group (1) without finish line, Group (2) with shoulder finish line. Each group had 10 molars with buccal groove extension and 10 molars without it of different thickness 1&1.5 mm. Scanning electron microscope was used to measure the marginal gab before and after bonding process.

Results: The restoration thickness of 1.5mm without buccal groove showed the larger microgab distance 85.8 µm while restoration thickness of 1.5mm with buccal groove showed 71.1 µm. Buccal extention design had a statistically significant ($p \leq 0.05$) influence on the marginal gab.

Significance. Usage of auxillary retentive means is recommended than conventional design on the effect of the marginal gab.

Key words: occlusal, veneers, e_max, marginal gab

Introduction

Erosion and abrasion are very common due to the type of diet and some pathologic habits [1]. They affect the vertical dimension of occlusion and make some sensitivity during eating [2].

Esthetics and occlusal stability are the main our concern but the marginal gab of control the success of the restoration [3,4].

Multiple full-coverage restorations, endodontic treatment and crown lengthening could be a type of treatment of eroded dentition [5]. But its design requires over reduction of healthy tooth structure. Direct resin composite restoration has become such a way of adhesive concepts to preserve tooth structures [6].

Lithium disilicate (LDS) has the best esthetic and mechanical out come when used in thin layers to be conservative of tooth reduction. CAD/CAM technology give the faster and more marginal adaptability restorations with controlling of its thickness [7].

The adhesive technique used has the great role in increasing the mechanical properties of the restoration and decreasing its marginal gab [8].

Scanning electron microscope (SEM) has the advantage of measuring the microgab between any two surfaces which are fit to each other such as the enamel surface and the fitting surface of LDS material [9,10].

MATERIALS AND METHODS

Forty sound molars were chosen which are free from caries, filling or any defect. The teeth were restored with ceramic occlusal venners of CAD /CAM lithium disilicate material ceramics. Samples were divided into 2 groups according to the absence or presence of a finish line (20 samples each). Then each group was subdivided into 2 subgroups 10 samples each according to the thickness of the restorations and each subgroup was further subdivided to 2 parts (5 samples each) according to the presence or not of a buccal groove.

The teeth were fixed in acrylic block and its roots were coated with gum resin (Germany) to act as an artificial periodontal membrane. A custom made standard hard wax was used to cover the roots of the teeth which was positioned along their long axis and covered by a self-curing acrylic resin material. The teeth were received different occlusal veneer preparation according to the sample design. All different types of preparations had no sharp edges and its angles were rounded.

The occlusal surface had a semi-anatomic shaping this is to reach to the constant thickness of the restoration. The master casts fixed in its position in the milling machine. By CAD/CAM technique LDS (IPS e.max. CAD, IvoclarVivadent) occlusal veneers were performed to the desired thickness according to the sample design (figures 1,2,3).

Figure 1. Preparation without finish line

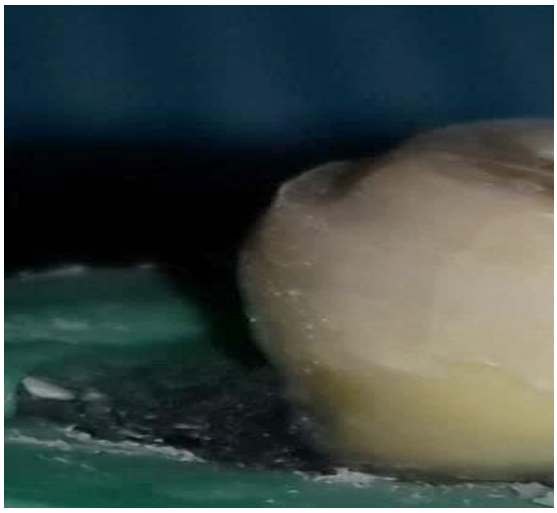

Figure 2. preparation with shoulder finish line

Figure 3: Measuring the central fossa by caliber

A self-etching primer (3M ESPE) was positioned on the tooth surface after etching by 35% orthophosforic acid gel.

Using 5% hydrofluoric acid etching gel (IvoclarVivadent) for 20 sec to make surface treatment(etching) of the occlusal veneers bonding surfaces. After etching process, water was used to remove the acid and clean the restorations. After that air drying was used to remove the water. For 60 sec the silane coupling agent (Ivoclar Vivadent) was applied. After that air drying was performed.

The bonding process was performed by using the dual-curing luting composite resin (3M ESPE) from the auto mix syringe to cover the bonding surfaces of the occlusal veneers. Using a special loading apparatus to keep in place the restorations with a constant load of 50 N. All the venners and its margins were light cured for 20sec.

The scanning electron microscope (SEM) with fixed magnification of 40x was used to measure the marginal gab with a built-in camera which was connected to a compatible computer. The marginal gab distance was measured before and after cementation.The data were collected and statistically analyzed using one and two way ANOVA and paired t- tests.

RESULTS

The marginal gap (MG) results measured in microns (µm) for the two groups before cementation showed no significant difference with (P) values recorded p >0.05.the largest MG distance with 1.5mm thickness without buccal groove extension reached (42.05 ± 2.21 *µm*) while the lowest marginal gab distance was with the thickness of 1.5 mm with shoulder finish line with buccal groove extension which reached (40.8 ± 1.23 *µm*) .After cementation process the marginal gab distance was increased .The group (2) at the restoration thickness of 1.5 mm showed the larger microgab distance . The mean values and standard deviations (SD) for both groups were presented in table (1), (Figures 4,5).

Table 1. **Mean values (±SD) results of the marginal gap distances (µm) of the e.max CAD**

Group (1) conventional 20 without F. L				Group (2) 20 with shoulder F. L			
1 mm		1.5 mm		1 mm		1.5 mm	
Without B. G	With B. G	Without B. G	With B. G	Without B. G	With B. G	Without B. G	With B. G
A	B	C	D	A	B	C	D
73.4	71.3	73.5	71.1	85.6	82.2	85.8	82

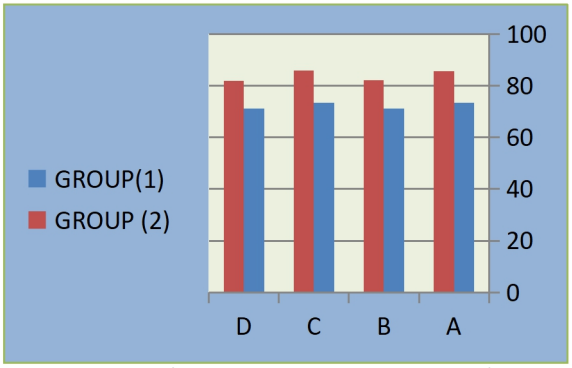

Figure 4. Bar chart representing mean marginal gap distance(µm) of the two groups

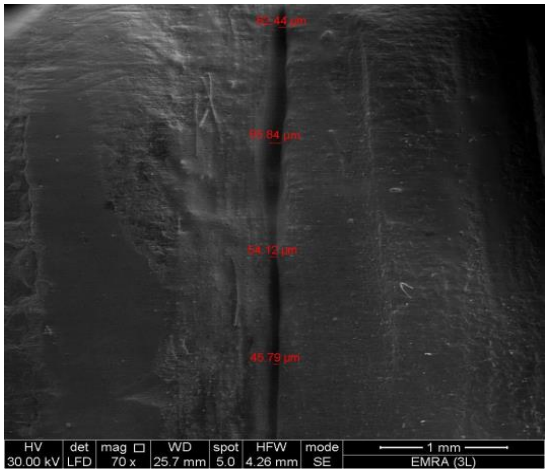

Figure 5. Scanning electron microscope image of marginal gap

Discussion

The prosthodontic treatment of severly abraded teeth is so important that it preserve the vertical dimension of occlusion, function and esthetics.lithium disilicate material gives the chance for conservative restoration of the tooth structure[11]. Recently resin cements contained (the Bisphenol A glycidyl methacrylate) compound are being used in bonding different components surfaces (teeth and its restorations).

LDS ceramic material has the best bonding strength of all restorations. this is why we used it in this current study.This material can affected by the etching process and give the best surface treatment results. The bond strength of the restorations bonded to enamel reach 28 MPa [12] while to dentin reach13 to 20 MPa when using the total etching technique [13,14]. Some used the self-etching primers to simplify the adhesive technique [15].

Finishing the preparation and roundation of the line angles is so important for all-ceramic restorations [16,17].

Newly developed conservative restorations, such as occlusal veneers had been based on the concept of micro-retention which allows better conservative treatment of the dental structure provided that appropriate adhesive procedures are used. [18-20]

To reach to the similarity of the dimensions of veneers, molars of similar crown sizes were used. CAD/CAM machine used to construct the veneers to minimize possible variations and errors and give restorations with the ordered thickness. Used extracted human teeth to give similarity of the patient mouth. [21] Mandibular teeth were chosen with respect to tooth architecture and morphology, as proposed by previous studies. [22,23]

Teeth were mounted in epoxy resin blocks as its modulus of elasticity value (12 GPa) is near to that of human bone (18 GPa). [24]

Usage of silane coupling agent that were applied on the ceramic surface contains two different functional groups that react with inorganic matrices (hybrid ceramics), and the organic materials (resin cement); this promoting mechanical adhesion between resin cement and the restoration. [25]

Usage of the resin cement in bonding of veneers to the tooth structure to give the required bonding strength [26] besides, it increased the fracture resistance values. [27]

The occlusal veneers were cemented using the dual cure adhesive resin cement to give the advantages of controlled working time and make sure of completing the polymerization process in case of light is not sufficient in deep areas.

The accuracy of the restoration could be known by using the vertical marginal gap measurement. [28] In spite of the presence of various testing methods and measuring tools, the SEM was the adopted method for measuring the cervical marginal accuracy. [29]

Shoulder finish line preparation increased the retention of the restoration in spite of its action on the marginal gab than of the traditional design. Statistically, there were no significant difference between the two groups in measuring the marginal gab before the bonding process but after bonding the marginal gab increased to reach to 85.8 μm in group (2) without buccal groove extention.The bonding process increased the marginal gab distance as it takes some space for it. The buccal extention decreased the marginal gab after bonding the restoration to reach to 71.1 μm in group (1).

Conclusion

Usage of lithium disilicate ceramic occlusal veneers were recomended in treatment of tooth abrasion conservatively. Usage of auxillary retentive means is recommended than the conventional design on the effect of the marginal gab.

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