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Evaluation of Shear Bond Strength of E.Max Veneers Bond to Enamel Tooth Structure (An in Vitro Study)

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Abstract
Objectives: Patient demand for aesthetic dentistry is growing, Which lead to ceramic veneers using in dentistry has been increased. Aims:the aim of this study is to evaluat the shear bond strength of empress E.max veneer to enamel tooth structure using different light intensity.mehods: Ten maxillary and mandibular extracted premolar for orthodontic purpose was used.20 E.max empress disc were prepared according to manfacture instruction then the discs randomly dived into 2 groups .the cement used to cementind the disc to enamel tooth surface was bisco choice2 translucent light cured resin cement.The groups dived into A group and B group, Group A: low light intensity group in which Standard power has at 1000mW / cm² (10 Sec) applied for each disc bonded to enamel tooth surface. Group B: high light intensity group which is high power intensity at 1400 mW/cm² (4 Sec) for each disc bonded to enamel tooth surface to complet set. Results: Statistically high significant difference (<0.001) between group A and B in which the means for low intensity groups is 14.05±1.417 Mpa while the high intensity light groups mean 23.79±1.693. Conclusions: According to this study the use of high power intensity curing unit with veneer thickness 1mm give better bond strength of veneer to the tooth than when usind low power intensity curing unit with same veneer thickness.
Keywords: e.max,veneer,light intensity,shear bond.

1. Introduction

Patient demand for aesthetic dentistry is growing. Which lead to ceramic veneers using in dentistry has been increased. For the success of the veneer, not only the esthetic of veneer is important also the firmly attach of porceline veneer to the tooth when cemented by resin cement .Porcelain veneers are no thicker than a fingernail, which are thin porcelain shells that are bonded to the surface of teeth. Only a thin layer of enamel must be removed because veneers are so thin, which made enough space to the veneers. (1)

Emax veneers are as normal veneers has the same principles which is creating a straight, white smile, when the natural teeth were covered with a synthetic laminate, and cemented permanently in place. The more traditional designs and Emax veneers differs in that they are made out of a specially treated ceramic, so that because Emax veneers made out of a more hard-wearing material it can be be cut much. The wax pattern of veneer was first made with pressed ceramics, then to produce the chosen design,it has been shaped and contoured. Then casted the waxed veneers and then invested under pressure the molten porcelain which produce the final veneer.

For indirect restorations cementation the latest type of cements are the resin cements which contain the capacity to connect to the structure of the tooth and the inner surface of the restoration. Resin type cements have lower concentration of filler particles which are the equivalent basic component that the composite restorative material composed from (2).

The conventional cements has lower compressive, flexural, and tensile strength compared to resin cements.(3)

The bond strength of the resin cement is the mainly vital factor affecting the success of resin cements. The procedures of pretreatment, the depth of curing , intensity of light and polymerization degree of the resin cement, and adhesive resin incompatibilities between with the resin cement were widely affected the bond strength .(3)

The micromechanical retention is important to adhere resin cements to the tooth structure. Which has been achieved by etching the tooth, priming, and bonding the surface that are the usual adhesive steps which must be apply on the tooth enamel and dentin to form a table hybrid layer.The incompatibilities between adhesives systems and resin cements should be avoided by most of resin cement systems contain the adhesives needed. The using of etch and- rinse adhesive systems (tooth etch-and-rinse or total etch resin cements) Some cements typies , although adhesives useing which include self-etch primers (self-etch resin cements)by other cements .(3)

The adheres of cement to the tooth structure was ensured by tooth bonding procedures and by pretreatment of the restoration inside surface. A good restoration internal surface adhesion requires (1) increase the bonding surface area by roughening of the restoration internal surface and (2) increasing cement wettability to the restoration and form between the cement ,the ceramic, the fillers chemical bonding . which is done

depending on the restoration material was by air abrasion, sandblasting, or etching the surface with a hydrofluoric acid (for ceramic and composite restorations). (3)

By silanating agent applying on the etched porcelain or the composite the second procedure is achieved. The ceramic chemically adhere to the resin cement by assist of silane which makes the hydrogen bonds and through covalent (4). When the indirect composite restorations internal surface of silanating ensures that the composite fillers react and adhere with the resin type cement (5).

The VALO curing unit was used in this study .According to the intensity of the light it is offers 3 programs for light curing . The first program is standerized the power out put is at 1000 m W /cm² (10 sec for every layer),the second is high outpit power at 1400 mW/cm² (4 sec for every layer) , the last is Xtra out put power at 3200m W /cm² (3 sec for layer).

The cement use in this study was Choice 2 light-cured cement used specifically for porcelain and composite veneers cementation.

Because the light pass easily through the indirect type restoration due to restoration translucency and minimum thickness the light cure type cement was used.

2. Materials And Methods

In the existing study use lithium disilicate ceramic material (E-Max Press). Ten sound, extracted premolars for orthodontic purpose from maxillary arch and the mandibular arch were selected for the study. Examined the extracted teeth for no presence of caries and hypo plastic defects free, without restorations and who consider fit to be used for the study.

Any deposits of calculus and remnant of soft tissues were removed. Distilled water was used to store the samples after extraction. Then randomly divided the teeth into two equal groups. Each group composed of five teeth.

A rectangular plastic block that has measurement 35mm × 10 mm × 20 mm was made which show in figure one. A plastic plate of 35mm × 10mm × 1mm measurement with a rounded opening made which has diameter 3mm in the center prepared to used in this study show in figure two.

This constructed plate exactly fits on the top of a plastic block .The plastic perforated plate adhere on to the plastic block by adhesive to make the block and plate together one part of plastic mold show in figure three.

Then duplicate this plastic mold by preparation of special tray that made from resin self cured acrylic for making to the plastic mold impression . The impression of plastic mold was taken by polyether type of impression materia show in figure four. The impression of plastic mold was poured with durguix blue colour stone which show in figure five.

The 3 mm width central portion on the stone block was marked. The die spacer in this region was painted in two layers to be like the clinical work . when dried the die spacer, the laminates Wax patterns were prepared in the circular opening by flowing pattern wax . Then sprued the circular wax patterns with the help of spruce wax of diameter 2 mm which shown in figure six . Then the investing procedure was carried by carfully placing the IPS silicon type ring which contain wax pattern of the disc used in this study on the ring base without damge the waxing objects. After that the ring is filled with the IPS investing material and leave the ring without movement for aperiod of time determind by manfacture .

The investing ring ready now to be place in preheating furnace and after completion of preheating cycle the investing ring removed ,then place the cold ingot of e.max press and the plunger inside the hot ring then placing the ring in the center of hot press furnace.After complet the press cycle remove the ring from the furnace and make it cool then do the divesting .The junction of e.max disc and sprue wet first to avoid ceramic heating then cut using fine diamond disc .Then finishing and polishing the disc ,this procedure is done for making all thedisc used in the study to obtain standrization for all discs .

The discs that obtain from the laboratory work has one mm in thickness, which show in figure seven and 3mm diameter of the disc which shown in figure eight which was measured by using digital vernier (total TMT322001) .

2.1 Tooth speciment:

The ten extracted teeth was kept out of normal saline ,then mold of heavy body made with inner side empty constructed. This mold use for construction of cold cure acrylic in which the root of teeth was fixed inside the acrylic block which shown in figure nine.

After fixation of extracted teeth in the acrylic block the buccal and lingual surface of each teeth cut used diamond disc to exposed the enamel surface only and obtain flat surface to set the E-Max Press disc without rocking which will affect the result .

Etch enamel with UNI-ETCH (32% phosphoric acid) for 15 seconds.buccal and lingual surface Rinse thoroughly and air dry to remove excess water but do not desiccate; preparation should appear visibly moist.

Then mixing all bond (3) type A and type B and apply 1-2 coat to enamel surface of buccal and lingual wall,then air dry for minmum (10 sec) and then light cure for 10Sec according to manfacture instruction.

The heavy body mold which who made like aflat table was constructed and the e.max disc was placed on the heavy body then the discs etched by using 9.6% hydrofluoric acid for 90 Sec., washing for 15 sec with triple syringe,then dried for 15 sec period with air syringe .

Then mixing bis-silane part A and type B and apply 1-2 coat to each disc surface of e.max and wait for 30 sec. then dry with air syringe .After that apply avery thin layer of porcilin bonding resin to the surface of e.max disc that set on the tooth surface and not light cure then line the same part of the disc with choice 2 light cure resin cement first Light cure for 3 seconds to removed excess cement then light cure completely according to group . The VALO cord less curing unit was used in this study show in figure ten .

Group A: low light intensity group in which Standard power has at 1000mW / cm² (10 Sec) applied for each disc bonded to enamel tooth surface.

Group B: high light intensity group which is high power intensity at 1400 mW/cm² (4 Sec) for each disc bonded to enamel tooth surface to complet set.

2.2 Shear bond strength (μSBS) testing

Each specimen contains disc of lithium disilicate ceramic material (E-Max Press) bonded to the enamel of tooth was secured by tightening by prasser closed to the acrylic base that the tooth embedded in it, on to the Universal testing machine fixed compartment with a load cell of 5N. The other disc aligned with the upper movable section loading axis of the testing machine.

By appling the shearing load together with the tensile mode of force via the testing machine at a crosshead speed of 0.5 mm/min.(6)

In order to produce a shearing force that produce the debonding of of disc from enamel tooth surface the relatively slow crossing head speed selected . The debonding load was recorded in Newton and the computer software were used for recording the data.Then to to express the bond strength in MPa the load at failure (Newton) was divided by bonding area (mm2). The results were collected, tabulated and statistically analyzed.

3. Result

Data analysis was carried out by SPSS version 21.0. Mean and standard deviation (Mean±SD) for each variable were calculated and statistical comparison was performed by using Paired sample t-test .

The two groups compared their bonds strength to tooth structure first group apply low light intensity and the second group appy high light intensity .each group composed of 20 speciment .

The table one show mean value and the stander deviation of first group of low power intensity and the group of high power intensity which show highly signnficant difference between the high intensity power group and the low intensity group which mean that using high power light with lithium disilicate ceramic material (E-Max Press) give better result and powerfull shear bond strength to flat enamel tooth surface .

4. Discussion

The presense of photo-initiators in light-cure resin cements , which need to be activated by light. The penetrate to all areas by light and the photo-initiators activation is important with this type of cement. the working time of light-curing cements compared to the other cure types were increased.(2)

The single paste of light cure cement contain a photoinitiator system which is composed of the photosensitive component (usually camphorquinone) and a tertiary amine. The wavelength 480 nm (the visible spectrum in the blue region) of light activates camphorquinone(7)which first binds to the tertiary amine and then releases two free radicals then conversion of the monomers start. The polymerization of photo-cured resin cements starting after the material exposure to light(8)

The resin cement curing dependent on exposure time of cement to the light to a certain extent after a period of time of exposure to light-curing unit the maximum polymerization could be achieved, (9)

The tooth and the restoration durable bond depends mainly on the adhesive agent chemical composition and luting agent, the laminates and the tooth surface treatment . (10).

The used of distilled water as a storaging medium in this study because Enas H. Mobarak ,2010 carried out study that concluded the shear bond strength of dentin to composite not affected by the storage media/ conditions . (11)

Stangel et. al in 1987 concluded that the presence of silane in dentin adhesive when composite resin bonded to etched porcelain result in high shear bond strengths.(12)

For the clinical success of ceramic restorations that adhere to the tooth, it is important to establish a perfect bond among the sub-strate, cement, and ceramic, allowing for clinical longevity in the restoration. Thus, when there is not anadequate bond, there can be clinical failures, leading to the fracture of ceramic restorations or failure of the bond (13)

The light polymerized type resin luting agents polymerization for all- restorations composed of ceramic when the low output intensity polymerization units are used may be incomplete (14) .For this reason, the light curing unit with a high intensity and the polymerization times lengthening affect the bond strength values directly. Feng *et al.* ,et.al 2009 suggested the photocuring period that recommended from the manufacturer must at least double .(15)

The light curing materials polymerization depending on the intensity of the light source, wavelength, duration of exposure, the tip of the light source size, location and orientation, and the material shade, thickness and composition (16)(17). The mechanical properties like shear bond strength may be enhance by adequate polymerization (18).

Increased solubility of the resin cement especially at the margins caused by insufficient polymerization which leading to marginal gaps and secondary caries, and absorption of fluid increased, in which the unreacted camphoroquinone photoinitiators can lead to hygroscopic expansion. The mechanical properties such as hardness, fracture toughness, and wear resistance and bond strengths may be decrease caused by insufficiently polymerization of resin cement (19).

The result of this study agree with the result of Rasetto FH ,et.al 2004which found that the adequate polymerization of resin cements through veneers in a markedly shorting the time needed when high intensity curing lights used.(14)

The intensity of the light curing unit consider in relation to the extant of polymerization of resin-luting cement. (8)

When the low output polymerization of the curing units are used polymerization of the light-polymerized resin-luting agents for all-ceramic restorations may be incomplete. For this reason, bond strength values directly affected by high intensity of the light-curing unit and long polymerization period . (15)

The result of this study agree with Hickel and ilie 2008 ,they found the application of high power curing unit indenistry will reduce the curing time of resin based material and obtain maximum mechanical properties which was the same as this study in which better bond strength of e.max veneer to tooth structure obtain when used high power for curing resin cement.(9)

Ozyesil et.al 2003 agree with this study ,theu observed that higher degree of conversion of resin based material achieved with polymerization by high intensity light.(20)

Anne Peutzfeld et.l 2016 disagree with this study result and many other study ,they found the increase in light irradiance has no determinantal effect on polymerization of resin based materials.(21)

Seok-Hwan et.al 2015 agree with this study , they found that light cure resin cement affect by light intensity and show increase in polymerization when increase light intensity.(22)

5. Conclusion

According to this study the use of high power intensity curing unit with veneer thickness 1mm made of lithium disilicate ceramic material (E-Max Press) give better bond strength of veneer to the tooth than when usind low power intensity curing unit with same veneer thickness.

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Figures and tables:

Table 1. The mean difference between low and high intensity groups.

groups	Mean±SD	P
Low	14.05±1.417	<0.001
High	23.79±1.693	

Figure (1) rectangular plastic block

Figure (2) A plastic plate

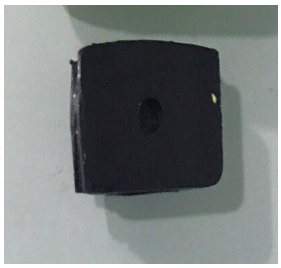

Figure (3) A plastic mold

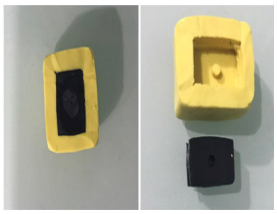

Figure (4) heavy body impression material for the plastic mold

Figure (5) heavy body impression material poured in type IV improved stone

Figure (6) sprued the circular wax patterns

Figure (7) disc thichness one mm.

Figure (8) disc diameter three mm.

Figure (9) the extracted teeth with acrylic base

Figure (10)The VALO cord less curing unit