



## Fracture Strength of Two Different Designs of Laminate Veneer (Bilaminar and V-shape) with Two Types of Ceramic (In Vitro Study)



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### Abstract:

**Aim of the study:** evaluate the fracture strength of two different laminate veneer designs (Bilaminar and V- shape) using two different ceramic materials (IPS e.max press and Metoxit Z-CAD zirconia ceramic).

**Materials and methods:** Forty intact human maxillary central incisors were reduced 2 mm incisally and 1 mm palatally to simulate erosion, then classified in to 2 main groups (n=20) according to laminate veneer design; (B) bilaminar veneer design and (v) v-shape veneer. Each main group was further subdivided into 2 subgroups (n=10) according to type of ceramic used; (E) e.max press ceramic, and (z) zirconia ceramic suspected to fracture strength test using universal testing machine, data were collected and analyzed using t test and two way ANOVA test.

**Results:** It showed a statistical significance between the two materials in the same design. On the other hand, it showed no statistical significance between the two designs with the same materials.

**Conclusion:** The design of laminate veneer (bilaminar or V- shaped) has no effect on the fracture strength, but the type of ceramic effect on the fracture strength of the laminate veneers.

### Introduction

Dental erosion is defined as a pathological chronic loss of the hard dental tissue<sup>1</sup> caused by the chemical effect of extrinsic and intrinsic acids without bacterial involvement<sup>2</sup>. In severe cases, restorative intervention is considered mandatory to restore aesthetics, function, and stop the destructive progress of the dental tissues<sup>3</sup>.

### Material and method :

A total of forty-carries free central incisors with homogenous size that were extracted for periodontal reasons were collected.

Teeth were mounted vertically epoxy resin block 2 mm apical to the cemento enamel junction (CEJ)<sup>5</sup>. A sectional index was made using a putty polyvinyl siloxane material (ghensyl, lascod, Italy) Teeth were reduced to remove 2 mm incisally and 1mm palatally to simulate class IV of ACE classification of erosion.

Teeth were randomly divided into 2 main groups (n=20) according to the type of laminate preparation used.

Group B: Teeth preparation for bi-laminar veneer.

Group V: Teeth preparation for V- shape veneer.

Each group was further subdivided into two subgroups according to the type of ceramic material used

Subgroup E: Veneers constructed from IPSe.max press ceramic.

Subgroup Z: Veneers constructed from zirconia ceramic.

Bilaminar veneer preparation (group B):

Preparation for group (B) was done with facial reduction 0.3 mm in the cervical third and 0.5 mm in the middle and incisal third following the cervical curvature and extending mesially and distally to the mesiobuccal and distobuccal line angles, and palatal reduction was only establishing 0.5 mm chamfer

Then *furus*<sup>4</sup> developed new approach " the V – shape veneer and bilaminar porcelain veneer", the V-shape veneer design was made for both facial and palatal restoration.

The aim of this study was to determine the density of microvessels and MCs in odontogenic cysts. Correlate the microvessel density with their corresponding mast cells density in the three types of cysts, in order to detect their possible role in the variable behavior of these odontogenic cysts.

finish line 0.5 mm incisal to the CEJ and extending from mesiopalatal to distopalatal line angle<sup>5</sup>.

V-shape veneer preparation (Group V):

It was done like bilaminar preparation with removing facial undercuts. Impression was done and poured with type IV dental stone (Zhermack, Italy)

Construction of E max laminate veneer

Construction of Bilaminar E max laminate veneers:

Facial laminate veneer:wax pattern ( Yeti dental , Germany) was made bystaining techniqueThe wax pattern was extended below the inciso palatal line angel to include the incisal edge. Lithium disilicate glass-ceramic (IPS e.max Press, Ivoclar Vivadent) was used to fabricate porcelain laminate veneers.

Palatal laminate veneer:After fabrication of the labial veneer, each one was fixed to its stone die with water soluble glue (UHU Glue Stick, USA). Then palatal veneer wax pattern was fabricated in the same way as the labial.

Construction of E-max V- shape veneer:It was made as one piece for the V- shape veneer

Construction of zirconia laminate veneers.

Construction of bilaminar zirconia laminate veneers.

Construction of facial laminate veneers.: Veneers were constructed by the CAD / CAM system using Metoxit Z-CAD smile blank this process consisted of three steps: scanning using 3D optical scanner (ceramill map400, #179140,

amanngirbach GmbH, Germany), designing using ceramill software (Ceramill Mind CAD, version 3.5.6.1408, Amann Girrbach GmbH, Germany). And milling using A 5-axis milling machine (ceramill motion 2/ 5x, #179250S, Amann Girrbach GmbH, Germany) according to manufacturer's instructions.

Construction of the palatal veneers:

After fabrication of the labial veneer, it was fixed to the stone die with the water soluble glue and scanned, then palatal veneer was fabricated in the same way as the labial one

Construction of V-shape zirconia veneers: The V-shape veneer was designed as one piece .

Cementation:

-Surface treatment for e-max laminate veneers (BE, VE) was done by applying hydrofluoric acid (5 %) (Ultradent, USA) on the fitting surface of each veneer for 20 seconds, then rinsed with water spray and dried

-Surface treatment for zirconia laminate veneers (VZ, BZ) was done by air born particle abrasion with alumina particles (50  $\mu$ ) at 30 psi, 10 mm distance to the intaglio surface of the veneers.

### Results:

Results of this study showed in table (1)

Table (1): Mean and Standard deviation of fracture strength test (in n) between studied groups

zirconia	B group		V group	
	Mean	SD	Mean	SD
	957.38 $\pm$ 227.71		898.99 $\pm$ 168.89	
e-max	486.17 $\pm$ 198.43		521.59 $\pm$ 178.40	

Student *t*-test was used to compare fracture strength of different material with the same design. Between group (BZ, BE)  $t=4.93$ ,  $P<0.001$  and (VZ, VE)  $t=4.85$ ,  $P<0.001$  showed a highly statistical significance difference between the two materials in the same design. On the other hand, Student *t*-test was used to compare fracture strength of different designs with the same material, between group (BZ, VZ)  $t=0.651$ ,  $P=0.523$  and (VE, BE)  $t=0.420$ ,  $P=0.680$  showed no statistical significance difference between the two designs with the same materials.

Two ways ANOVA test showed that the type of ceramic restorative materials used in this study (e.max, zirconia ceramic), regardless of the veneer design (bilaminar, v-shape) had a highly statistically significant influence on the mean fracture strength of the laminate veneers (p value $<0.001$ ), whereas, the type of the veneer design regardless of type of material used had no statistically significant effect on the mean fracture strength (p value=0.853).

### Discussion:

Although oral cavity is considered the ideal environment for the experimental study of dental materials, it has disadvantages as it is time-consuming and usually is not cost-effective, so for a successful *in-vitro* experiment, Natural teeth were used because of their unique characteristics such as elasticity, strength, bonding

-Laminate veneer surface treatment was done through Monobond

-Tooth priming was done by mixing the two primer liquids A, B in 1: 1 ratio. They were applied on the prepared surface of the tooth, scrubbed for 30 seconds and were dispersed with gentle air spray. After that Resin cement " multilink N " was applied from the automix syringe on the fitting surface of restoration and light cured.

-A specially- designed cementing device was used to make a constant load of 250gm on the ceramic veneers through the cementation procedure. The device consists of 2 separate parts, each part was designed for cementation of one design of the laminate veneers (bilaminar and V- shape veneers).as shown in

#### Fracture load test :

tooth was loaded in vertical direction at the incisal edge, The fracture load was done using universal testing machine (instron universal testing machine model 3345, England). till failure occurred. The resultant data were collected and tabulated

properties, enamel thickness, and quality that could affect results.<sup>6</sup>

In this study, natural central incisors were used as dental erosion more commonly occur in today population in the palatal surface of the maxillary anterior teeth and on the occlusal surface of lower first molar<sup>7</sup>

Teeth were embedded centrally and vertically in the epoxy resin to equally distribute the force of the fracture strength test all over the whole structure of the specimens. Teeth size were selected as much close as possible to uniform the surface area to which the force was applied.

Putty index was made before any tooth preparation to continuously evaluate the exact amount of reduction of the tooth . Before veneer preparation. The sample size involved 10 teeth in each group like in many previous studies<sup>8-10</sup>,

Fracture strength test was applied in a vertical direction at the incisal edge of the specimens. This direction of force was chosen as it occurs on all anterior teeth during anterior protrusive movement. In addition, teeth were loaded in this direction during the experimental assessment of masticatory force<sup>10</sup>

The first hypothesis of this study was rejected as The statistical analysis showed no significant difference of fracture strength of the two designs (v shape and bilaminar veneers) with the same materials, however, the second hypothesis was accepted as it showed significant difference between the fracture strength of e-max press and zirconia ceramics with the same design which coordinates with previous researches<sup>11,6</sup> however this difference can be clinically accepted as both type of ceramics could withstand the amount of masticatory force applied in the anterior area of the oral cavity which ranges between 98 and 270 N in the incisor area<sup>12</sup>.

The results of both designs of e.max were in agreement with those obtained by Tugcu<sup>6</sup> et al in 2018 reported the fracture strength value of e-max press laminate veneers constructed on maxillary central incisors that were prepared with three different preparation depths ranges from 389.55 to 219.21,

On the other hand, **gupta**<sup>13</sup> et al in 2018 had reported the fracture strength of e-max press laminate veneer of different designs. It ranged from 920 N to 1503 N. This variation in results could be attributed to difference in the designs.

Fracture strength of zirconia veneers ranges from 898.99 for the V-shape design and 957.38 for the bilaminar design.

some researchers reported lower values than that study, **al-ghazzawi**<sup>14</sup> et al in 2012 reported fracture strength of zirconia laminate veneers with two preparation designs to range from 224 to 244 N. this could be attributed to that in this study, natural teeth were not used, and also the different design and direction of force. Also

**Conclusion:** The design of laminate veneer (bilaminar or V- shaped) has no effect on the fracture strength, but the type of ceramic effect on the fracture strength of the laminate veneers.

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