

FRACTURE RESISTANCE AND COLOR STABILITY OF TWO HYBRID CERAMIC VENEERS VERSUS LITHIUM DISILICATE GLASS CERAMIC VENEERS

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ABSTRACT

Purpose: To compare the color stability and fracture strength of two hybrid ceramic (Suprinity and Enamic) veneers versus Lithium Disilicate ceramic veneers.

Materials and methods: Thirty freshly extracted maxillary central incisors were divided equally into three groups (n=10): group Em (IPS empress II, Ivoclar Vivadent) as a control, group VS (Suprinity, Vita Zahnfabrik), and group VE (Enamic, Vita Zahnfabrik). An incisal reduction of 1.5 mm was made with a butt-joint margin and 0.6 mm chamfer finish line was prepared on the labial surface of each specimen and on the middle of the proximal surfaces. Each group received different type of veneers according to the sample grouping.

Using spectrophotometer (Nippon Densmoku industries), ΔE was recorded for each specimen before and after 15 days of immersion in a coffee solution considering the value of $\Delta E = 3.3$ as clinically significant staining threshold. All the specimens were subjected to fracture strength test using universal testing machine (The Testometric Company Limited) using cross head speed of 0.5 mm/min at 135 degrees' angle. One-way ANOVA and chi-square were used for statistical analysis.

Results: Regarding the mean color stability between studied groups, group VS scored the least ΔE (3.52 ± 2.46) followed by group VE (4.14 ± 1.94) then group Em (4.49 ± 2.45). On the other hand, group VS scored the highest fracture strength values (471.04 ± 274.5) followed by group Em (442.13 ± 236.1) then group VE (394.72 ± 160.84). One-way ANOVA revealed no significant differences between groups in both color stability ($P = 0.636$) and fracture strength ($P = 605$).

Conclusion: The tested hybrid ceramics could present an acceptable treatment option for fabricating ceramic veneers.

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INTRODUCTION

Dental ceramics comprise a large family of inorganic non-metal materials, and are commonly divided into three groups: i) mostly glassy ceramics (feldspathic porcelain), ii) particle filled ceramics (e.g. e-max) and iii) polycrystalline ceramics (e.g. Zirconia)¹. Feldspathic veneers are the most esthetic and artistic veneers. A skilled lab technician can build life like teeth shapes and colors using these materials. Their main draw back is their low flexural strength (60 - 70 Mpa)², which necessitates excessive removal of tooth structure and possible exposure of dentine islands³.

e-max belongs to the particle filled ceramic category and is the most material used and preferred by many clinicians to fabricate veneers. Although it is inferior in esthetics to feldspathic porcelain but a 0.6 mm preparation thickness protocol can be adopted due to its high flexural strength (360-400 Mpa) It can be used as a monolith structure or bilayered but the later may necessitates more removal of valuable bonding enamel structure⁴. Polycrystalline ceramics are superior to all ceramic groups in flexural strength chemical solubility and flexural strength. In the past zirconia was accused of being "white". It had a dull artificial color due to its opaque, glass-free nature. It wasn't indicated for veneers. Its use was limited to coping material in posterior region which will be later veneered by more esthetic ceramics. Recently High translucency zirconia solved the "opaque white" problem and was indicated by manufacturers for esthetic veneers. And due to its high flexural strength it dominated sectors of minimal preparation veneers (Varioneers)⁵. Few years ago, VITA ENAMIC (Vita Zahnfabrik) was introduced. It was the first hybrid dental ceramic with a dual-network structure. Where dominant ceramic network is strengthened by a polymer network⁶. It was said that it combines the best characteristics of a ceramic and a composite. More recently, a new generation of glass ceramic material was present-

ed, Vita Suprinity (Vita Zahnfabrik) and Celtra duo (Dentsply). They are the same material but presented by two different companies. In these materials, glass ceramic is enriched with zirconia (approx. 10 % by weight), resulting in zirconia reinforced lithium silicate ceramic (ZLS). This glass ceramic featured a special fine-grained and homogeneous structure, which was claimed by the manufacturer to provide excellent physical qualities, consistent high load capacity, long-term reliability and excellent esthetic properties⁷. Both of the materials were indicated for esthetic veneer restoration as a successful substitute for classical ceramics. The null hypothesis of this study is that there will be no significant difference between the tested groups.

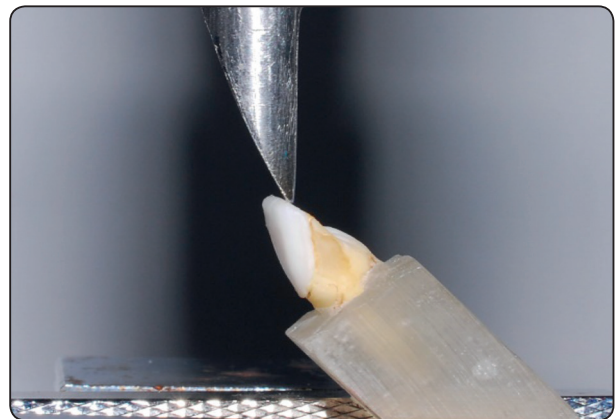


Fig. (1) Mounted specimen under loading.

MATERIALS AND METHODS

Thirty freshly extracted maxillary central incisors were divided equally into three groups (n=10): group Em (IPS empress II, Ivoclar Vivadent) as a control, group VS (Suprinity, Vita Zahnfabrik), and group VE (Enamic, Vita Zahnfabrik). In incisal reduction of 1.5 mm was made with a butt joint margin and 0.6 mm finish line was prepared on the labial surface of each specimen and on the middle of the proximal surfaces. Each group received different type of veneers according to the sample grouping.

A one-step double-consistency silicon impression material was taken for each specimen. Stone dies were poured and individually scanned using digital scanner, where a CAD model was generated for each specimen individually. After milling, veneers were cut off the block, sintered, finished and polished according to manufacturer instructions. Specimens and teeth were surface treated to receive its corresponding veneer and then cemented using light cured resin cement.

Using spectrophotometer (Nippon Densmoku industries), ΔE was recorded for each specimen before and after 15 days of immersion in coffee solution. The specimens and the spectrophotometer were always in the same position during all the measurements. Using a spectrophotometer, 3 color parameters were recorded for each ceramic veneer before and after immersion in a coffee solution according to the following equation: $\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$; where ΔL^* is the variation of L^* , Δa^* is the variation of a^* , and Δb^* is the variation of b^* . ΔE^* were obtained in this study for the 3 groups tested. Considering the value of $\Delta E^* > 3.3$ as clinically significant staining. Each specimen was then mounted individually in universal testing machine using a cross head speed

of 0.5 mm/min at 135 degrees to the long axis of the tooth on palatal surface to simulate the average angle of contact between maxillary and mandibular incisors in class 1 malocclusion, using a specially designed load application jig simulating mandibular central incisors. One-way ANOVA and chi-square tests were used for statistical analysis.

RESULTS

1- Color stability

VS group scored the lowest ΔE mean value (3.52) followed by VE group (4.14) and the highest value scored by Em group (4.49). One-Way ANOVA test revealed no significant differences between the tested groups ($P=0.636$). For clinical acceptability of color changes, Chi-square test was applied to ΔE at 3.3 threshold and the results revealed no significant differences between the tested groups ($p=0.387$).

2- Fracture resistance

VS group scored the highest mean value of fracture resistance (471.04) followed Em group (442.13) and lowest value scored by VE groups (394.72). One-Way ANOVA test was applied to studied groups and there were also no significant differences ($P=0.534$).

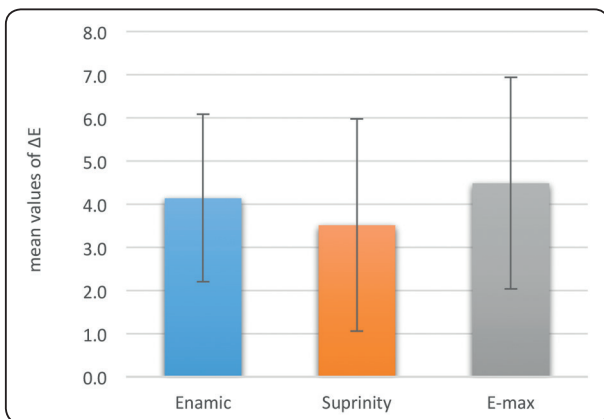


Fig. (2) Mean values of ΔE of the studied groups.

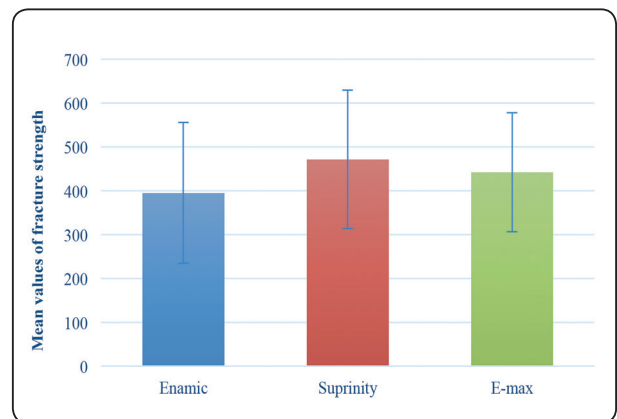


Fig. (3) Mean (Newton) values of fracture strength.

DISCUSSION

In current study, certain procedural steps were adopted to ensure proper standardization and that the purpose of the study was fulfilled.

Stone dies were used for scanning without imaging powder, instead of the natural teeth was adopted to prevent powdering the tooth which may interfere with the adhesion of the veneer as recommended.⁸

Light cure resin cement was utilized because of its recommendation for esthetic metal-free restorations (Simon and de Rijk 2006). An advantage of these cements is the increased working time compared to the other cure types⁹ in addition to their color stability.¹⁰

CIELAB (Commission Internationale de l'Eclairage) color coordinates system is a very useful mode, providing information about location of object color in a uniform 3 dimensional color space as documented by Gupta et al. (2005).¹¹ A customized plastic box having the same diameter as the measuring tip of the spectrophotometer was fabricated, in order to constrict the readings on the tooth only without reading of the surrounding colours.

Although there were no significant differences between the groups, Suprinity exhibited the best colour stability values ($\Delta E=3.52$) followed by Enamic ($\Delta E=4.14$) and then e-max ($\Delta E=4.49$). This insignificant difference between Enamic, and Suprinity compared with the control group (e-max), may be attributed to the fact that Enamic contains 86% ceramic filler which may render the material to act like ceramic material than a resin material¹², as well as the Suprinity which contains only 10% zirconia fillers.⁷

The high ΔE of all the groups could be due to surface roughness of the veneers, as they were only mechanically polished without addition of glazing material. This is in accordance to a recently published research¹³ which revealed that the

absorption of extrinsic stain from coffee is affected by surface roughness, integrity, and polishing regime. However, it is hard to relate the results of this study to the clinical conditions as the colour stability of restorative materials cannot be related to a single beverage, but it is the consequence of complex reaction of different chemicals for different food, drinks and mouth rinses.¹⁴ Further investigations are needed to assess the effect of polishing and glazing of the discoloured composite, and ceramic laminate veneers on the improvement of the discoloration.

Regarding the fracture resistance test, mounting of the specimens was guided using 45 degrees angled cuts on proximal surfaces of the resin blocks which give an interincisal angle of 135 degrees which simulate the angle in class I malocclusion.¹⁵

Fracture resistance results showed, highest values for Suprinity (471 N) followed by e-max (442 N) and the lowest was for Enamic (394 N) but with no significant differences between them. Several factors may influence the fracture resistance-ceramic restoration such as microstructure and fatigue of the ceramic material, fabrication technique, preparation design and luting method. The slight surpass of Suprinity in the fracture resistance, could be attributed to its composition of zirconia fillers which increase its fracture strength. On the other hand, the approximate values of fracture resistance exhibited by Enamic, compared with the control (e-max), could be due to the existence of polymer in its composition which reduces the brittle fracture and lead to increase fracture resistance.¹⁶ The large standard deviations obtained in this study could be attributed to various factors, including natural variations in tooth properties and anatomy as well as defects introduced during preparation and the CAM processing or statistical variations regarding sample size.

The null hypothesis was accepted as there was no statistical difference among tested groups.

CONCLUSION

Within the limitation of this study it was concluded that,

- 1- There was no perceivable color difference between Suprinity, Enamic and e-max.
- 2- There was no significant difference in the fracture resistance between Suprinity, Enamic and e-max.
- 3- The two tested hybrid ceramics could present an acceptable treatment option for fabricating ceramic veneers compared to e-max.

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