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# EFFECT OF CEMENT TRANSLUCENCY AND CERAMIC THICKNESS ON THE RESULTING COLOUR MATCH OF ZIRCONIA-REINFORCED LITHIUM SILICATE RESTORATIONS CEMENTED OVER DARK-COLOURED SUBSTRATE

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## *ABSTRACT*

**Objective:** Vita Suprinity zirconia-reinforced lithium silicate dental ceramics were tested using various thicknesses and hues of resin cement to determine how well they could disguise colour. **Materials and Methods:** Fifty-four (Vita Suprinity) ceramic discs with different thicknesses (0.5, 1 and 1.5mm thickness) were used, eighteen discs in each group were then subdivided into two equal subgroups (n=9) according to the cement shade used (translucent or opaque), one discolored substrate (C4) was used. Translucency parameter (TP) and colour difference (ΔE before and after cementation to the substrate) were evaluated by spectrophotometer. **Results:** The three groups of ceramic thicknesses did not differ statistically significantly in terms of the translucency parameter, however there was a statistically significant difference between the two investigated colours of resin cement (translucent and opaque). Between the three groups, there was no statistically significant difference in the colour change (ΔE). **Conclusions:** Between the three various ceramic thicknesses that were employed, there was no statistically significant variation in the translucency parameter (TP). The colour changes (ΔE) for the three dental ceramic thicknesses utilized were within the clinically acceptable range (3.33). Accordingly, no matter what colour the luting agent was, Vita Suprinity measured thicknesses showed enough colour masking capacity to cover up the discoloured substrate (C 4) that was being employed.

**KEYWORDS:** Color masking, Dental ceramic, Translucency

## INTRODUCTION

One of the main aspirations of various dental treatments is to naturally mimic teeth aesthetically, based on the needs and personal requests of the patient. Possibilities to reach that goal have evolved over the past decade through newer innovative treatment strategies, advanced aesthetic dental materials, and newer techniques and technologies[(1)]. So, patient satisfaction and fulfilling patient expectations is the main objective of aesthetic treatment[(2)]. Currently, there is a wide array of treatment modalities that are either invasive or non-invasive. These various treatment approaches involve vital bleaching, micro-abrasion, diode laser bleaching, resin infiltration, veneering, or crowns [(3)].

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Novelty in materials is always thriving due to the huge aspirations for esthetic treatments among both physicians and patients. Zirconia-reinforced lithium silicate glass ceramic, has a unique structure gathering the mechanical benefits of zirconia with the visual benefits of glass ceramics. Therefore, it may be used in the anterior and posterior areas of complete or partial coverage restorations like laminate veneers and crowns [4,5].

Final restoration color should mimic the natural color of the tooth, particularly in the anterior region either by ceramic or composite materials. It is possible to match shades visually using shade tabs that resemble teeth or instrumentally with color-measuring equipment. Physical and subjective components make up the visual shade guide approach. The clinician's range in age, experience, colour blindness, eye tiredness, emotional vagaries, illusions, and judgement mood are the subjective variables. Extreme light sources, environmental factors, light source type, intensity, incidence angle, surface texture of the teeth, and colour of the surroundings are examples of physical variables. The human errors in shade visualization are greatly reduced by the instrumental method of colour evaluation [6].

Due to a lack of cement colour options and the thin cement film thickness utilized, it may not be possible to conceal a dental substrate with cement; the restorative material's capacity to mask colour is of primary concern. It was reported that the masking capacity is correlated with the values of translucency parameters [7]. The final hue may be influenced by the thickness and colour of the ceramic, the luting cement being used, and the colour of the dental substrate beneath. Translucency is a characteristic that adds to the difficulty of the shade-matching procedure since ceramics allow light to enter and scatter. The underlying dental substrates have a significant influence on the final shade as a consequence [8]. The translucency parameter is determined by calculating the colour differences for the same specimen thickness over black and white backgrounds (TP). Colour difference is the difference between two colours in terms of CIElab color coordinates [9].

Ellakany et al., found that a thickness of 0.5 mm of ceramic veneering material (LT IPS Emax CAD and IPS Empress CAD) showed the highest colour difference and translucency parameter, while 1.5 mm thickness exhibited the lowest ones after cementation to various dark-colored substrates. This is because an increase in ceramic thickness greatly affects both translucency and colour masking ability of the underlying dental substrate. The translucency parameter decreases as ceramic thickness increases, which improves the aesthetic restoration's ability to cover imperfections [10].

According to a prior study, high-translucency zirconia must be at least 4 mm thick to entirely conceal the substrate, but tooth preservation causes challenges and prevents increasing ceramic-layer thickness [11]. To cover up discoloured substrates, different shades of luting cement have developed to cement exceedingly translucent restorations. More research is required, nevertheless, into studies looking at resin cement shade and how it affects the aesthetic value of high-translucent monolithic-zirconia restorations [11].

Therefore, this study aimed to evaluate the colour-masking ability of Vita Suprinity dental ceramic (Zirconia-reinforced lithium silicate, ZLS) at different thicknesses (0.5, 1 and 1.5 mm) against dark substrate, when two translucencies of luting cement were applied (translucent and opaque). Null hypothesis (H0) stated that there was no relation between ceramic thicknesses and hues of resin cement in color masking stability, while alternative hypothesis (Ha) claimed that there was direct relation between thicknesses and hues of resin cement in color stability.

## MATERIALS AND METHODS

Materials used in this study (table 1).

| Material | Material specification | Composition | Manufacturer |
|---|---|---|---|
| Vita Suprinity shade A2 | Zirconia-reinforced lithium silicate glass-ceramic | 8%-12% $ZrO2$, 55%-64% $SiO2$, \ The average crystal particle is 0.5 mm | VITA Zahnfabrik Bad Sackingen, Germany |
| Filtek TM Z350 XT, Universal restoration | Resin composite shade C4 | Nano-filled resin composite | 3M ESPE, USA |
| Choice 2 | Resin cement (Shade: opaque and translucent) | Urethane Dimethacrylate, BisGMA, Tetrahydrofurfuryl Methacrylate | Bisco, USA |
| Vita Akzent® plus | Glaze material and finishing agent | Low-fusing glaze material | Bad Sackingen, Germany |

## METHODS

### I. Sample size calculation

To study the effect of three ceramic thicknesses (0.5, 1, and 1.5) on the resulting shade using transparent versus opaque cement on color of zirconia-reinforced lithium silicate restorations cemented over a dark-coloured substrate, ANOVA test was used for intergroup comparison.

According to a previous study [4] mean color difference varied from 1.6 ±0.4 to 0.7±0.1 with different thicknesses using opaque cement; in comparison to 1.1±0.3 and 1.1±0.6 with different thicknesses using translucent cement. For determining sample size, the G power statistical power analysis tool (version 3.1.9.4) is used. The results of a two-sided hypothesis test using a total sample size of fifty-four samples (n=54), split into 18 samples for each thickness group and further divided into 9 samples for each cement subgroup, was enough to detect a substantial effect size (f) of 0.43 and real power (1-beta error) of 0.8 (80%) and a significance level alpha error of 0.05 for two-sided hypothesis test.

### II. Ceramic Samples preparation

A low-speed diamond saw was used to cut 54 disc-shaped Vita Suprinity specimens with an 8 mm diameter into 18 discs of each thickness (0.5, 1 and 1.5 mm) [12,13]. (Fig.1). Digital caliper (New Toyota, Japan) was used to check the required thickness after milling.

FIG (1) Isomet disc cutting ceramic disc

Ceramic discs were glazed with Vita Akzent® plus glaze material, then put onto honey combed firing tray, which was used to fix different types of discs in a furnace to avoid any contamination during crystallization of Suprinity discs.

Crystallization and glazing for ceramic samples were done in a ceramic Programat furnace following the manufacturer's specifications. Then, the discs were left outside the oven to cool. After the firing procedures of the discs, digital caliber was used again to check the required thickness [14].

**TABLE (2)** Sample grouping and experimental design

| Group No. | Vita Suprinity ceramic disc thickness | Subgroup (shade of resin cement) |
|---|---|---|
| I | Ceramic disc thickness 0.5 mm (N=18) | Translucent cement (T) (N=9) |
| | | Opaque cement (O) (N=9) |
| II | Ceramic disc thickness 1 mm (N=18) | Translucent cement (T) (N=9) |
| | | Opaque cement (O) (N=9) |
| III | Ceramic disc thickness 1.5 mm (N=18) | Translucent cement (T) (N=9) |
| | | Opaque cement (O) (N=9) |

Based on the thickness of the ceramic disc, 54-disc samples were divided into three equal groups (n=18) (0.5, 1 and 1.5 mm). Based on the colour of the resin cement used to cover the colour of the substrate, each group was divided into two equal subgroups (n = 9) (translucent and opaque resin cement) [(15)].

**III Testing procedures before cementation:**

Before cementation of ceramic discs to the composite substrate, translucency parameter and color values of ceramic discs were measured.

***Translucency parameter evaluation:***

The specimens were assessed by a spectrophotometer (Fig.2) (Model RM200QC, X-Rite, Neu-Isenburg, Germany). Aperture size was set to 4 mm. Centralized measurements were performed for each specimen on white (CIE L*= 88.81, a*= -4.98, b*= 6.09) and black substrates (CIE L*= 7.61, a*= 0.45, b*= 2.42) relative to the CIE standard illuminant D65. The specimens were left in the same position for the two backgrounds.

Translucency parameters (TP) values were obtained by calculating the colour change of the samples on black and white backings according to the equation:

$$TP= [(L_B^* - L_W^*)^2 + (a_B^* - a_W^*)^2 + (b_B^* - b_W^*)^2 ]^{1/2}$$

W stands for a white background, whereas B stands for a black one. Specimens are described by L* values ranging from 0 to 100, respectively. This coordinate represents the material's brightness. The sample becomes brighter as the L* value increases. The a* (ranges from- 90 to 70) and b* (ranges from -80 to 100) values, which define the redness-greenness and yellowness-blueness respectively. For a*, positive values represent how much of the sample is red, while negative values represent how much of it is green. The b* coordinate is a measure of chroma along the yellow-blue axis. The sample's level of yellowness is represented by positive b* values, while its level of blueness is represented by negative b* values. Data were collected, tabulated and statistically analyzed.


FIG (2) Reflective spectrophotometer.

The CIE L*a*b* colour coordinates of ceramic disc samples were calculated by a spectrophotometer. Three readings for each sample were recorded and an average was taken, the capture time was 0.2 seconds.

**IV. Discolored substrate fabrication and ceramic cementation**

Teflon split mould former was made with 8 x 5mm diameter and thickness measurements, respectively. To create a smooth surface, a Teflon split mould former was placed on a glass slide, composite resin was then applied in the mold's opening, and the mould was then covered with another glass slide. Composite resin was cured using a light curing unit with an 800 MW/cm$^2$ intensity and wavelength range of 420-480nm (LY-A180 Demetron; Demetron Research Corp, Danbury, Conn) for 20 seconds for each increment. Specimens were cured again for another 20 seconds after removal of the glass slides. Composite discs were finished with silicon carbide fine abrasives [14].

A layer of resin luting agent was injected between ceramic discs and the dark substrate. The used resin cement was translucent and opaque according to each subgroup. Cementation was carried out using a load applicator of 250 g load for 20 seconds until initial cement polymerization and then removed for further light curing for another 20 seconds [16].

**V. Calculation of colour difference (ΔE) after cementation:**

Three axes (L*, a*, b*) are found in the CIE L*a*b 3D colour system and give a numerical value of the colour positions.

Colour difference was calculated by the following equation:

$$\Delta E=[(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$$

Where ΔE*: colour difference or colour change.

$$\Delta L^* = L^*_w - L^*_0$$

$$\Delta a^* = a^*_w - a^*_0$$

$$\Delta b^* = b^*_w - b^*_0$$

0: ceramic without luting agent over white backing.

W: ceramic-substrate assembly with the cement.

L*: Brightness or lightness is indicated by a colour coordinate, which ranges from 0 to 100.

a*: A colour coordinate with a range of - 90 to 70 that corresponds to redness on the negative axis and greenness on the positive.

b*: A colour coordinate with a range of - 80 to 100 that denotes the positive axis for yellowness and the negative axis for blueness [14,17].

Clinical acceptability level was set to a delta E value of 3.3. If it is higher than 3.33, the colour mismatch is identifiable by the naked eye after cementation to the discoloured backing [18].

## RESULTS

**I - Translucency parameter (TP) results**

For all material thickness groups using both kinds of cement, the mean and standard deviation (SD) values are summarized in Table (3) and (Fig.3)

***A. With Translucent cement;***

The mean translucency parameter value for the GI (0.5 mm) group was greatest (TP=4.48), followed by the mean value for the GII (1mm) group (TP=3.83), and the mean value for the GIII (1.5 mm) group was lowest (TP = 3.67). According to one-way ANOVA (P=0.2159> 0.05), there was no statistically significant difference between the means of the groups.

With regard to opaque cement, it was discovered that GIII (1.5mm) recorded the highest mean translucency parameter value (3.79 TP), followed by GII (1 mm) mean value (3.45 TP), and GI (0.5 mm) recorded the lowest mean translucency parameter value (0.3 TP) (3.29 TP). According to statistics, there was no statistically significant difference between the groups' mean values (P=0.4356 > 0.05).

**TABLE (3)** Translucency parameter (TP) results (Mean values ±SDs) for all material thickness groups with both types of cement

| Variable | | Translucent cement Mean | Translucent cement SD | Translucent cement 95% CI Low | Translucent cement 95% CI High | Opaque cement Mean | Opaque cement SD | Opaque cement 95% CI Low | Opaque cement 95% CI High | Statistics t-test P value |
|---|---|---|---|---|---|---|---|---|---|---|
| Material thickness | GI (0.5 mm) | 4.48 | 0.82 | 3.97 | 4.99 | 3.29 | 0.87 | 2.75 | 3.83 | 0.0056* |
| | GII (1 mm) | 3.83 | 1.08 | 3.16 | 4.49 | 3.45 | 1.12 | 2.76 | 4.14 | 0.4499 ns |
| | GIII (1.5mm) | 3.67 | 1.25 | 2.9 | 4.45 | 3.79 | 0.52 | 3.47 | 4.11 | 0.7824 ns |
| Statistics | ANOVA P value | 0.2159 ns | | | | 0.4356 ns | | | | |

*Different letters in the same column indicating significance between groups (p<0.05)*

**; significant (p<0.05)* *ns; non-significant (p>0.05)*

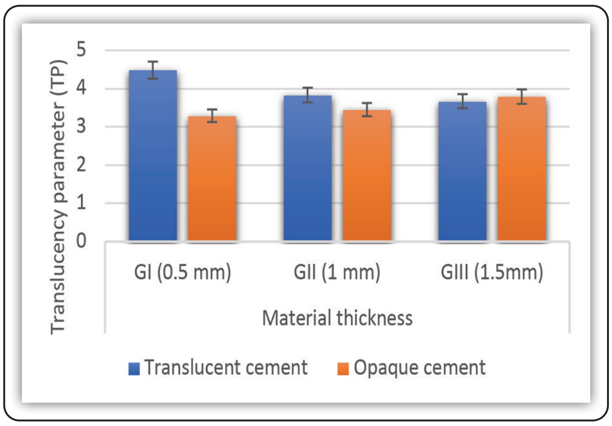


FIG (3) Column chart of the mean values of translucency parameter for all material thickness groups with both cements

### *B. Translucent cement vs. opaque cement;*

According to paired t-test results (P=0.0056 0.05), GI (0.5 mm) bonded with transparent cement explained a statistically greater translucency parameter mean value (TP=4.48) than opaque cement did (TP=3.29).

A paired t-test (P=0.4499 > 0.05) confirmed that GII (1 mm) cemented with Translucent cement accounted statistically non-significantly higher translucency parameter mean value (TP=3.83) than one of opaque cement (TP=3.45).

By using a paired t-test, it was shown that GIII (1.5mm) cemented with opaque cement explained statistically non-significantly larger translucency parameter mean value (TP=3.79) than Translucent cement one (TP=3.67).

### *C. Total effect of material thickness group on translucency parameter mean value;*

Regardless to cement type, it was found that the differences between the material thickness groups were statistically non-significant as revealed by the two-way ANOVA test (p=0.7129<0.05) where (GI (0.5 mm) ≥ GIII (1.5mm) ≥ GII (1 mm)).

### *D. Effect of cement type on translucency parameter mean value;*

The two-way ANOVA test revealed that translucent cement recorded a statistically significant higher mean translucency parameter value than opaque cement, regardless of the material thickness group (P=0.05).

**II-Color change (ΔE) results:**

***A. Effect of ceramic thickness (comparison between different thicknesses):***

The mean and standard deviation (SD) values for all material thickness groups using both cements are shown in the colour change (E) findings in Table (4) (Fig.4).

With Translucent cement; a comparison between the three groups revealed a non-significant difference as indicated by the one-way ANOVA (P=0.58 > 0.05). With opaque cement; a comparison between the three groups revealed a non-significant difference as indicated by one-way ANOVA (P=0.09 > 0.05).

***B. Effect of cement type (comparison between translucent cement versus opaque cement):***

With GI (0.5 mm); a non-significant difference was found between both cement types by paired t-test (P=0.77 > 0.05). With GII (1mm): a non-significant difference was found between both cement types by paired t-test (P=0.27 > 0.05). With GIII (1.5mm); a non-significant difference between both cement types by paired t-test (P=0.39 > 0.05).

**TABLE (4)** Color change (ΔE) results (Mean values ±SDs) for all material thickness groups with both cement types

| Material thickness | Cement type | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Translucent cement | | Opaque cement | | Difference | | | | |
| | Mean | ± SD | Mean | ± SD | MD | SEM | 95% CI L | 95% CI U | P value (Independent t- test) |
| **GI (0.5 mm)** | 1.86 | 1.48 | 1.72 | 0.47 | 0.14 | 0.48 | -0.88 | 1.17 | 0.77 |
| **GII (1 mm)** | 2.49 | 1.57 | 1.85 | 0.82 | 0.63 | 0.55 | -0.54 | 1.8 | 0.27 |
| **GIII (1.5mm)** | 2.08 | 0.88 | 2.52 | 1.18 | 0.43 | 0.46 | -1.41 | 0.54 | 0.39 |
| **P value (One Way ANOVA test)** | 0.58 | | 0.09 | | | | | | |

*Different letters in the same column indicating significance between groups (p<0.05)*

**; significant (p<0.05) ns; non-significant (p>0.05)*

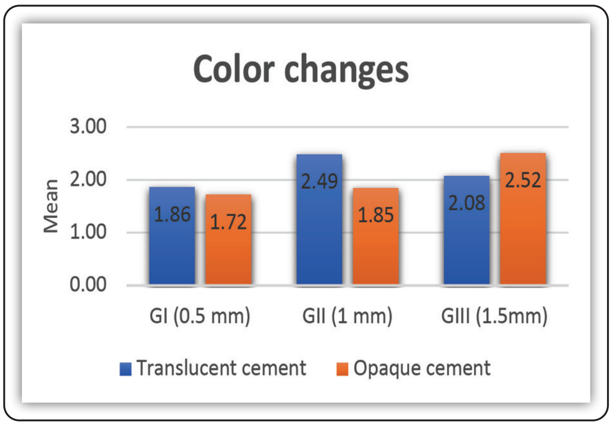


FIG (4) Column chart of the mean values of color change for all material thickness groups with both cement types

## DISCUSSION

The results of this study support adopting the null hypothesis about the impact of various ceramic thicknesses on colour masking because the translucency parameter and the colour change (ΔE) did not substantially differ for the used variable thicknesses of zirconia-reinforced lithium silicate. Although the translucency parameter mean value for translucent cement was statistically greater than that of opaque cement, the cement colour had no significant impact on the colour of the zirconia-reinforced lithium silicate ceramic after it had been cemented over the discoloured substrate. As a result, the null hypothesis regarding the measured cement shadow was partially accepted.

To address the issues with lithium disilicate, Vita Suprinity® was launched to the dental market in 2015. According to the producer, this innovative glass ceramic is strengthened with zirconia, combining mechanical properties of zirconia with the aesthetically pleasing properties of lithium disilicate. It was also mentioned that it might conceal the hue of the primary substance. Along with a number of benefits like toughness, superior mechanical qualities, ease of milling, and outstanding translucency, opalescence, and fluorescence (18).

If the employed repair is made from an enamel-like translucent ceramic, a darker abutment may negatively affect the aesthetic expectations of an upcoming ceramic restoration (19). The thickness of the ceramic, the colour of the substrate, and the shade of the luting cement are only a few of the factors that may have an impact on the ultimate outcome of the all-ceramic restoration. If the substrate is darker, the final restoration will also be darker, and vice versa (20).

Different Suprinity CAD/CAM material thicknesses were employed in the current investigation to replicate various clinical scenarios. The thinnest veneer preparation is 0.5 mm thick. The suggested thickness for the anterior full coverage preparations is one millimeter. For full-coverage restorations on either the front or posterior teeth, and in cases of severe discolouration, thicknesses of 1.5 are recommended (18).

In this study, the spectrophotometer was used for measuring both the translucency parameter and the color difference of the ceramic specimens. Spectrophotometer can explore delicate colour changes undetectable by the naked eye. ΔE of two colors is the judgment of color matching. When ΔE is close to zero there is an ideal masking ability (less than 1 unit) (6,21).

The mean of ΔE values (color difference measured before and after cementation) for the three different thicknesses of Vita Suprinity (0.5, 1 and 1.5 mm) was lower than 3.33, which is lower than the clinically acceptable range when cemented to C4 background using both opaque or translucent cement.

In this research, it was concluded that irrespective of the material thickness, translucent cement recorded a statistically significant higher translucency parameter mean value than opaque cement (better masking effect of opaque cement). Regarding the effect of resin cement shade on colour change, this study recorded no statistically significant difference for all groups.

A previous study (12) indicated that the ceramic final shade can be affected by resin cement shade; the degree of affection is due to the cement's optical characteristics. A cement that is opaquer than the restorative material can be used to complete the shade of ceramic restorations. To eliminate unintended fluctuations in the restoration's final shade, a cement that is more translucent than the restoration could be employed. This was in agreement with the current study, due to the inherent opacity of zirconia-reinforced lithium silicate, which may be more opaque than both translucent and opaque resin cement types, especially when cements are utilized in extremely thin sections.

Another agreement was found with Carrabba et al. (12), who found that the cement colour could affect the final shade of the lithium disilicate crowns but does not affect zirconia veneers due to their authentic opacity.

In an in vitro study on Leucite-reinforced glass ceramic (12), The intrinsic translucency of the material might also explain the observation that the cement shade can affect the final shade of veneers with less than 0.8 mm thickness. Previous similar research recorded a significant impact of the cement shade on the colour difference. (22,23)

Some previous studies stated that different cement shades did not mask the effect of the discolored substrate and cannot adjust it significantly [16,24]. This might be due to the low-translucent glass-ceramics used in these studies that could reflect more light and pass less light to the underlying structure; this can mask the impact of the cement color. Also, it is unclear whether using different cement brands might affect the outcome [17].

A prior study assessed the colour masking capability of 0.5 mm zirconia thickness on various discoloured substrates and noted a substantial difference between the groups in the (ΔE) values with regard to the impact of ceramic thickness on colour masking. All of the groups' (ΔE) values exceeded the predetermined perceptible threshold. So, it was determined that a minimum thickness of 0.9 mm was needed to attain respectable aesthetics. The very dark substrates (grey and black) employed in the earlier investigation are an easy explanation for this contradiction with the current study [20].

Our findings were also in disagreement with Bai et al. [17], which stated that as veneer thickness decreased, TP values were significantly improved, and that could markedly affect the optical characteristics of esthetic restorative material. (ΔE) values significantly drop as ceramic thickness increases. The dispersed reflection effects of the underlying substrate are lessened as ceramic thickness increases [22]. Morsy et al. reported similar results [25]. High and low translucency ceramics have a limited capacity to disguise the colour of the underlying substrate, making them less than ideal materials to cover substrates with a range of discolorations. It was discovered that improving shade matching required thickening the ceramic to 2.5 mm [16].

This contradiction can also be explained based on the type of ceramic used for substrate masking, as in our present study zirconia-reinforced lithium silicate was used, as opposed to more translucent glass ceramics used by previous studies, like vita mark II, lithium disilicate, and Vita Enamic ceramics. The presence of zirconia in Vita Suprinity used in the current study could mask the colour of the discolored substrate even at the thickness of 0.5mm, using opaque or translucent cement.

Another explanation is the color of the substrate used by Zahran et al. [16]. Four different substrates (zirconia, shade A2 nano-ceramic filled resin composite, and dual-cure composite core build-up (shades light opaque and A3) were used. It was proved that more opaque backgrounds could result in greater color differences before and after cementation, especially when cemented to translucent ceramic material in thin sections.

Our results were in contradiction with the results of El Adawy et al. [19], who concluded that ceramic thickness (IPS E max CAD and Celtra Duo ZLS) influenced the final colour of the ceramic, as the thicker ceramic discs were less translucent. This contradiction can be due to different materials, methodology, and testing procedures used in both studies

Previous studies indicated that the ceramic thickness should be at least 2mm in order to cover up the colour variations of the beneath cement. It was claimed that feldspathic porcelain veneer of 1mm thickness may conceal the colour shift of the cement employed because the opacity of ceramic rises with thickness [25].

## CONCLUSION

Within the limitations of this study, it was concluded that:

- The three used ceramic thicknesses (0.5, 1 and 1.5mm) of Vita Suprinity (ZLS) ceramic had no significant difference regarding the translucency parameter.
- Translucent cement recorded a statistically significant higher translucency parameter mean value than opaque cement, only with GI (0.5 mm). For other thickness groups (1- and 1.5-mm

groups), there were no statistically significant differences between both cement types. So, it is recommended to use ceramic thickness as thin as 0.5 mm for veneers if the background color is C4 to conserve the tooth structure.

- Regarding colour difference (ΔE): there was non-significant difference between all ceramic thickness groups. There was a non-significant difference between both cements for all ceramic thickness groups.
- According to our study, it is advisable to use vita Suprinity veneers with a thickness of only 0.5 mm to mask a C4 background for the sake of conservation.

## RECOMMENDATIONS

- A wider range of ceramic materials with different translucencies and darker substrates (like CoCr - titanium) should be considered in future studies.
- Cement shade definitions are not universal and considered material-dependent, so further studies using different cement brands with a wider range of shades are advisable.

## REFERENCES

1. Blatz M, Chiche G, Bahat O, Roblee R, Coachman C, Heymann H: Evolution of Aesthetic Dentistry. J Dent Res 2019; 98(12):1294-1304.
2. Jafri Z, Ahmad N, Sawai M, Sultan N, Bhardwa A: Digital Smile Design-An innovative tool in aesthetic dentistry. J Oral Bio Cranio Res. 2020; 10 (2):194-8.
3. Quadros G, Sugandhan S, Deepak B, Basappa N, Raju O, Shagale A: Objective comparison of three different treatment modalities in the esthetic improvement of mild-to-moderate dental fluorosis: A randomized clinical trial. IJOHS. 2021; 11(1): 48-54.
4. Çakmak G, Donmez M, Kashkari A, Johnston W, and Yilmaz B: Effect of thickness, cement shade, and coffee thermocycling on the optical properties of zirconia reinforced lithium silicate ceramic. J Esthet Restor Dent. 2021; 33(8): 1132–8.
5. Sorrentino R, RuggieroG, DiMauro M, Breschi L, Leuci S, Fernando Zarone F: Optical behaviors, surface treatment, adhesion, and clinical indications of zirconia-reinforced lithium silicate (ZLS). J Dent. 2021; 112:103722.
6. Borse S and Chaware S: Tooth shade analysis and selection in prosthodontics: A systematic review and meta-analysis. J Indian Prost Soc. 2020; 20 (2):131-40.
7. Porojan L, Vasiliu R and Porojan S: Masking Abilities of Dental Cad/Cam Resin Composite Materials Related to Substrate and Luting Material. *Polymers* 2022; *14*(3), 364-74.
8. Alayad A, Alqhatani A, Alkatheeri M, Alshehri M, AlQahtani M, Osseil A, Almusallam R: Effects of CAD/CAM ceramics and thicknesses on translucency and color masking of substrates. S D J. 2021; 33(7): 761-8.
9. Begum Z, Chheda P, Shruthi C, and Radhika Sonika: Effect of Ceramic Thickness and Luting Agent Shade on the Color Masking Ability of Laminate Veneers. J Indian Prosthodont Soc. 2014 Dec; 14(Suppl 1): 46–50.
10. Ellakany P, Madi M, Aly N, Al-Aql Z, AlGhamdi M, AlJeraisy A, and Alagl A: Effect of CAD/CAM Ceramic Thickness on Shade Masking Ability of Discolored Teeth: In Vitro Study. Int J Environ Res Public Health. 2021; 18(24): 13359.
11. Bacchi A, Boccardi S, Alessandretti R, Pereira GKR. Substrate masking ability of bilayer and monolithic ceramics used for complete crowns and the effect of association with an opaque resin-based luting agent. J Prosthodont Res 2019; 63:321-6.
12. Carrabba M, Vichi A, Tozzi G, Louca C and Ferrari M: Cement opacity and color as influencing factors on the final shade of metal-free ceramic restorations. J Esthet Restor Dent. 2020;1–7.
13. Mohamed A, Abd-Elghany O and Moselhy S: Color Masking Ability of Three Dental Ceramics with Different Translucencies. ADJ-for Girls, Vol. 9, No. 3, July (2022) — PP. 461: 9.
14. Abo Ria H, Ibrahim R, Taymor M and Rabie Z: Influence of the background color and thickness of zirconia reinforced glass ceramics on the optical properties compared to lithium disilicate glass ceramics. E D J 2019;65: 3607-15.
15. Yildirim B, Recen D and Simsek A: Effect of cement color and tooth-shaded background on the final color of lithium disilicate and zirconia-reinforced lithium silicate ceramics: An in vitro study. J Esthet Restor Dent 2021 Mar; 33(2):380-6

16. Zahran M, Sabbahi D, Abdulgader A, Alrowithi H, Aqely M, Faydhi A and Rushan S: Influence of Background And Cement Shades on The Color of Low-Translucency Lithium-Disilicate Ceramics. Annals of Dental Specialty 2020;8 (2):39-44.
17. Bai X, Yan Y and Li Q: Spectrophotometric evaluation of color errors generated in the visual color duplication procedure for current ceramic veneers. JDS (2021) 16, 145-153. https://doi.org/10.1016/j.jds.2020.06.023.
18. Al Fouzan A, Al-Otaibi H, Labban N, Al Taweel S, Al-Tuwaijri S, AlGazlan A and Tashkandi E: Influence of thickness and background on the color changes of CAD/CAM dental ceramic restorative materials. Mater. Res. Express 7 (2020) 055402.
19. Eladawy M, Ragab M, Gamal M, Azer A, Ashour Y and Taha M: Evaluation of translucency of two types of glass ceramics with different thickness: An in vitro study. Int J Dent Mater 2020; 2(4): 117-121.
20. Tabatabaian F, Sharif M, Massoumi F and Namdari M: The color masking ability of a zirconia ceramic on the substrates with different values. J Dent Res Dent Clin Dent Prospects. 2017; 11(1): 7–13.
21. Tabatabaian, F., Dalirani, S., Namdari, M., 2019: Effect of thickness of zirconia ceramic on its masking ability: an in vitro study. 28(6), 666–671.
22. Chaiyabutr Y, John Kois C, LeBeau D and Nunokawa G: Effect of abutment tooth color, cement color, and ceramic thickness on the resulting optical color of a CAD/ CAM glass-ceramic lithium disilicate reinforced crown. J Prosthet Dent. 2011 Feb;105(2):83-90. doi: 10.1016/S0022-3913(11)60004-8.
23. Zahran M , Sabbahi D , Alghamdi A , Al-Otaibi A , Altaefi B , Baessa L , Bahha L: Influence of Background And Cement Shades on The Color of High-Translucency Lithium-Disilicate Ceramics. 2020 Annals of Dental Specialty Vol. 8; Issue 1. Jan – Mar.
24. Jirajariyavej B, Wanapirom P and Anunmana C: Influence of implant abutment material and ceramic thickness on optical properties. J Prosthet Dent. 2018;119(5):819– 25.
25. Morsy Z, Ghoneim M, Afifi R: Influence of Luting Resin Cement Polymerization Mode and Veneer Thickness on the Color Stability of Feldspathic CAD/CAM Veneers. Alex Dent J 2020; 45(2):111-6.