***Article type**: Original Article*

Assessment of Capability of Lithium Disilicate Glass Ceramics to Reproduce the A2 Shade and to Mask A4 Substrates

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Abstract

Aim: Capability of lithium disilicate glass ceramics to reproduce the A2 shade and to mask A4 substrates.

Materials and Method: 32 lithium disilicate ceramic specimens were classified materials into 8 groups of 4 each. Group I- III high translucency (HT) monolayer discs, group IV- VI had low translucency (LT) monolayer discs, group VII- VIII had medium translucency (MO) bilayer discs. A2 shade tab shade guide (VITA classical A1-D4) was used for CIE L*a*b* measurements of control. Color differences using thresholds was as follows: for imperceptible ($\Delta E < 1.0$), perceptible ($1.0 < \Delta E < 3.3$), and clinically unacceptable ($\Delta E > 3.3$) differences.

Results: ΔE in group IV exhibited highest (9.92±0.21) and group III lowest (8.08± 0.25) value. When the complex was compared to the A4 substrate, significant difference among all groups ($p < 0.05$) was found. ΔE values when the complex was compared to the A2 shade tab, group III exhibited highest (4.82±0.16) and group V lowest (0.72±0.06) value. In groups I specimens had acceptable differences, group II had perceptible differences, group III had perceptible differences, group IV had acceptable differences, group V had imperceptible differences, group VI and VII had acceptable differences and group VIII had imperceptible differences.

Conclusion: Authors suggested to use LT ceramics with less thickness in the range of 0.5 mm- 0.7 mm to mask discoloration.

***Key words:** Ceramics, discoloration, shade*

Introduction

Discoloration of teeth is not uncommon phenomenon. It may be result of traumatic injury or internal resorption.[1] Traumatic injury is usually seen in maxillary anterior resulting from fall, road traffic injury and domestic violence etc.[2] Management of discolored teeth is of paramount importance so as to satisfy the patient and to restore the normal function as well as esthetics.[3] To fulfill the satisfaction level is a biggest challenge for dental surgeon. Tooth colored restoration is needed in anterior region which can mimic natural teeth.[4]

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Patients' awareness and desire to get natural tooth colored restoration contributed to the advancement in the field of all-ceramic restorations. These materials possess higher biocompatibility, longevity and better esthetic properties.[5] These do not require extensive cavity preparation as needed with silver amalgam restorations, so these are conservative in nature. Attempts have been done to improve their physical and mechanical properties by reinforcing these materials with crystalline phases.[6] Lithium disilicate glass ceramics exhibit flexural strength ranging from 350–450 MPa which has been achieved by incorporating 70% lithium disilicate crystals as the crystalline phase. This ensures adequate bonding of material with tooth. Because of its wide range of shades availability, it can be used with anatomical contouring.[7]

Factors such as material type, thickness, type of luting agent used, natural tooth colour and type of ceramic affects the translucency of the ceramic restoration.[8] Off all these, ceramic thickness determines successful shade reproduction.[9] This study was undertaken with the aim to assess the capability of lithium disilicate glass ceramics to reproduce the A2 shade and to mask A4 substrates.

Methodology

In this study lithium disilicate ceramic (IPS e.max Press, shade A2; Ivoclar Vivadent AG, Schaan, Liechtenstein material was used for fabrication of 32 disks of variable thickness, structure and translucency. We classified materials into 8 groups of 4 each. Group I comprised of 0.5 mm thick high translucency (HT) monolayer discs, group II had 0.7 mm thick high translucency (HT) monolayer discs, group III had 1 mm thick high translucency (HT) monolayer discs, group IV had 0.5 mm thick low translucency (LT) monolayer discs, group V had 0.7 mm thick low translucency (LT) monolayer discs, group VI had 1 mm thick low translucency (LT) monolayer discs, group VII had 1 mm thick medium translucency (MO) bilayer discs in combination of 0.3 mm core/0.7 mm veneer and group VIII had 1 mm thick medium translucency (MO) bilayer discs in combination of 0.5 mm core/0.5 mm veneer.

In group I to III, monolayer discs of A2 shade of HT were used and for group IV to VI monolayer discs of A2 shade of LT ceramics were used. The wax patterns were invested with a proprietary IPS e.max Press powder and pressed using a Programat EP 3000 furnace followed by bench-cooling, treatment with 1% hydrofluoric acid for 60 seconds, followed by rinsing and air drying.

In group VII and VIII bilayer discs of A2 shade of MT were used. The first layer was pressed in 2 thicknesses (0.3 or 0.5 mm). The ceramic discs were then covered with veneering ceramic and the firing and layering procedures was done.

After fabrication of specimens, polishing with silicon carbide abrasive papers of varying grit size was performed and with the help of vernier caliper final thickness was assessed. Glazing on one side of specimen followed by firing for one minute at the temperature of 40.3 degree and subsequently drying for 6 minutes was done

A2 shade tab shade guide (VITA classical A1-D4) was used for CIE L*a*b* measurements of control. The values were calculated at the center of its middle third as follows (L* = 74.8, a* = 0.7, b* = 20.0). As per the manufacturer's instructions, dark dentin substrate was simulated with a 4-mm-thick IPS e.max Press ceramic. The CIE L*a*b* color coordinates were calculated with a reflectance spectrometer. Color differences using thresholds was as follows: for imperceptible ($\Delta E < 1.0$), perceptible ($1.0 < \Delta E < 3.3$), and clinically unacceptable ($\Delta E > 3.3$) differences. Results were statistical analyzed using SPSS version 20. (Chicago, IL, USA), with 0.05 value considered significant.

Results

Table I shows that ΔE in A4 substrate were 8.92± 0.51 in group I, 8.16±0.08 in group II, 8.08± 0.25 in group III, 9.92±0.21 in group IV, 8.56±0.45 in group V, 8.70±0.81 in group VI, 9.40±0.64 in group VII and 8.57±0.35 in group VIII. Group IV exhibited highest (9.92±0.21) and group III lowest (8.08± 0.25) value. When the complex was compared to the A4 substrate, significant difference among all groups ($p < 0.05$) was found. ΔE values when the complex was compared to the A2 shade tab was 3.28±0.23 in group I, 3.60±0.12 in group II, 4.82±0.16 in group III, 1.04±0.09 in group IV, 0.72±0.06 in group V, 1.34±0.27 in group VI, 2.90± 0.15 in group VII and 3.24±0.10 in group VIII. Group III exhibited highest (4.82±0.16) and group V lowest (0.72±0.06) value. There was significant difference between all groups except for groups II (3.60±0.12) and

III (4.82±0.16).

Table II shows that in groups I specimens had acceptable differences, group II had perceptible differences, group III had perceptible differences, group IV had acceptable differences, group V had imperceptible differences, group VI and VII had acceptable differences and group VIII had imperceptible differences.

Table I ΔE values in comparison to the A4 substrate and the A2 VITA shade tab

Groups	A4 substrate	A2 VITA shade tab
	Mean± SD	Mean± SD
Group I	8.92± 0.51	3.28±0.23
Group II	8.16±0.08	3.60±0.12
Group III	8.08± 0.25	4.82±0.16
Group IV	9.92±0.21	1.04±0.09
Group V	8.56±0.45	0.72±0.06
Group VI	8.70±0.81	1.34±0.27
Group VII	9.40±0.64	2.90± 0.15
Group VIII	8.57±0.35	3.24±0.10

Table II ΔE values based on colour threshold

Groups	ΔE < 1 Imperceptible	1 < ΔE < 3.3 Perceptible	ΔE > 3.3 Clinically unacceptable
Group I	0	2	1
Group II	0	0	3
Group III	0	0	3
Group IV	1	2	0
Group V	3	0	0
Group VI	0	3	0
Group VII	0	3	0
Group VIII	0	1	2

Discussion

Restoration of discolored tooth structures in anterior teeth region needs selection of appropriate materials which can maintain the esthetics.[10] It is found that lithium disilicate glass-ceramics have a needle-like crystal structure that offers excellent optical properties.[11] In this study we assessed the capability of lithium disilicate glass ceramics to reproduce the A2 shade and to mask A4 substrates.

We took lithium disilicate ceramic material for fabrication of 32 disks of variable thickness, structure and translucency. We classified materials into 8 groups of 4 each where specimens from group I to III were of high translucency (HT) monolayer discs, group IV to VI had low translucency (LT) monolayer discs and group VII and VIII had medium translucency bilayer discs.

In this study we found that Group IV exhibited highest ΔE (9.92±0.21) and group III lowest (8.08± 0.25) ΔE value. A significant difference among all groups ($p < 0.05$) was found when the complex was compared to the A4 substrate.

Iravani et al[12] evaluated lithium disilicate ceramics to reproduce the A2 shade and to mask A4 substrates using 24 discs of different translucency ie. high, low and bilayer discs translucency. Results showed significant difference between groups regarding A4 substrate and the A2 shade. The ΔE values in all groups were in the non-acceptable range when compared to A4 substrate. When compared with the A2 shade, the ΔE values in all groups, except groups 2 and 3, were in the clinically acceptable range.

We found that ΔE values when the complex was compared to the A2 shade tab, group III exhibited highest (4.82±0.16) and group V lowest (0.72±0.06) value. There was significant difference between all groups except for groups II (3.60±0.12) and III (4.82±0.16). Dede et al[13] assessed the effect of composite resin foundation (CRF) and resin cement materials on the color of lithium disilicate ceramics with 20 medium-opacity and high opacity disks, 5 CRF disks in A1, A2, A3, B2, C2 shades and 30 resin cement disks translucent, universal, and white-opaque shades. It was found that CRF shades, resin cement materials affected the ΔE 00 values and s significant difference was observed (P<.05). Type of ceramic did not affect the ΔE 00 values. Wo cement groups had 1.73 to 2.96 ΔE 00 values which was higher than other cement shades with 0.88 to 1.29 values for each ceramic type and CRF shade.

We found that in groups I specimens had acceptable differences, group II had perceptible differences, group III had perceptible differences, group IV had acceptable differences, group V had imperceptible differences, group VI and VII had acceptable differences and group VIII had imperceptible differences. Basso et al[14] assessed the masking ability and translucency of monolithic and bilayer CAD-CAM ceramic structures and found that higher translucency and the ΔE_{00} values resulted from the thinner lithium disilicate layer. The effect of ceramic thickness on both translucency and masking ability was more pronounced for the monolithic structures. Result showed that monolayers showed more color variation than their bilayer counterparts. The metallic background produced greater ΔE_{00} than the C4-shaded substrate.

Pande and Kolarkar[15] found that the best shade reproduction of LT IPS e.max was found in MO and high-opacity groups.

The shortcoming of the present study is small sample size.

Conclusion

Authors suggested to use LT ceramics with less thickness in the range of 0.5 mm- 0.7 mm to mask discoloration.

Ethical Clearance- Taken from. Government Dental College and Hospital

Committee, Kadapa, Andrapradesh..

Source of Funding- Self

Conflict of Interest - nil

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