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Color and Translucency of Repressed Lithium Disilicate Subjected to Multiple Firings and Aging

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ABSTRACT

Purpose: The objective of this study is to evaluate the effect of multiple firings (2 & 4) and aging on color and translucency of repressed (three times) lithium disilicate (IPS e.max press)

Materials and methods: A total of 84 discs (15 mm diameter x 1 mm thickness) were fabricated using heat pressed technique. They were divided into three main groups according to number of pressing: **Group I :** IPS e.max lithium disilicate was pressed once (n=28). **Group II :** IPS e,max lithium disilicate was pressed twice (n=28) **.Group III:** IPS e.max lithium disilicate was pressed thrice (n=28) .Each main group was subdivided into 2 subgroups according to number of firing cycles:**Subgroup A:** 2 firing cycles (n=42) **Subgroup B:** 4 firing cycles (n=42). And then all specimens were subjected to thermocycling (10000 cycle) . Color and translucency were evaluated by spectrophotometer three times. 1st after pressing and repressing to evaluate the effect of repressing , 2nd after the firing cycles to evaluate the effect of multiple firings ,3rd after aging to evaluate the effect of aging.

Results of this study showed that third press showed the statistically significantly highest mean ΔE while the first press showed the statistically significantly lowest mean ΔE. The mean ΔE after two firing cycles showed statistically significantly lower value than four firing cycles. There was a statistically significant increase in mean ΔE after aging. First press showed the statistically significantly highest mean TP while Third press showed the statistically significantly lowest mean TP . The mean TP after two firing cycles showed statistically significantly higher value than four firing cycles. There was a statistically significant decrease in TP after aging.

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Conclusion : Third press group after aging showed clinically unacceptable results. More research is required on third press group to be used as a core material.

1.Introduction

Nowadays, the use of dental ceramics has become tremendously popular owing to their biocompatibility, high mechanical properties in addition to their exceptional outstanding esthetics as they have the ability to produce life-like restorations that mimic the natural teeth. Dental ceramics, thanks to their properties, have a wide range of indications for example; partial coverage restorations, crowns, three-unit bridges to full arch bridges and denture teeth.

A wide range of ceramic materials and systems are now available for the fabrication of all-ceramic restorations. Among these systems is the heat pressing technology. It promotes better marginal adaptation, better crystalline dispersion, less porosity in addition to its simplicity if compared to other fabrication techniques. IPS e.max press is one of the heat pressable glass ceramics that are mostly used nowadays. It is a lithium disilicate heat-pressed glass ceramic material that consists of 70 % lithium disilicate crystals embedded in a glassy matrix .It has high mechanical, physical properties and high translucency that allows its use without a veneering material and in construction of minimal invasive restorations as mini-veneers ,veneers, onlays ,inlays ,anterior and posterior crowns and three-unit bridges. IPS e.max press is supplied from the manufacturer in the form of ingots. After the pressing procedure, the remaining parts (buttons) and sprues are discarded but this leads to massive amount of leftover material as sometimes an ingot is used to fabricate only a single restoration. So, for economical reasons and for protection of the natural resources from depletion, many laboratories nowadays tend to reuse this leftover material.

Nowadays, construction of restorations that mimic natural teeth in color and translucency is a great challenge as there are many factors that affect the final shade of the all-ceramic restoration. Among these factors: number of firing cycles, firing temperature , surface glaze [1] structure of the ceramic material, surface finishing protocols, stains, the resin cement used in addition to amount, size, the fabrication techniques[2] and different surface treatment [3] and distribution of porosity [4;5] affect the translucency and color of lithium disilicate ceramics.

Ozturk et al in 2008 [6] evaluated the effect of different thicknesses and repeated firings on color of IPS e.max press and DC-Zirkon . 3,5,7,9 firing cycles were performed and then color was compared to the initial color. Spectrophotometer (vita easyshade) was used to measure color differences. It was found that there were significant changes as the number of firings increased.

Zaghloul et al in 2013 [7] appraised the effect of repeated pressing on color and translucency in addition to surface roughness of IPS e.max zirpress, IPS Empress Esthetic and IPS e.max press. Results revealed that L* and a* values were significantly decreased after repressing while b* and C*ab values were increased. Translucency of e.max zirpress after repressing was significantly decreased while there was non-significant decrease in that of IPS Esthetic press and IPS e.max presses.

El-Etreby in 2017 [8] assessed the effect of repeated pressing and glazing on color, translucency and surface roughness of IPS e.max Press. Results revealed that regarding color, translucency and surface roughness, there was no significant difference between pressed and repressed group but there was significant difference between unglazed and glazed ceramics.

Alp et al in 2018 [3] evaluated the influence of surface treatments and thermocycling in coffee on color and translucency of CAD/CAM glass ceramics (lithium disilicate glass ceramic and zirconia- reinforced lithium silicate glass ceramic). Specimens were exposed to thermocycling (5000 cycles) in coffee. Color coordinates were measured

by spectroradiometer before and after thermocycling. It was concluded that color changes after coffee thermocycling were not perceivable in all groups except for lithium disilicate-polished group. Also, translucency of both materials decreased after thermocycling.

The purpose of this study is to evaluate the effect of multiple firings (2 & 4) and aging on color and translucency of repressed (three times) lithium disilicate (IPS e.max press)

2. Materials and methods :

Wax discs (1mm thickness X15 mm diameter) were constructed by using a Teflon mold. Spruing, investing, preheating, pressing procedure using LT A1 ingots, divesting, finishing and polishing were done to construct the discs of the 1st press group. Then, leftover buttons of the 1st press group were adjusted to be used in construction of the discs of the 2nd press group. Then, leftover buttons of the 2nd press group were adjusted to be used in construction of the discs of the 3rd press group. Color and translucency were evaluated using spectrophotometer to assess the effect of repressing.

Half of the specimens of each group was then subjected to two firing cycles (simulating staining technique) and the other half was subjected to four firing cycles (simulating layering technique). Color and translucency were evaluated using spectrophotometer to assess the effect of number of firing cycles.

After that, all specimens were subjected to 10000 cycles of thermocycling (equivalent to one year intra-orally). Color and translucency were evaluated using spectrophotometer to assess the effect of aging.

3.Statistical analysis

Numerical data were explored for normality by checking the distribution of data and using tests of normality (Kolmogorov-Smirnov and Shapiro-Wilk tests). All data showed parametric distribution. Data were presented as mean, standard deviation (SD) and 95% Confidence Interval for the mean (95% CI) values.

The significance level was set at $P \leq 0.05$. Statistical analysis was performed with IBM*® SPSS**® Statistics Version 20 for Windows.

4.Results

Regardless of firing cycles and aging; third press showed the statistically significantly highest mean ΔE.

Regardless of pressing and aging; the mean ΔE after two firing cycles showed statistically significantly lower value than four firing cycles.

Regardless of firing cycles and pressing; there was a statistically significant increase in mean ΔE after aging.

Bar chart representing mean and standard deviation values for ΔE before and after aging with different interactions of variables

5.Discussion:

Third press showed the statistically significantly lowest mean TP. This results don't coincide with **Zaghloul et al** [7] **and El-Etreby** [8] as no statistical significant difference in mean ΔE and mean TP was found between the pressed and the repressed group. This could be justified as repeated heat pressing lead to significant influence on the microstructure of lithium disilicate glass ceramic and produced blunt rod-like shape, larger grains (Ostwald ripening: this occurs when the microstructure coarsens and liberates free surface energy due to solubility of small particles) and orientation of the crystals . This microstructure of wider crystal size and sparser crystal distribution after repeated pressing suggest that the intergranular crack can propagate more easily through the residual glass matrix [3;9] .

Regarding the effect of number of firing cycles, regardless of pressing and aging; the mean ΔE after two firing cycles showed statistically significantly lower value than four firing cycles. This results coincides with

Uludag et al [10] **and Ozturk et al** [6] as they attributed the increase in color difference as the number of firing cycles increased to the color instability of metal oxides after exposure of the ceramics to firing temperatures. Regarding the translucency, the mean TP after two firing cycles showed statistically significantly higher value than four firing cycles. This results don't coincide with **Bayindir et al** [11] and **Li S et al** [12] As their studies proved that the increase in number of firing cycles lead to an increase in translucency owing to the decrease in the total opening pore volume.

Regarding the effect of aging (thermocycling), regardless of firing cycles and pressing; there was a statistically significant increase in mean ΔE after aging. Regarding the translucency, there was a statistically significant decrease in TP after aging. These results coincide with **Alp et al** [3] **.**They attributed the increase in color change and the decrease of translucency after coffee thermocycling to the water sorption and surface properties (glazing or polishing) of the lithium disilicate glass ceramic. Also, thermocycling affected surface roughness of ceramic materials [13] that might be the cause of the color change and the decrease of translucency after aging.

6.Limitation of the study:

Further investigations as microstructural analysis and x-ray diffraction should be carried out to evaluate the effect of second and third heat pressing on the crystalline phases of this material. It is recommended in further studies to evaluate the effect of third press (used as a core material) on color and translucency of IPS e.max Press.Furthermore, in vivo studies are indicated to simulate the oral environmental conditions.

7.Conclusions :

Within the limitations of this study the following can be concluded:

Third press group after aging showed clinically unacceptable results. More research is required on third press group to be used as a core material.

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