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Effect of Repeated Heat-Pressing on Color and Translucency of Lithium Disilicate Glass Ceramic Crowns

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ABSTRACT

Purpose: To evaluate the effect of repeated heat-pressing and thermomechanical fatigue on color and translucency of lithium disilicate glass ceramic crowns. **Materials and Methods:** A freshly extracted human maxillary right 1st premolar was prepared according to standardized preparation for all-ceramic crown restoration. The preparation was duplicated to produce thirty epoxy resin dies. The resin dies were divided into three groups (n=10), according to the number of heat-pressings of IPS e.max Press used for crowns construction. **Group 1:** Control group using freshly pressed ingots, **Group 2:** Repressed 1 using leftover repressed buttons for 1st time, and **Group 3:** Repressed 2 using leftover repressed buttons for 2nd time. Thirty IPS e.max Press crowns were fabricated by heat-pressing technique. The constructed crowns were cemented by adhesive resin cement. Color and translucency were measured after cementation by X-Rite Reflective Spectrophotometer. Then samples were subjected to the thermo-mechanical fatigue with a ROBOTA chewing simulator, simulating 6 months chewing conditions. After thermo-mechanical fatigue, color and translucency were measured by X-Rite Reflective spectrophotometer. **Results:** IPS e.max Press showed no statistically significant color change after repressing and thermomechanical fatigue. Regarding translucency, IPS e.max Press showed no statistically significant difference in translucency after repressing, however, there was a statistically significant decrease in translucency after thermomechanical fatigue. **Conclusions:** Repressing and thermomechanical fatigue have no significant effect on color of IPS e.max Press crowns. Repressing has no significant effect on translucency, however, thermomechanical fatigue has a significant effect on translucency of freshly pressed and repressed e.max Press crowns.

KEYWORDS

Lithium disilicate, Repressing, Color, Translucency, Thermomechanical fatigue.

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INTRODUCTION

Recently, the use of dental ceramics has become most popular owing to their biocompatibility, high mechanical properties, in addition to their exceptional outstanding esthetics; as they can produce life-like restorations that mimic the natural teeth. Dental ceramics offer a wide choice of applications due to their properties; for example, partial coverage restorations, crowns, three-unit bridges to full arch bridges and denture teeth[(1)].

For the fabrication of all ceramic restorations, a wide choice of ceramic materials and systems are currently available. One of them is the heat-pressing technique; it provides better marginal adaptation, better crystalline dispersion, less porosity in addition to its simplicity if compared to other fabrication techniques [(2)].

In 2005, IPS e.max press, a novel pressable lithium-disilicate glass ceramic with increased mechanical properities and superior translucency, was released to achieve durability with superior esthetics[(3)]. It is supplied in the form of ingots, sometimes one ingot is used to fabricate only a single restoration; thus, a large amount of leftover material (i.e., remaining part of the ingot; button and sprue) will be discarded. Therefore, for economic reasons and for protection of the natural resources from depletion, recently many laboratories tend to reuse this leftover material.

One of the most critical factors influencing the success of dental restoration is color. The International Commission of I'Eclairage (CIE) has developed a number of methods for numerically expressing the spectral curves to increase the accuracy of color reading of an object. color space CIE L*a*b* is the method that is used in dentistry. Color space is measured and expressed in term of three coordinate value (L*, a*, b*) that identify the color of an object within the CIELAB color space. Color brightness is represented by the L* coordinate, which is ranging from white to black.The lighter the specimen, the larger the L*. The chromaticity of the color along the red-green axis is represented by the a* coordinate; a positive a* corresponds to the degree of redness, while a negative a* corresponds to the degree of greenness in a specimen. The b* coordinate, also representing the chromaticity of the color but along the blue to yellow; a positive b* corresponds to the degree of yellowness, while a negative b* corresponds to the degree of blueness of the specimen [(4)].

Translucency of ceramics is extremely important as it gives a life-like appearance. Translucency is strongly affected by scattering of light. Many factors influence the light scattering, including refractive indices among ceramic phases, the presence of voids and porosities, high crystalline content, and the quantity and size of crystal, espcially when the crystal particles are slightly larger than the incident light'wavelength [(5)].

Translucency parameter (TP) or the contrast ratio (CR) are commonly used to determine the translucency of esthetic restorative materials. Becuause the TP is defined as the color difference of a material of a certain thickness over a white and black background, it was created to link the human visual perception to the translucency. A high TP value denotes high translucency and low opacity [(6,7)].

In 2017, the effect of repressing and glazing on the color reproduction, translucency, and surface roughness of lithium dslilicate glass-ceramics (IPS e.max Press) was studied. It was stated that significant difference was found between glazed and un-glazed ceramics, and no statistically significant difference was found between Pressed and repressed groups. It was concluded that the IPS e.max Press leftover pressed buttons can be safely reused with no significant effect on color, translucency, and surface roughness while glazing is critical to increase color reproduction, translucency and decrease surface roughness of IPS e.max Press[(8)].

In 2018, the effect of number of firing cycles and aging on color and translucency of repressed lithium disilicate glass ceramic was studied. The result showed that the number of firing cycles and thermocyclying aging had an effect on the color and translucency of repressed lithium disilicate glass ceramic[7].

Also, in 2020, the effect of repressing of lithium disilicate glass ceramic with different weight percentages on color, translucency and bond strength with veneering material was investigated. It was concluded that the mix of new ingot with repressed ceramic was in the clinical acceptance range as regard ΔE, however, the 100 % re-pressing of ceramic could affect the final color. Ceramic repressing had no significant effect on translucency. Weight percentage of repressed ceramic had a negative effect on bond strength to veneering material[2].

Moreover, in 2021, the impact of repressing on color and translucency of lithium disilicate glass ceramic (IPS e.max Press) was studied. It was concluded that repressing IPS e.max resulted in a significant color difference which was beyond the clinically detectable limit (ΔE) selected in the study. Moreover, repressing IPS e.max press resulted in significant translucency changes[9].

Only a few studies have looked into the effect of repressing the leftover on color and translucency, therefore, this study was aimed to study the effect of repeated heat pressing and thermomechanical fatigue on color and translucency of lithium disilicate glass ceramic crowns. The null hypothesis was that IPS e.max Press could be repressed and reused several times without adversely affecting its color and translucency.

MATERIAL AND METHOD

To study the effect of repressing on color and translucency, a total sample size of 30 (10 in each group) was sufficient to detect an effect size approximately 0.60, with a power (1-β error) of 0.8 (80%) using a two-sided hypothesis test, with a significance level (α error) 0.05 for data [8].

A freshly extracted human maxillary right 1st premolar with completed roots, free of caries, fractures and cracks was selected for this study. Ethical approval for the use of extracted human teeth was obtained in accordance with guidelines from Research Ethic committee (code:REC-CR-21-03) Approval of Faculaty of Dental Medicine for Girls Al-Azhar University. The selected premolar was cleaned, disinfected, and kept hydrated at room temperature in distilled water. A plastic cylinder (2cm height and 1.5cm diameter) was used as a mold for constructing epoxy resin block (East coast, USA). The inner wall of the cylinder was painted with a separating medium (Acrostone, Egypt). The premolar was aligned to be parallel to the outer surface of the plastic cylinder by using milling surveyor (BEGO PARASKOP M, Germany). Epoxy resin polymer and monomer (2:1) were mixed according to manufacturer instructions, then poured into the plastic container. The tooth was mounted vertically in the epoxy resin block to a level of 2mm apical to the buccal cemento- enamel junction marked on the root surface simulating the natural biologic width. The tooth was prepared using a dental surveyor and milling machine (BEGO PARASKOP M, Germany) by using tapered diamond stone with round end 1.8 mm (no.856L-018-018, Brasseler, USA)) to receive a lithium disilicate posterior crown (1.5 mm anatomical occlusal and axial reduction with deep chamfer finish line of 1mm depth placed coronal to the cervical line by 0.5mm) [10]. Sharp corners, edges and internal angles were avoided by using yellow finishing stone (Dentsply, Maillefer, Switzerland).

Thirty impressions of the prepared tooth were taken using condensation silicon- based rubber impression material (Zetaplus, Zhermack, Italy) in plastic cylinders (2cm height and 1.5cm diameter) to produce thirty molds. Epoxy resin (Crystal Clear Epoxy Resin, East Coast Resin, USA) was mixed following manufacturer's instructions with a ratio of (2 polymer: 1 monomer). The molds were left undisturbed for 24 hours till complete setting of epoxy resin. After 24 hours, the thirty epoxy resin dies were separated from the molds and became ready for construction of thirty all ceramic crown restorations. The constructed epoxy resin dies (N=30) were divided into three groups (N=10) according to the number of heat-pressings of IPS e.max Press material used for crowns construction. Group (1): Control group using freshly pressed ingots, Group (2): Repressed 1 using leftover repressed buttons for 1st time, and Group (3): Repressed 2 using leftover repressed buttons for 2nd time.

To standardize the constructed crowns among all groups, the design used for the construction of CAD/CAM wax patterns for the control group (Group 1) was followed during the construction of wax patterns for the tested groups (Group 2 and Group 3). A desktop computer connected to DOF swing Dental Scanner (Structured light tech., South Korea), Exocad (Exocad GmbH, Darmstadt, Germany) computer software that is responsible for designing the restoration then imports an STL file to the milling machine, a 5-axis CAD/CAM Roland machine (Roland DWX-52D) was used for indirect fabrication of crowns' wax patterns (DWAX-W14 CO Korea).

All milled wax patterns were tried over their corresponding duplicated dies to check for accuracy, fit and marginal adaption. The milled crowns were handled gently to avoid distortion and any defective wax pattern was discarded.

All wax patterns were sprued and invested following manufacturer's instructions with BEGO Bellavest (Begosol, BEGO Co, Germany). The investment was set for an hour before starting wax elimination. Wax elimination was performed with wax burn out furnace (Ney,US Dental Depot, USA) according to the manufacturer's recommendation. The crowns were pressed following manufacturer's recommendations in a EP600 press furnace (Ivoclar, Schaan, Liechtenstein, Germany) by using new IPS emax ingots following manufacturer's instruction. The investment ring was removed from the furnace immediately after the program was completed. The investment ring was left to cool at room temperature for about 60 minutes on a wide-meshed grid (IPS e.max cooling rack, Ivoclar, Schaan, Liechtenstein, Germany) which insured quick and even cooling of the investment ring. Crowns were retrieved from the investment ring using a disc (Ivoclar, Schaan, Liechtenstein, Germany) mounted on straight hand piece. Rough divestment was carried out with polishing beads (Ivoclar, Schaan, Liechtenstein, Germany) at 4 bar (58 psi) pressure, maintaining a safe distance to avoid damage of the freshly pressed restoration. Once the crowns were exposed, fine divestment was carried out with polishing beads at 2 bar (29 psi) pressure. The pressed crowns were immersed in Invex liquid (Ivoclar, Schaan, Liechtenstein, Germany) (1% hydrofluoric acid) for 30 minutes to remove the reaction layer of the investment, then rinsed under running water and dried. After that, crowns were blasted with glass beads at 2 bar pressures to remove any remaining reaction layer.

The crowns were cut from the sprues and the remaining buttons from the pressing process by using a disc; the sprues were discarded, and the buttons were kept for further use. The buttons were finished and adjusted in a way to resemble the shape of a new IPS e.max Press ingot using diamond discs and stones (Ivoclar Vivadent, Schaan, Liechtenstein). All the previously mentioned steps were carried out again using the trimmed leftover buttons to produce 1st time-repressed crowns (Group 2). Then the leftover buttons produced from the repressed crowns (Group 2) were trimmed and reused to produce the repressed crowns for the second time (Group 3).

IPS e.max Press crowns of all tested groups were finished then glazed according to the manufacturer's instructions. Finished crowns were inspected and checked over their corresponding dies for marginal accuracy and proper seating by using digital video microscope (EASY view 3D, Renfert, Germany), and any defective restoration was discarded.

Cementation procedure was followed according to the manufacturer recommendations. Hydrofluoric acid gel (5% IPS Ceramic Etching Gel, Ivoclar Vivadent, Liechtenstein, Germany) was applied to the fitting surface of each crown for 20 seconds, rinsed thoroughly and air dried. Porcelain primer was applied to the fitting surface of each crown using a micro brush (JAAN MED co, China) for 60 seconds then air dried. Aureocem NE; a dual -curing self adhesive resin cement (Promedica, Germany) was applied into the fitting surfaces of the crowns via the auto-mix syringe and every crown was seated on its corresponding die with gentle finger pressure and any excess cement was removed with a scaler after brief polymerization for 2 seconds according to manufacturer instructions. Glycerin gel was applied along the cemented crown margins to eliminate oxygen-inhibition layer. Cemented crowns were subjected to a fixed load of (3Kg) using a custom made load applicator. The cement was cured for 20 seconds per surface using light curing device(SDI, Australia) [11].

Measuring color and translucency after cementation:

- ***Color measurement***

The samples' color of the three tested groups was measured using a portable reflective spectrophotometer (X-Rite, model RM200QC, Neu-Isenburg, Germany). The aperture size was set to 4 mm and the samples were exactly aligned with the device. The measurements were performed at the middle third of the buccal surface of each sample over a white background. Three measurements were determined for each crown and an average was calculated[12], the measurements were made according to the CIE L*a*b* color space relative to the CIE standard illuminant D65. The color changes (ΔE) of the specimens were evaluated using the following formula [13]:

$\Delta E_{CIELAB} = (\Delta L^*2 + \Delta a^*2 + \Delta b^*2)$ ½, where:

L* = lightness (0-100).

a* = (change the color of the axis red/green).

b* = (color variation axis yellow/blue).

- ***Translucency measurement***

The samples' translucency of the three groups was measured using a reflective spectrophotometer (X-Rite, model RM200QC, Neu-Isenburg, Germany). The aperture size was set to 4 mm and the samples were exactly aligned with the device. The measurements were performed at the middle third of the buccal surface of each sample over a white and black background, and then they were kept in the same position for the two measurement. Three measurements were determined for each crown and an average was calculated [12].

The translucency parameters (TP) values were obtained by calculating the color difference of the samples over black and white backgrounds by using the following equation [14].

$TP= [(L_b^* - L_w^*)^2 + (a_b^* - a_w^*)^2 + (b_b^* - b_w^*)^2]^{1/2}$,

where letters "b" and "w" refer to color coordinates over the black and white backgrounds.

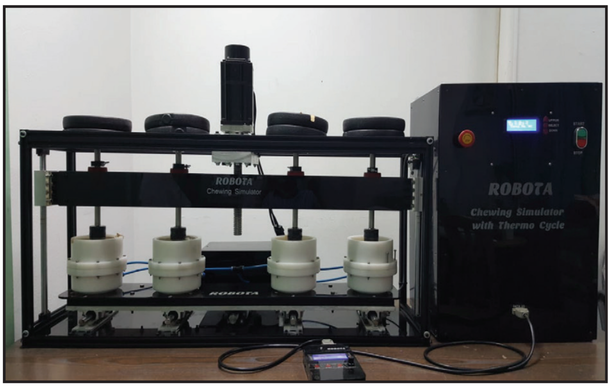
Thermomechanical fatigue:

Samples of the three tested groups were subjected to thermomechanical fatigue using a programmable logic-controlled equipment ROBOTA chewing simulator (Robota, AD-TECH Technology CO., Germany) integrated with thermocycling protocol operated on servomotor (Fig.1).

ROBOTA chewing simulator has four chambers simulating the vertical and horizontal movements simultaneously. Each chamber consists of an upper Jackob's chuck as hardened steel antagonist holder that can be tightened with a screw and a lower plastic sample holder in which the sample can be embedded. The procedure included the application of a weight of 5Kg, comparable to 49 N of chewing force, in the center of the occlusal surface for 75000 cycles to clinically simulate 6 months chewing conditions. Simultaneously, samples were subjected to thermocycling between 5-55 ^{0}C with a dwell time of 60 seconds [15]. All Chewing parameters used are presented in Table (1). After thermomechanical fatigue, color and translucency of samples of the three groups (1, 2 and 3) were measured. The values were compared among all groups before and after thermomechanical fatigue.

Table (1) *Chewing simulator (ROBOTA) parameters:*

Cold/hot bath temperature: 5 - 55˚C	Dwell time: 60s
Vertical movement: 2 mm	Horizontal movement: 3 mm
Rising speed: 90 mm/s	Forward speed: 90 mm/s
Descending speed: 40 mm/s	Backward speed: 40 mm/s
Cycle frequency: 1.6 Hz	Weight per sample: 5 kg
Torque: 2.4 N.m	



Figure(1) ROBOTA chewing simulator.

Statistical analysis and data interpretation:

The mean and standard deviation values were recorded for each group in each test. Data were investigated for normality using Shapiro-Wilk tests, data showed parametric (normal) distribution. One-way ANOVA followed by Tukey post hoc test was used for pairwise comparison. Paired t-test was used to compare before and after themomechanical fatigue in the same group. The significance level was set at P≤0.05. Statistical analysis was performed with IBM® SPSS® Statistics Version 20 for Windows.

RESULTS

First: Color change (ΔE)

- ***Effect of repeated heat pressing on color change:***

There were no statistically significant differences (P<0.05) between (ΔE 1) (difference between group 1 and group 2) (3.29±0.45), (ΔE 2) (difference between group 1 and group 3) (3.31±0.39), and (ΔE 3) (difference between group 2 and group 3) (3.22±0.58) as shown in table(2) and (Fig.2).

Table (2) *Mean values and SD of (ΔE) between tested groups:*

ΔE	ΔE 1	ΔE 2	ΔE 3
Mean	3.29	3.31	3.22
SD	0.45	0.39	0.58
P- Value		0.901	

SD= Standard deviation P= Probability

- ***Effect of thermomechanical fatigue on color change:***

There were no statistically significant difference (P<0.05) between (ΔE 1) (difference between group 1 before and after thermomechanical fatigue) (3.64±0.57), (ΔE 2) (difference between group 2 before and after thermomechanical fatigue) (3.48±0.46), and (ΔE 3) (difference between group 3 before and after thermomechanical fatigue) (3.71±0.38) after thermomechanical fatigue as shown in table (3) and (Fig.2).

Table (3) *Mean values and SD of (ΔE) after thermomechanical fatigue.*

ΔE	ΔE 1	ΔE 2	ΔE 3
Mean	3.64	3.48	3.71
SD	0.57	0.46	0.38
P-Value		0.53	

SD= Standard deviation P= Probability

Second: Translucency Parameter (TP)

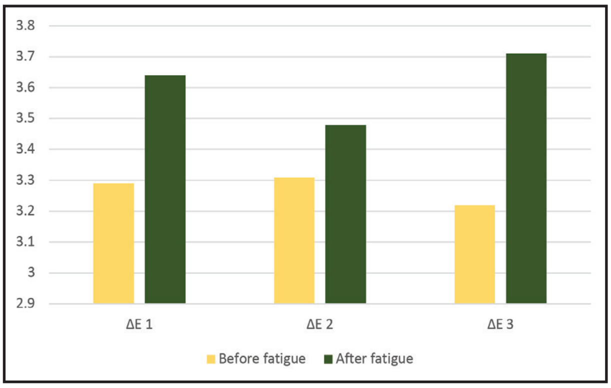


Figure (2) Column chart of color change (ΔE) mean values between the tested groups before and after thermomechanical fatigue.

- ***Effect of repeated heat pressing on translucency parameters:***

There were no statistically significant differences (P<0.05) between (Group 1) (7.55±0.91), (Group 2) (6.77±1.51), and(Group 3) (6.57±0.86) as shown in table (4) and (Fig.3).

Table (4): *Mean values and SD of translucency parameter (TP) for the tested groups.*

Groups	Group 1	Group 2	Group 3
Mean (TP)	7.55	6.77	6.57
SD	0.91	1.51	0.86
P- Value		0.142	

SD= Standard deviation

P= Probability

- ***Effect of thermomechanical fatigue on translucency parameters:***

There were no statistically significant differences (P<0.05) between (Group 1) (5.10±0.4), (Group 2) (4.86±0.49), and (Group 3) (4.85±0.51) after thermomechanical fatigue as shown in table (5) and (Fig.3).

Table (5): *Mean values and SD of translucency parameter (TP) for the tested groups after thermomechanical fatigue.*

Groups	Group 1	Group 2	Group 3
Mean (TP)	5.10	4.86	4.85
SD	0.49	0.499	0.51
P- Value		0.462	

SD= Standard deviation

P= Probability

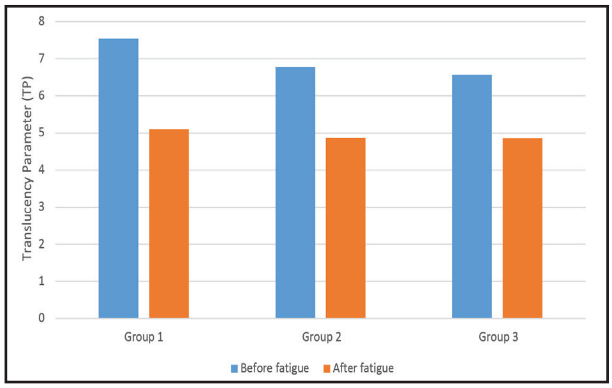


Figure (3) Column chart of translucency parameter (TP) for the tested groups before and after thermomechanical fatigue.

- ***Comparison of translucency parameter before and after thermomechanical fatigue within each group:***

There were a statistically significant decrease in translucency after thermomechanical fatigue in all groups. In Group (1), the TP decreased from (7.54±0.91) to (5.10±0.491) with 32.4 %. In Group (2), the TP decreased from (6.77±1.51) to (4.86±0.499) with 20.6%. In Group (3), the TP decreased from (6.57±0.86) to (4.85±0.51) with 26.2% as shown in table (6) and (Fig.3).

Table (6): *Mean values of translucency parameter and SD before and after thermomechanical fatigue in all studied groups.*

	Before thermomechanical fatigue.		After thermomechanical fatigue		P- Value	Percentage of change
Groups	**Mean**	**SD**	**Mean**	**SD**		
Group 1	7.54	0.91	5.1	0.49	p<0.001*	32.40%
Group 2	6.77	1.51	4.86	0.499	p=0.008*	20.60%
Group 3	6.57	0.86	4.85	0.51	p<0.001*	26.20%

SD= Standard deviation

P= Probability

DISCUSSION

Recently, fabrication of restorations that exactly mimic the natural teeth in color and translucency is a great challenge due to the presence of many factors that may have an effect on the final color of all-ceramic restoration; abutment shade, firing temperature, number of firing cycles, microstructure of the ceramic material, finishing protocol, amount, size, and distribution of the porosity [16].

Heat pressing technology has become a common technique to fabricate glass-ceramic restorations due to its simplicity, better crystalline dispersion in the glassy matrix, better marginal adaptation, and less porosity if it is compared with the sintering technique [8]. IPS e.max Press was selected to be used in this study because of its high esthetic and mechanical properties. It is composed of 70 % lithium disilicate crystals in a glassy matrix [8].

This study was conducted to focus on the effect of repeated heat pressing on color and translucency of IPS e.max Press. Color and translucency were measured at two stages; first after pressing and repeated pressing procedures, second after thermomechanical fatigue.

Color was evaluated using X-Rite spectrophotometer that depend on CIE L*a*b* color order system. The arrangement of of the CIE lab color system as an approximately homogenous three-dimensional color space is its most important feature. CIE lab color difference formula provides numerical data (ΔE) that describes the magnitude of color difference between two objects. CIE lab units are uniformly spaced in terms of visual perception, allowing spectral readings to be associated with subjective observations, which is an advantage over the Munsell system (hue, chroma, and value) [4].

Translucency parameter (TP) is commonly used to determine the translucency of esthetic restorative materials. Instead of contrast ratio (CR), the translucency parameter(TP) was used since it conforms to standard visual assessment of translucency. When materials have large scattering and absorption coefficients , the contrast ratio (CR) measures diffuse reflectance and does not detect minor changes in light transmission [7,17].

Thermomechanical fatigue might result in a significant clinical changes; the intraoral environment was simulated by exposing the samples to artificial thermodynamic fatigue to evaluate its influence on color and translucency over a period of time.

Based on the results of the present study, IPS e.max Press showed no significant color change after repressing and thermomechanical fatigue. Regarding translucency, IPS e.max Press showed no significant decrease in translucency after repressing, however, IPS e.max Press showed statistically significant decrease in translucency after thermomechanical fatigue.

Regarding the effect of repressing, there were no statistically significant differences between (ΔE1) (3.29±0.45), (ΔE2) (3.31±0.39), and (ΔE3) (3.22±0.58) as shown in Table (2). Regarding the translucency there were no statistically significant differences between (Group 1) (7.55±0.91), (Group 2) (6.77±1.51), and (Group 3) (6.5±0.86) as shown in Table (4). These findings could be explained and supported with SEM presented in previous study[8] which reported that both groups (pressed and re-pressed) were found to be almost free of pores in the surface. This pore-free microstructure was mainly attributed to using only the leftover buttons and not using the leftover sprues. This prevented the trapping of air in-between the repressed material thus producing a repressed ceramic with nearly pore–free structure that is similar to that provided by the manufacturer and was used for the pressed group.

These results also coincide with another study [18] which reported that lithium disilicate was a dominate crystaline phase in the studied lithium disilicate-reinforced glass-ceramic materials, and the quantity of these crystals did not increase after heat-pressing, however, the repressed material'lithium disilicate crystals appeared to be larger than those of the pressed samples. This is known as "Ostwald ripening" and it occurs in all precipitated materials. This behavior occurs when the microstructure is becoming more coarse and liberates surface energy excess as a result of the solubility of small particles, larger grains are projected to form at the expense of those small particles.

On the other hand, these results did not coincide with a previous study [7] in which the number of firing cycles and thermocyclying aging had an effect on the color and translucency of repressed lithium disilicate glass ceramic. By the increase in number of firing cycles, the color change increased, and translucency decreased especially on the long-term evaluation. This might be due to that in the previous study the effect of multiple firing cycles and thermocycling aging on color and translucency of IPS e.max Press was studied, however, the effect of repeated heat pressing and thermomechanical fatigue on color and translucency of IPS e.max press was studied in the current study.

However the results of the present study were not in agreement with a previous study which stated that repressing IPS e.max resulted in a significant color difference which was beyond the clinically detectable limit (ΔE = 2.6) selected in the study. Moreover, repressing IPS e.max press resulted in significant translucency changes. This could be due to the use of leftover buttons and sprues during the repressing procedures, however, only leftover buttons were used in the current study[9].

Regarding the effect of aging, the results of the present study showed no statistically significant difference between (ΔE 1) (3.64±0.57), (ΔE 2) (3.48±0.46) and (ΔE 3) (3.71±0.38) after thermomechanical fatigue as shown in Table (3). The recorded (ΔE) for the studied groups were within the clinically accepted range selected in this study (ΔE less than 3.7) [19].

Regarding the translucency, there was a statistically significant difference within each of the test groups before and after thermomechanical fatigue. The translucency was statistically significantly decreased from (7.54±0.91) to (5.10±0.491) in (Group 1), from (6.77±1.51) to (4.86±0.499) in (Group 2), and from (6.57±0.86) to (4.85±0.51) in (Group 3) as shown in Table(6).

These results coincide with a previous study [20], which attributed the decrease in translucency after thermocycling to the water sorption and surface properties of the lithium disilicate glass ceramic, in addition, thermocycling affected surface roughness of ceramic material that might be the cause of the translucency decrease after aging. Moreover, these results coincide with another studies[7,19] which attributed these findings to water penetration inside the rough surface of the material and thus resulted into dissolution of silica network.

Furthermore, these results might be due to the mismatch that occurred between the glassy matrix coefficient of thermal expansion and the crystal contents after thermomechanical fatigue that might have led to formation of thermal stresses at the crystal–matrix contact, resulting in the creation of micro-crack that might have led to decrease in translucency [11].

The highest percentage of change in translucency after thermomechanical fatigue was found in (Group 1) (32.4 %) followed by (Group 3) (26.2%) and (Group 2) (20.6%) as shown in Table (6). These results might be due to the lithium disilicate crystals in the repressed material were larger than the lithium disilicate crystals in the pressed samples[18], this increase in the crystals' size might lead to decrease in the silica network resulting in decreased translucency.

CONCLUSIONS

Within the limitations of this study, repressing has no significant effect on color and translucency of IPS e.max Press crowns.Thermomechanical fatigue has no significant effect on color of IPS e.max Press crowns.Thermomechanical fatigue also negatively affects the translucency of both freshly pressed and repressed e.max Press crowns.

RECOMMENDATIONS

The results of this study may be helpful to dental technologist to avoid the use of left-over buttons of e.max press in constraction of restorations in esthetic area because of the significant decrease in translucency.

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CONFLICT OF INTEREST

There is no conflict of interest declared by authors.

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