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IMPACT OF RECYCLING OF TWO DIFFERENT PRESSED CERAMIC CROWNS ON THE MARGINAL ADAPTATION AND FRACTURE RESISTANCE

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ABSTRACT

Objective: the aim of this study was to impact of recycling of two different pressed ceramic crowns(IPS e.max Press & Celtra Press) on the marginal adaptation and fracture resistance .

Materials and methods: Fifty pressable (50) ceramic crowns with various concentrations were constructed. They were divided into two groups (n=25 in each group) according to the ceramic material construction (E) using IPS e.max Press ceramic blocks and group (C) using Celtra Press ceramic blocks. Then, further subdivided in to five subgroups (n=5 in each subgroup) according to the Wt. % of the virgin ceramic ingots to the repeated heat pressed ceramic. **Subgroup I** is 100 % virgin ceramics. **Subgroup II** is 75 % virgin and 25% repeated heat pressed ceramics. **Subgroup III** is 50 % virgin and 50 % repeated heat pressed ceramics. **Subgroup IV** is 25% virgin and 75% repeated heat pressed ceramics. **Subgroup V** is 100 % repeated heat pressed ceramics. For standardization of the preparation, a Computerized Numerical Control (CNC) Lathe-cut machine was used. Digital scan for the prepared tooth by the scanner. Then, a CAD software and 3D printer were used to print the fifty epoxy dies. Digital stereomicroscope (*Leica Microsystems, Switzerland*) was used evaluated the marginal adaptation at various points. After bonding of ceramic crowns, all samples were subjected to thermocycling (*Proto-tech: Version 2.1a, Portland, Ore.USA*). Then, universal testing machine (*Instron Universal testing machine model 3345, England*) was used for fracture resistance evaluation

Results: Regarding marginal gap of IPS e.max Press subgroups before thermocycling, Subgroup (I) recorded the least marginal gap (27.93 **µm**), while sub group (V) recorded the largest marginal gap (84.14 **µm**). Regarding marginal gap of IPS e.max Press subgroups after thermo-cycling,). Subgroup (I) recorded the least marginal gap (30.54 **µm**), while sub group (V) recorded the largest marginal gap (116.21 **µm**). Regarding marginal gap of Celtra-press subgroups before thermocycling. Subgroup (III) recorded the least marginal gap (23.27**µm**), while sub group (V) recorded the largest marginal gap (45.89 **µm**). Regarding marginal gap of Celtra-press subgroups after thermocycling ,Subgroup (II) recorded the least marginal gap (32.41**µm**), while sub group (V) recorded the largest marginal gap (53.45 **µm**).

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Fracture resistance values of IPS e.max Press Subgroups were greater than recorded for their respective Celtra-press subgroups. Regarding pairwise comparisons there was significant difference between all subgroups

Conclusions: Recycling techniques showed better fracture resistance values than pressable techniques, even if the same material was used. The addition of zirconia to lithium disilicate ceramics did not improve the fracture resistance of celtra press compared to IPS e.max Press .Recycling of Pressable processing techniques showed better vertical marginal gap distance for both ceramic materials used. Thermocycling resulted in significant increase in the vertical marginal gap distance for both ceramic types .

KEYWORDS: Repeated heat pressed ceramics, Recycling, fracture resistance, Marginal Adaptation.

INTRODUCTION

The main types of dental ceramics utilized are glass ceramics, highly compacted alumina, and ceramics based on zirconia. The mechanical properties of glass ceramics might vary due to differences in their composition and microstructure. These structural modifications can occur either in the glass matrix or in the crystalline phase. They include changes in volume percent, crystal size, dispersal, and shape.

For many years, pressable ceramic restorations have been manufactured using a widely used manufacturing technique known as heat pressing. The glass ceramic ingots undergo heating in order to enable the ceramic material to be pressed and flow into a lost wax mold . Lithium disilicate glass ceramics have been developed for the production of full-contour monolithic restorations that may be cemented using adhesive resin cement. These ceramics have proven to be a feasible option in cases where there is increased stress. Zirconia reinforced lithium silicates are a recent advancement in glass ceramics that use polycrystalline ceramics for reinforcement. The fracture resistance of lithium silicate ceramic is enhanced by incorporating 10% weight of zirconia, enabling the production of single restorations, veneers, inlays, onlays, and multi-unit bridges.[1-5]

Hot pressing of dental ceramics has become a widely used and straightforward procedure, in comparison to other methods such as sintering. It improves the marginal adaptation and the even distribution of crystals in the glassy matrix. Additionally, reduced shrinkage, porosity, and surface imperfections. [6-12]

Celta press is an innovative technique heat-pressed zirconia-reinforced lithium silicate. This process enhances the strength and esthetics of ceramics by inserting ten percent of dissolved zirconia into the glass matrix. [13-,14]

IPS Empress was introduced as the pioneering heat-pressed glass ceramic material that incorporates leucite ($Si0_2$, Al_20_3, $4K_20$) as its primary crystalline phase. [15-16]

The introduction of IPS Empress2 took place in 1998. The material in question is a lithium disilicate-reinforced glass ceramic ($Li_20S_2Si0_2$) . Based on the scientific data provided by the maker, [17] the predominant crystalline phase in the glass ceramic comprises needle-like crystals, which make up around 60% of the volume. With a strength of around 350 MPa, it can be used for short span fixed partial dentures. In 2005, IPS e.max Press replaced IPS Empress 2 due to its enhanced mechanical qualities and notably greater translucency. [18-20]. The microstructure of the material consists of 70% lithium disilicate crystals that are embedded inside a glassy matrix. The crystals exhibit an acicular form and have a length ranging from 3 to 6 mm.

The IPS E-max Press is offered in ingot form, with two different diameters and a variety of colors and translucencies. The selection process is contingent upon the specific requirements of each clinical scenario. Pressing many restorations from a single ingot simultaneously is a more cost-effective approach. Typically, this is not feasible and might lead to a significant quantity of remaining ceramic material from the removed button and sprue sections. The question arises as to whether the remaining material should be disposed of or re-pressed. Some dental laboratories find these remaining materials valuable for re-pressing due to budgetary considerations. Recycling, in general, is environmentally beneficial. [21-22]. There is currently a lack of adequate scientific proof about the safety of reusing this residue ceramic.

Valid concerns exist regarding the mechanical characteristics of the recycled material for experiments done in clinical research. Despite limited research on re-pressed glass-ceramics, conflicting findings have emerged, controversies were found, leading experts to take opposing positions on the matter. [22]

The primary focus of these investigations was to investigate the flexural strength, translucency, color, microstructure, and X-ray diffraction (XRD) of ceramic discs. No studies were conducted to investigate other mechanical qualities linked to the clinical performance of the restoration, such as marginal gap and fracture strength, in a repair that is already consist of repressed ceramic.

The long-term clinical effectiveness of a dental restoration is determined by various factors, including mechanical, aesthetic, and biological qualities, as well as the marginal fit. Restoration failure is caused by a significant gap between the restoration and the tooth, which results in the rapid disintegration of dental cement and the deposition of plaque. This leads to the leaking of substances around the restoration and the development of secondary caries. [23,24] Marginal fit of dental restorations has been demonstrated to be the primary cause in the development of secondary caries and periodontal disorders, ultimately resulting in the failure of the restoration. [25-29]

Optimal marginal adaptation is essential for the success of ceramic restorations. It is anticipated that a correctly fitted margin will reduce the accumulation of plaque, the recurrence of tooth decay that damages the tooth and the supporting periodontium, and may lower the lifespan of the restoration.[30]

There are other methods available for measuring marginal adaptation, such as: directly examining the margin under a microscope, inspecting cross-sectioned cemented samples under a microscope, measuring silicone replicas using light body silicone, using x-ray microtomography, using profilometry, and using laser videography[31]. The precise measurement of marginal discrepancy can be achieved by utilizing a stereomicroscope equipped with an integrated camera, which is considered a highly accurate method.

This study aims to examine the effects of recycling two distinct pressed ceramic on the marginal gap and fracture strength of ceramic crowns. The hypothesis is that the recycling of pressed ceramic will have an impact on both the fracture strength and marginal gap, perhaps leading to improved outcomes.

MATERIALS & METHODS

Ethical approval

This research was approved by the Research Ethics Committee of the Faculty of Dentistry at Minia University on July 25, 2023, under the reference number 98.Decision 792.

Calculation of the required sample size

The sample size for this study was determined by Nassar (2022) based on previous research. [52] Based on this study, it was determined that a minimum of 8 participants per group was required, assuming that the responses within each group followed a normal distribution with a standard deviation of 4.15. The calculated average discrepancy was 6.28, with a statistical power of 8O% and a significance level of O.O5. In order to guarantee a sufficient number of samples in each study group, the sample size was augmented to 12 patients per group.

Grouping Sample:

Fifty pressable ceramic crowns with various concentrations were constructed. They were divided into two groups (n=25 in each group) according to the ceramic material construction (E) using IPS e.max Press ceramic blocks and group (C) using Celtra Press ceramic blocks. Then, further subdivided in to five subgroups (n=5 in each subgroup) according to the weight percentage of the virgin ceramic ingots to the repressed ceramic. Subgroup I is 1OO % virgin ceramics. Subgroup II is 75 % virgin and 25% repeated heat pressed . Subgroup III is 50 % virgin and 50 % repeated heat pressed. Subgroup IV is 25% virgin and 75% repeated heat pressed. Subgroup V is 1OO % repeated heat pressed.

Fabrication of Crowns:

To standardize the dimensions of the preparations a Computerized Numerical Control CNC Lathe-cut machine was used. The specified requirements include a chamfer finish line that is 1 mm deep, 1.5 mm of occlusal reduction, and an axial reduction ranging from 1 mm to 1.5 mm from the finish line to the occlusal surface in order to achieve occlusal convergence.

Digital scan for the prepared tooth by the scanner (Omnicam AC; Dentsply-sirona . Germany) following the manufacturer's scanning protocol. The case file were saved to STL FILE (a standard tessellation language) to export to Exocad dental software.

Then a CAD software (Exocad Dental Cad 3.0 Galway) and 3D printer (Shining accuFab D1 3D printer, Kowloon Bay, Kowloon, Hong Kong, China) using software (Chitubox software) and Digital light processing additive manufactured with clear flexible photopolymer resin were used to print the fifty epoxy resin dies (Kemapoxy 150,CMB International, Egypt)after that fifty resin patterns were designed, sprued and weighed using a sensitive digital scale (Sartorius Biopharmaceutical and Laboratories, Germany). Figure (1)

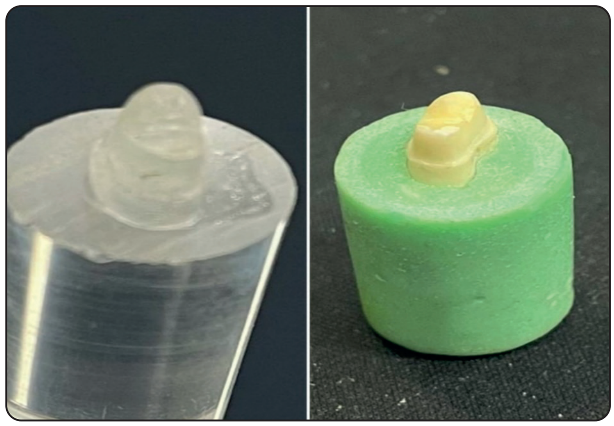

Fig (1) Samples preparation

For construction IPS e.max Press and celtra Press cermic crowns phosphate-bonded investment IPS Press Vest Premium (Ivoclar Vivadent, Schaan, Lichtenstein) were used.

Invested patterns were loaded in the furnace Programat EP3010 (Ivoclar Vivadent, Schaan, Lichtenstein). The ceramic ingots were then plasticized under pressure and a temperature of 920°C in a vacuum. At the end of the pressing procedure, the pressed crowns were weighed. Calculate the desired weight for pressed crowns.

The repeated heat pressed ceramics was crushed to suitable with the upper most of the investment mold. According to the desired Wt. %. the ceramic material was cited in the pressing cycle

Crowns cementation

The ceramic crowns were etched with IPS ceramic etching gel, which contains 5% hydrofluoric acid and was manufactured by (Ivoclar Vivadent, Schaan, Lichtenstein). Following the manufacturer's suggestion and let the etching process run for 20 seconds. After that, a water/air spray was used to clean the crowns completely. Using a brush, a coating of the silane coupling agent Monobond-S (Ivoclar Vivadent, Schaan, Lichtenstein) was applied to the inside of the crown for a length of one minute. After that resin cement (Breeze, Pentron Clinical Technologies, Wallingford, USA) was inserted into the crowns which were then seated on the epoxy dies . we got rid of any excess cement. Each crown was light cured (Bluephase Ivoclar Vivadent, Schaan, Lichtenstein) from all aspects for 60 seconds.

Thermal aging:

A thermal cycling simulation device (SD Mechatronic Thermocycler, Germany) was used to subject all research samples to 5000 cycles of thermal cycling simulation. Part of the process involved dipping the samples for 30 seconds into water that was 5 degrees Celsius colder than room temperature. After that, the samples were submerged for 30 seconds in water that was 55 degrees Celsius hot. For the purpose of simulating changes in oral cavity temperature, a 10-second interval was allowed between each immersion. Figure (2)

Fig (2) Thermocycling procedure

Marginal gap test

Each crown was seated in the mold made of copper. A holding device that was built specifically for the assembly was used to secure it. The Leica MZ6, a computer-linked stereomicroscope made in Switzerland by Leica Microsystems, was used to measure the marginal gap between the die and the crowns at sixteen distinct sites[28]. Leica Application Suite version 3.4 was utilized for the measuring process, and a magnification of 32x was employed.

Fracture resistance measurement:

Each crowns cemented to its correlated epoxy die was mounted in the lower fixed grip of the computer connected universal testing machine (Instron Universal testing machine model 3345, England). The static compressive loading was applied to each assembly until it broke. Operating the machine at a crosshead speed of 1mm/min, a steel rod was placed in the middle of the crowns' occlusal surfaces. Crown fractures were detected when a cracking sound was heard and the load deflection curve quickly decreased. The program running on the machine determined the size of the breaking force in Newtons. A statistical analysis test's findings are shown in Figure 3.

Statistical Analysis test

Data were collected and tabulated and statistically analyzed, Descriptive statistics by Mean and STD. Normality of Data tested by Shapiro-Wilk. Parametric data were analyzed by One-way analysis of variance One way (ANOVA) followed by Post hoc Tukey HSD for pairwise comparisons. Significance was set at 0.05.

RESULTS

Fracture resistance

Descriptive statistics of parametric data regarding fracture resistance of all tested subgroups of the two materials by means and standard deviations were presented in table (1) and figure (3). Significant difference between tested subgroups was determined by performing One way ANOVA test (P value < 0.05) followed by Post hoc Tukey test for pairwise comparisons of tested subgroups between the two materials (P value < 0.05). Fracture resistance values of all IPS e.max Press Subgroups were greater than recorded for their respective celtra press subgroups. Regarding pairwise comparisons there was significant difference between all subgroups (P value ***<0.001***).

TABLE (1) Comparison between IPS e-max and Celtra press regarding fracture resistance in newton (N).

Fracture Resistance (N)	IPS e.max Press	Celtra Press	P value
(I)	910.47±9.93	836.95±16.69	***<0.001****
(II)	906.78±10.22	833.98±19.17	***<0.001****
(III)	909.64±12.29	822.65±13.11	***<0.001****
(IV)	821.32±10.77	586.59±9.63	***<0.001****
(V)	841.09±15.04	486.96±11.74	***<0.001****

Marginal gap

Descriptive statistics of parametric data regarding marginal gap of all tested subgroups of the two materials before and after thermo-cycling by means and standard deviations were presented in table (2) and figure (4). Significant difference between tested subgroups was determined by performing One way ANOVA test (P value < 0.05) followed by Post hoc Tukey test for pairwise comparisons of tested subgroups between the two materials (P value < 0.05). Thermocycling resulted in an increase of marginal gap of each tested subgroup of both materials. Regarding pairwise comparisons of each material subgroup before and after thermo-cycling there was significant effect on marginal gap of each subgroup of both materials (P value < 0.05).

TABLE (2) Comparison between IPS e-max and Celtra press regarding the marginal gap in microns (µm).

Marginal Gap (µm)	Before	After	P value
	N=7	N=7	
IPS e.max Press (I)	27.93±1.82	30.54±1.27	***.009****
IPS e.max Press (II)	28.23±1.56	32.67±1.13	***<0.001****
IPS e.max Press (III)	28.86±1.39	31.10±1.48	***0.013****
IPS e.max Press (IV)	53.59±2.10	62.04±1.17	***<0.001****
IPS e.max Press (V)	84.14±2.98	116.21±3.73	***<0.001****
Celtra PRESS(I)	24.01±1.53	33.73±1.73	***<0.001****
Celtra PRESS (II)	23.73±1.50	32.41±4.35	***<0.001****
Celtra PRESS (III)	23.27±1.11	33.71±2.15	***<0.001****
Celtra PRESS (IV)	34.66±1.31	44.14±3.34	***<0.001****
Celtra PRESS (V)	45.89±1.76	53.46±1.87	***<0.001****

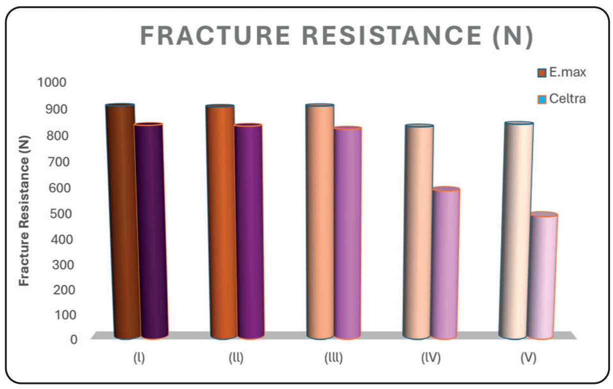

Fig (3) Comparison between IPS e-max and Celtra press regarding fracture resistance

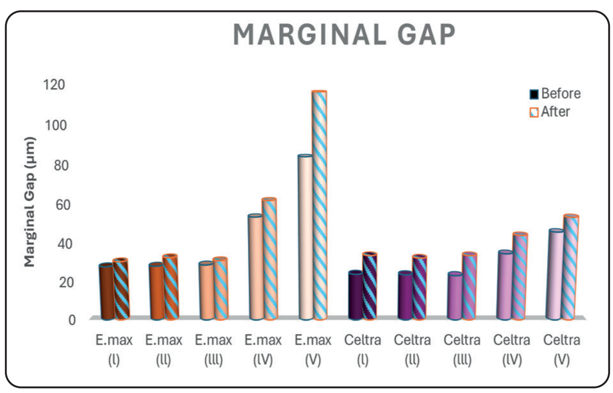

Fig (4) Comparison between IPS e-max and Celtra press regarding the marginal gap

Regarding marginal gap of all tested subgroups of the two materials before thermo-cycling, All celtra press subgroups recorded less marginal gap in comparison to their respective IPS e.max Press subgroups.

Regarding marginal gap of all tested subgroups of the two materials after thermo-cycling, IPS e.max Press subgroups (I, III) recorded less marginal gap in comparison to their respective celtra press subgroups. On the other side celtra press subgroups (II, IV, V) recorded less marginal gap compared to their respective IPS e.max Press subgroups. Figure (5)

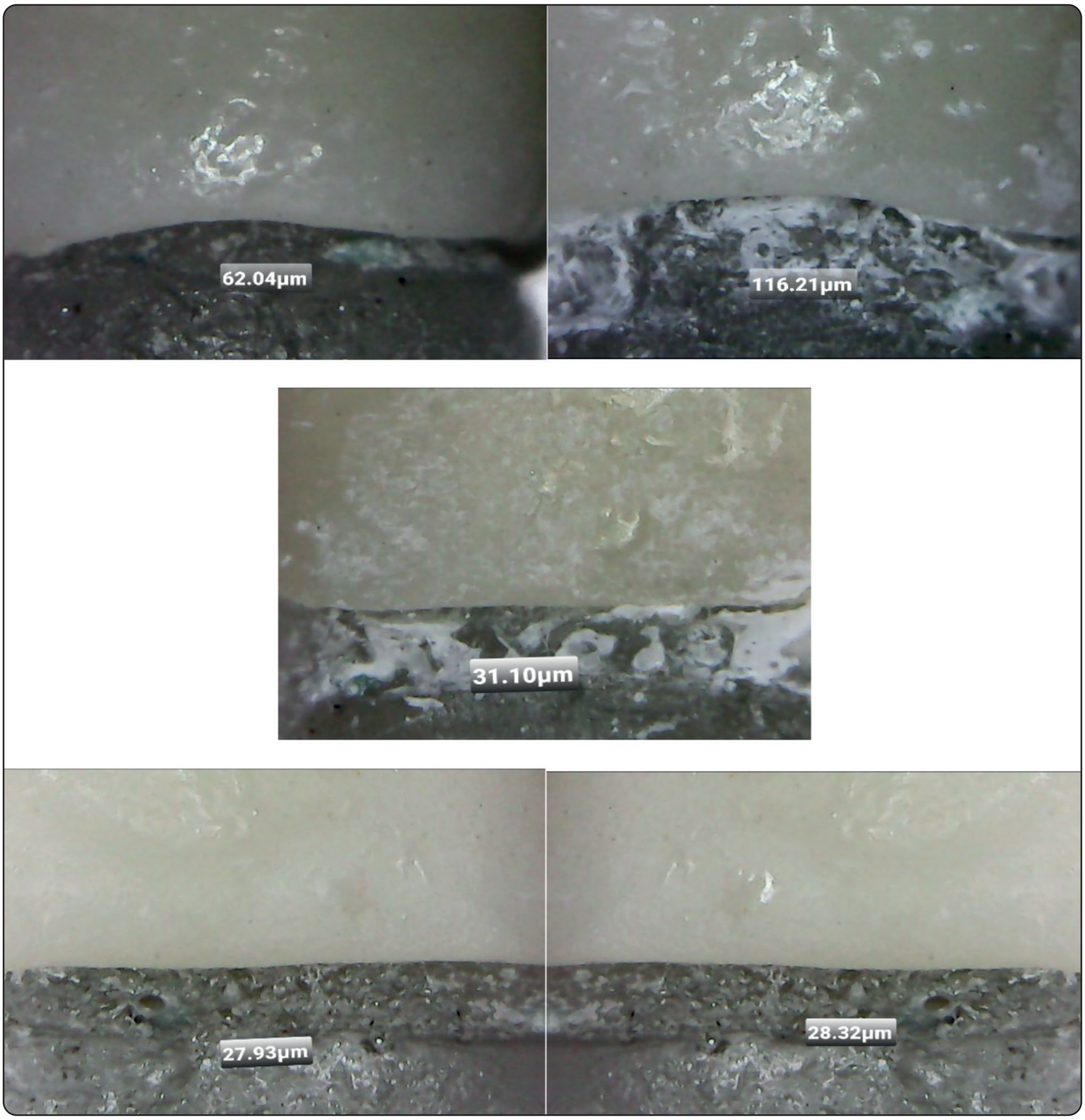

Fig (5): Marginal gaps measurement by Stereomicroscope.

DISCUSSION

Lithium disilicate ceramics and its derivative, zirconia reinforced lithium silicate, have become quite popular due to their exceptional fracture resistance and superior aesthetic qualities. These materials offer a robust alternative for several clinical scenarios. In addition to CAD/CAM technology, the heat pressing technique has been employed in the fabrication of these ceramics. This approach has several benefits, including reduced porosity, enhanced flexural strength, and superior marginal fit. Therefore, physicians now prioritize the careful selection of the most suitable ceramic material and the precise application of the appropriate processing procedure in order to achieve long-term success in ceramic restorations.

The metal die was manufactured using an industrial lathe machine for the purpose of standardization. A groove was created on the occlusal surface of the die to ensure accurate placement of the crown and to prevent it from rotating. A substantial chamfer finish line measuring 1.0mm was produced. While it was previously suggested that heavy chamfer and rounded shoulder finish lines should be used for all-ceramic crowns[32-34], a study by **Al-Zubaidi and Al-Shamma (2015)** demonstrated that heavy chamfer actually leads to in lower marginal gap compared to a 90° shoulder.[35] This was due to the less preparation depth and the more curved angle between the axial and gingival seat of the chamfer finish line. This allows for more precise preparatory scanning and crown placement. Thus, a shoulder with a 90° angle and a small roundness can result in inappropriate seating of the crown and an increased vertical marginal gap[36-38].

An important step is making of a accurate pattern. It greatly affects the marginal fit of restorations made of all-ceramic material. In this experiment, a computer numerical control (CNC) machine was used to scan a metal die and produce resin patterns. To get an accurate assessment of the system's accuracy and to eliminate the impact of the cementation process on the marginal fit, the resin patterns were constructed without cementation[39].

In this study, marginal gap mean values were found to be within the clinically acceptable range, as denoted by **Christensen (1966),**[40] who found that subgingival margins might be anywhere from 34 to 119 µm in width while supragingival margins could be anywhere from 2 to 51 µm in width. To be deemed clinically acceptable, dental restorations should not have a maximum marginal gap exceeding 120 µm, as proved in a 1971 research by **McLean and von Fraunhofer in (1971),**[41].

The new light polymerized modelling resins reach a condition of extraordinary stability and precision when light polymerization is complete[42-44].

Saleh O et al(2016),[43] discovered that IPS e.max Press crowns with 3D printed patterns had a better marginal fit. They also noticed that the crowns' fracture resistance improved because of increased internal adaptation .

Using a stereomicroscope, this research determined marginal adaptation. This process is easy and convenient, say **Elrashid et al. (2019)**[45] to simulate the clinical condition, the metallic die's marginal gap representing the prepared tooth was measured.

Both the precision of fit and the longevity of ceramic restorations have been greatly improved by developments in dental ceramic materials and processing techniques.

In line with what **Tang et al(2014)** found, this study's results could be linked to the negative effects of repressing on the mechanical and physical properties, and the change in microstructure, of IPS e.max Press [46]. That may explain why Groups II, III, and IV have a better margin than Group V.

The ceramic crowns were cemented to epoxy dies in to test facture strength . In order to mimic the modulus of elasticity of the teeth, epoxy has a low modulus of elasticity. **Øilo et al (2013),** [47,48] said that when the epoxy abutment is compressed due to axial loading, it bulges somewhat. The cemented crown's cervical area becomes strained due to this bulging. So fracture occurs at the cervical margin. They recommended this method to obtain clinically relevant fracture loads.

Group I, which was made entirely of novel ceramic material, had the greatest mean fracture strength. The average values were lower for the other four categories comes in agreement with **Tang. et al (2014),** [46] found that IPS e.max Press significantly lost density, strength, toughness, and hardness after many heat presses, while improving its porosity, therefore our results are in line with theirs. Scientists re-pressed lithium disilicate crystals to make them less densely packed, which led them to see a different pattern in scanning electron microscope (SEM) images. This may cause cracks to propagate more easily between the remaining glass matrix grains, weakening the matrix as a whole. So, they reasoned, that with so much heat pressing, the ceramic would eventually become unfit for use in medicine.

Albakry et al(2004),[49] accomplished three investigations to inspect the effects of reusing pressable ceramics; nevertheless, these results go against their conclusions. When comparing the pressed and re-pressed groups for biaxial flexural strength, the researchers discovered that the IPS Empress 2 re-pressing groups had just a little decrease. The pressing that happens when the soften glass ceramic is pressed is thought to be responsible for this occurrence. The scientists found that pressing and repressing the lithium disilicate crystals again and again increased their size. The total pressing time was found to be linearly related to the crystal length. They found that increasing flexural strength but not fracture toughness without changing the crystal distribution after re-pressing the ceramic material, They concluded that its mechanical properties were unaffected.

Gorman et al (2014),[50] investigated IPS e.max Press's reusability. They looked at how different pressings affected the microstructure, Vickers hardness, fracture toughness, and biaxial flexure strength of lithium disilicate. In order to do this, scanning electron microscopy and X-ray diffraction were employed. As the number of pressings increased, there was a little decrease in strength, although this was considered insignificant. Additionally, the material's mechanical qualities remained unchanged after consecutive pressings.

In addition, the results contradict what **Chung KH et al (2009),**[22] asserted in their study on how repetitive heat pressing affected the microstructure and biaxial flexure strength of Empress 2. Compared to the pressure-only group, the repressed group showed a had higher mean strength value. A larger lithium disilicate crystal with the appropriate orientation was produced after the repressing of an interconnected, densely packed microstructure; this result was similar to the one discussed before. They proposed recycling ceramic residual materials from single time in some dental laboratories.

Also, **El-Etreby A.S. and Ghanem L (2017)**,[51] determine the safety of utilizing the IPS e.max Press buttons that are still partially pressed. Surface roughness and biaxial flexural strength were the primary outcomes of the investigation.

One limitation of comparing our findings to others is that previous research has been concentrated on IPS Empress 2 repressing rather than IPS e.max Press. The crystal size and percentage of these two materials are different. Furthermore, disc-shaped specimens were used which surely affected crystal alignment. The structure of the specimen determines the arrangement of lithium disilicate crystals. The crystals have an asymmetrical orientation on the disk surface[51]. Because of the increased crystal ratio, heat pressing makes it easier for crystals to align in the pressing direction. The ceramic, while in a liquid condition, is guided into the specimen cavity via the sprue. The small thickness limits its movement as it expands in a circular pattern, filling the cavity entirely. The mechanical properties are improved and the capacity to resist fracture propagation in a direction perpendicular to the crystal alignment is increased by this alignment[49].

The idea of combining different quantities of new and old ceramics is a creative. It was not possible to find any studies that compared the outcomes in order to evaluate the fracture strength or marginal gap. With a rise in the fraction of repressed ceramic, the marginal difference widens. The average fracture strength in Groups II–V is also much lower than in Group I. The mean fracture strength is lowest in Group III, which consists of 50% new and 50% old material. The findings of this study are in agreement with those of **Gorman et al (2014),[50]** who found that the optimal IPS characteristics are e.max The first press is the only one that will produce a press. Reason being, increased strength is the outcome of homogeneous crystallization of interconnected needle-like crystals. Groups II (75% new) and III (50% new) have lower fracture strengths than Group I, according to this. Fracture strength was lowest in Group III, with the lowest average value, and highest in Group IV (75% elderly), which contrasted with Group I's stronger fracture strength. The variation in fracture strength can be explained by the fact that there was a 50/50 split in the degree of homogeneity. Plus, it shows that there isn't much of a difference between Groups IV and V, with Group V being stronger than Group IV.

The processing method may have improved or diminished the ceramic material's final strength and therapeutic utility. The research proved this by contrasting the two pressable recycling groups, e-max press and Celtra press, and looking at their average fracture resistance values. They found that e-max press groups had much higher mean values compared to the Celtra press groups. Pressable ceramics are made by subjecting the material to high temperatures and pressure in order to speed up the sintering process[53].

Mechanical property changes across materials with identical chemical compositions are mostly due to microstructure variances, according to a prior work by **Hallmann et al[54]** that looked at heat pressed glass ceramics. The average results for fracture resistance were not significantly different between e-max press and Celtra press. The flexural strength was not improved by adding zirconia to the glass matrix of lithium disilicate, according to **Apel et al[55].** This was because the presence of Zr02 caused the viscosity to be greater, accompanied decrease in crystal growth.

Results showing a confirmation of the hypothesis of ceramic repressing in terms of fracture strength and marginal gap were obtained from the data analysis. In particular, when contrasted with the ingots made entirely of fresh ceramic, the ceramic that had been 100% compressed showed a larger marginal gap and lower fracture strength. There was some partial validation of the hypothesis with respect to the effects of different mixing percentages.

CONCLUSIONS

Within the limitation of this study, the following conclusions were drawn:-

Recycling procedures exhibited superior fracture resistance values compared to pressable techniques, even when the same material was utilized.

The incorporation of zirconia into lithium disilicate ceramics did not enhance the ability of celtra press to withstand fractures when compared to IPS e.max Press.

Recycling of pressable processing procedures demonstrated superior vertical marginal gap distance for both ceramic materials employed.

Thermocycling caused a substantial increase in the lateral marginal gap separation for both types of ceramics.

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