

In Vitro Comparative Study of the Effect of Type of Temporary Crown and Polishing Agents on Color Stability of Provisional Restorations.

Hasan Aljaseem¹, Jihad Abou Nassar², Leen Ghassan Kattash³, Nour Aldeen Abdul Azim Alasad⁴

Department of Fixed Prosthodontics, Faculty of Dentistry, Damascus University, Syria¹

Prof in Fixed Prosthodontics, Faculty of Dentistry, Damascus University, Syria²

Graduated from Al-wataniya Private University, Syria³

Studying at Arab Private University for Science and Technology, Syria⁴



Keywords:

Provisional restoration, Color stability, Polishing agents.

ABSTRACT

This research aimed to study the effect of the type of provisional compensation material and polishing material on the color stability of compensation provisional to determine which temporary compensation and polishing materials studied are best and have the greatest color stability. The research sample consisted of 40 provisional crowns designed for an upper premolar that was prepared to receive a full ceramic crown, where the sample was divided after obtaining it into two main groups according to the type of compensation used (Bis-acryl by direct method and PMMA by indirect method by CAD/CAM technology), then each group of the study sample was divided into two groups according to the type of polishing material used (aluminum oxide paste or diamond paste), then the colorimetric measurements of the research sample were carried out using a spectrophotometer (VITA Easyshade V, Germani) The crowns were then immersed in a solution of coffee and distilled water and stored in an incubator at (37+-1)C for 7 days. Then the colorimetric measurements were re-performed and the amount of color change ΔE was calculated for each of the research samples. The data were analyzed using one-sided analysis of variance (ANOVA) and two-way comparison test using the method of least significant differences (LSD). At the confidence level of 95%, there are statistically significant differences in color stability in the average amount of change ΔE between Bis acryl crowns and PMMA crowns, there were no statistically significant differences between aluminum oxide and diamond in the chromatic stability of the studied temporary compensation. Within the limitations of this study, we conclude Samples that contain PMMA which manufactured by CAD/CAM method showed stability chromatically greater than samples that enter into the composition of Bis-acryl which manufactured by the direct method, and there was no difference between the effect of each of the two materials aluminum oxide And diamond in the chromatic stability of the temporary compensation material, and the type of temporary compensation material had the greatest effect In the color change ΔE of the studied sample compared to the type of polishing substance used.



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1. INTRODUCTION

Temporary restoration aims to preserve the vitality of the endodontic and periodontal system, promote tissue-guided healing in order to achieve an acceptable appearance, evaluate oral care, prevent abutment infiltration, provide an appropriate occlusal plan, evaluate the relationships of the upper and lower jaws [1], and achieve the aesthetic aspect by masking the shape of the prepared tooth. By simulating the basic characteristics of natural teeth and preserving those characteristics including the size, location, shape and color of the prepared tooth [2], the need for temporary prosthesis becomes more important in cases of oral rehabilitation, where several teeth are prepared in these cases and temporary prosthesis is used for relatively long periods (6-12) weeks to monitor the patient's comfort and satisfaction and allow any necessary adjustments to be made later [3] and then the temporary compensation must provide the aesthetic aspect, especially in the frontal area where we face the problem of discoloration [4], due to its exposure to many colors such as coffee and tea, which increases the color change of the temporary restoration [5].

Studies have shown that adequate finishing and polishing is crucial to the restoration's resistance to plaque build-up and discoloration [6], since insufficiently polished surfaces lead to plaque build-up, gum irritation, and Low aesthetic results, in addition to increasing the chance of discoloration of the surface of restorations [7]. In fact, optical properties and color stability are affected by surface changes caused by polishing procedures [8].

Several polishing materials are currently available such as pumice powder, glass, varnish, diamond paste and alumina paste, and because there are different recommendations made by different researchers on their own products regarding polishing techniques, it is very difficult to determine which polishing technique is best for a particular material type [9]. Alumina and diamond are two of the most common materials that are used as liquefied particles in polishing pastes [10].

Despite the impact of the applied polishing technique, studies have shown that the temporary restoration can still experience visible discoloration due to other factors such as the type of material, the patient's diet, oral care, and incomplete sclerosis [11].

Color stability is an important criterion when choosing a trapping material [12], [13], as there are many materials currently available for making traps but so far none of them has been proven to be the most accurate and chromatically stable, and each material has its own advantages and disadvantages [14].

Polymethyl methacrylate (PMMA) has long been used in the manufacture of temporary restorations. Although this material provided satisfactory results in terms of functionality and aesthetics for temporary restoration [15] such as bending resistance, good chromatic stability and repairability [16], it was accompanied by defects such as heat generation during hardening. In addition, hardening contraction and a high level of free monomers [17], and as a result of these defects, the diacryl resins (Bis- acryls) have replaced polymethyl methacrylate (PMMA) as the most widely used temporary material that is commercially available with an automatic mixing system which simplifies the manufacture of the restoration in addition to better polishability and good color stability but with higher fracture resistance and lower repairability [18].

Studies on the color stability of temporary substitutes have shown that PMMA-based resins are less susceptible to discoloration than other temporary resins, including bis-acryls [12], [17]. However, some studies have reported superiority for some bis-acryl based resins. In terms of color stability relative to its PMMA based counterpart [19], [20].

Recently, as a result of advances in technologies and the ease of use of computers in dentistry, new methods of temporary restorations have been introduced through CAD-CAM technology, which uses pre-polymerized (PMMA) blocks prior to grinding to produce temporary restorations with better strength and homogeneity than Conventional PMMAs, as well as reducing the contracture problems and excessive release of monomers with conventional PMMAs, however there are no long-term studies or results for these new materials; Thus, its advantages and disadvantages compared to traditional temporary installations need to be reconsidered. Due to the major prevailing demand for highly aesthetic restorations, temporary restorations are essential and can be used as an early reversal of the final restoration and for this it is necessary to identify the optimal cosmetic materials to be used in the temporary restoration [21].

2. The purpose of the research

The research aims to study the effect of the type of temporary compensation material and polishing material on the chromatic stability of temporary compensation, to determine which of the studied temporary compensation and polishing materials achieve the greatest color stability.

3. Materials and Methods

Third: Research materials and methods:

3.1 Get a sample search

The research sample consisted of 40 temporary crowns designed to restore a newly extracted upper premolar for orthodontic reasons, without caries and restorations. It was cleaned of ligament and blood remnants and preserved in 0.5% T chloramine solution to prepare it later to receive a full ceramic crown.

The sample was divided into two main groups according to the type of temporary compensation used (Bis_Acryl by direct method and PMMA by indirect method by CAD/CAM), then each main group was randomly divided into two subgroups according to the type of polishing material used (aluminum oxide paste or diamond paste) Thus, we have four groups, as follows:

First group A1: 10 temporary crowns made directly from Bis_Acryl, which will be polished with diamond paste.

Second group A2: 10 temporary crowns made by direct method of Bis_Acryl, which will be polished with aluminum oxide paste.

Third group B1: 10 temporary crowns manufactured indirectly by CAD/CAM from PMMA material, which will be polished with diamond paste.

Fourth group B2: 10 temporary crowns manufactured indirectly by CAD/CAM from PMMA material, which will be polished with aluminum oxide paste.

Initially, a Huge Chinese company made a Denture Base Polymers base in A2 color for the upper first premolar, which will be the mainstay of all the crowns of the research sample.

The upper first premolar was prepared to receive a full ceramic crown according to the principles of academic preparation, with a semi-deep chamfer termination line with a width of 1 mm and a thickness of 1.5 mm preparation for the axial walls as in Figure (1).



Fig. 1: Master die

3.2 Manufacture of temporary compensation samples indirectly from PMMA

After preparing the tooth, it was digitally scanned using a device (MEDIT T500, Korea) attached to the CAD/CAM device (MAXX DS 200-5Z, Korea) to obtain a three-dimensional image of the prepared tooth. CAM, and adjusting the thickness of the vestibular surface of the crown (because it is the most important surface on which the color readings process will take place) according to the previous preparation at 1.5 mm then the PMMA compensations are manufactured in the form of crowns with the imposed dimensions, and thus the temporary prosthesis crowns were obtained from PMMA by the indirect method via CAD /CAM.

3.3 Manufacture of temporary compensation samples by direct method from Bis_Acryl

After obtaining the indirect prosthesis samples by CAD/CAM, a polypropylene translucent sheet mold was made from (3A Medes, Korea) measuring 125 x 125 and thickness 0.5 mm (best for temporary prosthesis) [22] for each sample of PMMA Previously obtained, PMMA crown was applied to the prepared abutment when the mold was prepared by a pneumatic vacuum device.

A groove was made on the acrylic mold of the prepared tooth to preserve the position of the vacuum mold with the prepared tooth correctly during the preparation of Bis_acryl samples in the next stage, where Bis_acryl was injected into the mold using a special compactor (3M, USA) and then the mold filled with Temporary prosthesis on the prepared tooth that was wiped with a cotton swab with Vaseline [23] with finger pressure on both sides of the edges of the mold until the hardening is complete to be removed and the temporary prosthesis crown loosened. The previous process was repeated until a set of Bis-acryl crowns was identical in shape and dimensions to the PMMA crowns we obtained earlier. The excess edges were then appropriately removed and trimmed to ensure that they are free of any bubbles, and then 1.5 mm of thickness on the vestibular surface of the Bis_acryl crowns was verified by the direct method with a thickness gauge (Aeculap, Germany) so that it is similar to its PMMA counterparts by the indirect method [23].

Thus, the complete research sample was obtained in Figure (2).

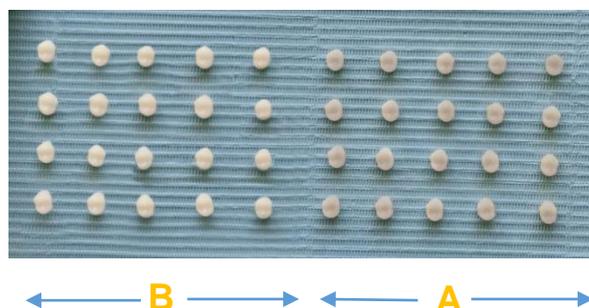


Fig. 2: obtaining the research sample where group (A) represent bis-acryl crowns and group (B) represent

PMMA crowns.

3.4 Finishing and polishing

Samples were finished with grit (1000)P silicon carbide sandpaper from the company (AOT, Tiland) applied through a holder mounted on a straight-grip microtor attached to a microtor from the company (M&F, Australia) at low rotation speed for 10 seconds.

Where the samples were placed on the prepared tooth after fixing its acrylic base with gypsum to prevent any change in the position of the crowns during the termination, with the frequent replacement of the lichen paper after the completion of each crown. Figure (3)



Fig. 3: The process of finishing temporary crowns.

After completing the research sample, the first and third groups were polished with diamond paste, while the second and fourth groups were polished with aluminum oxide paste. For this stage, a rubber funnel was used on the grip of a warped microengineer (nsk, Japan) connected to the microtor used in the previous stage where it was installed on a device Planning in order to unify the distance and pressure applied between the samples and the tool carrying the polishing material (polishing funnel), where the acrylic base of the laughter was fixed with gypsum and the samples to be polished were placed on it without sticking in order to avoid any change in the position of the crowns during the polishing process²⁴, then polishing pastes were applied to the studied samples After wetting its surface with water, so that the polishing funnel is in contact with the surface of the sample ²⁵, and each sample was polished for 30 seconds. Figure (4) (5)



Fig. 5: Polishing with aluminum oxide past



Fig. 4: Polishing with diamond paste

Then each set of samples was ultrasonic cleaned in distilled water by an ultrasonic cleaner (CODYSON, China) for 5 min 10.

3.5 Colorimetric measurement of samples before immersion in the colored solution

The colorimetric measurements were carried out using a Vita Easyshade® V spectrophotometer from the German company VITA (Fig. 6), where the samples were applied to the prepared main support (to simulate

the clinical condition and represent a white background under the samples)²⁶, and then moistened with a wet cotton, to begin the measurement process for the temporary compensation samples, where the colorimetric measurements were taken at a reference point on the vestibular surface (in the middle third) according to the manufacturer's instructions. Fig. (7).

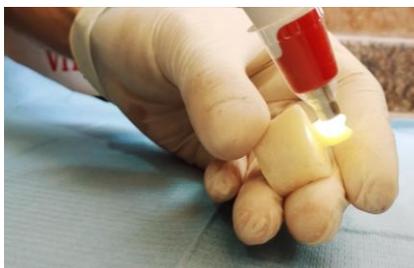


Fig. 7: Color measurement at reference point (middle third)

3.6 Immersion of samples

Samples were immersed in coffee stained solution (Nescafe Classic; Nestle Suisse, Vevey, Switzerland) at the manufacturer's suggested concentration of 1.2 g coffee powder per 100 ml of boiled distilled water after 10 minutes of mechanical stirring with a portable electronic mixer (Generic, China) then filtered through filter paper to separate the undissolved coffee sediment, where the samples that were immersed in the coffee solution were kept for 7 days [27] at a temperature of (37±1) °C by an incubator with daily alteration of the solution [27], after immersion the samples were washed with distilled water and cleaned with paper towels [28].

3.7 Measure the color after immersion and calculate the amount of color change ΔE

The colorimetric readings of the samples after immersion were re-recorded to calculate the amount of color change ΔE .

Then the amount of color change was calculated for each of the studied temporary crowns in the research sample according to the color system CIE (L*a*b*) through the following equation:

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

4. Results

4.1 Sample Description

The research sample consisted of 40 temporary crowns divided into four equal groups according to the type of temporary compensation material and the polishing material used.

Table No. (1) shows the distribution of the research sample groups:

- The research sample is distributed according to the type of temporary crown and the polishing material used:

Table No. (1)

Research sample group by type of temporary crown and polishing material used	Number of temporary crown	percentage
Group 1: Bis-acryl crowns polished with diamond paste	10	25.0%

Group 2: : Bis-acryl crowns polished with alumina oxide paste	10	25.0%
Group 3: PMMA crowns with CAD/CAM polished with diamond paste	10	25.0%
Group 4: PMMA crowns with CAD/CAM polished with alumina oxide paste	10	25.0%
the total	40	100

4.2 Descriptive statistics

Table No. (2) shows the arithmetic mean, standard deviation, standard error, the minimum and the upper limit of the amount of chromatic change ΔE , in the research sample groups.

Table No 2

The studied variable = The amount of color change ΔE						
Type of temporary crown and polishing material used	Number of temporary crowns	Arithmetic mean	Standard deviation	Standard error	Minimum	Maximum
Group 1: Bis-acryl crowns polished with diamond paste	10	6.38	0.38	0.12	5.07	8.68
Group 2: : Bis-acryl crowns polished with alumina oxide paste	10	6.98	0.88	0.28	5.76	8.14
Group 3: PMMA crowns with CAD/CAM polished with diamond paste	10	4.73	0.89	0.59	3.41	7.79
Group 4: PMMA crowns with CAD/CAM polished with alumina oxide paste	10	4.09	0.32	0.1	3.41	5.10

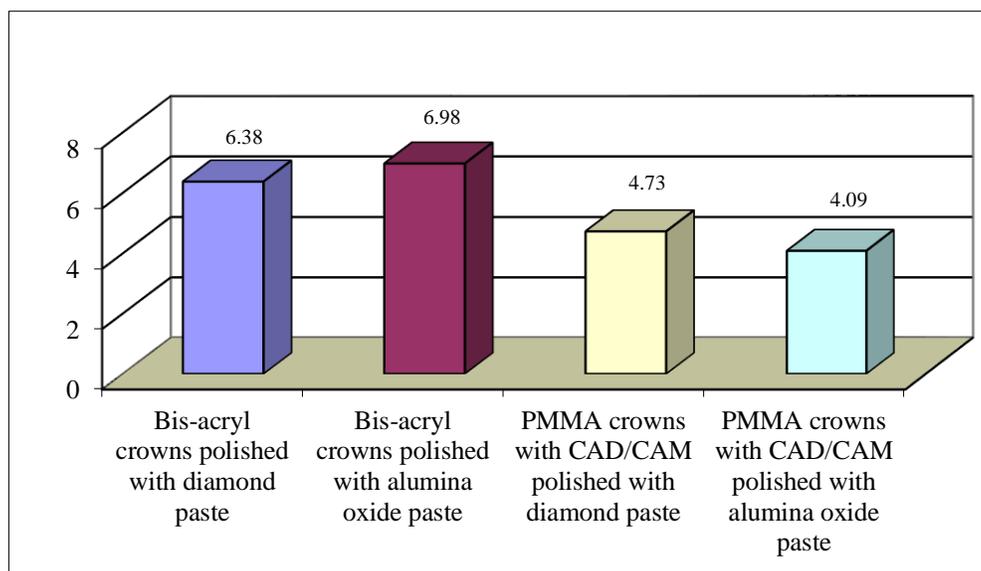


Diagram no.1: represents the arithmetic mean of the amount of color change ΔE in the research sample according to the type of temporary crown material and the polishing material used.

4.3 Statistical Analytical Study

The amount of color change ΔE was measured for each of the studied temporary crowns in the research sample, then the effect of the polishing material used and the type of temporary crown material on the amount of color change ΔE in the research sample was studied, and the results were as follows:

* Study the effect of the type of temporary crown material and the polishing material used on the amount of color change ΔE in the research sample:

One-sided analysis of variance ANOVA was conducted to study the significance of the differences in the mean amount of color change ΔE between the four groups in the research sample as follows:

4.3.1 The results of the one-way analysis of variance ANOVA

Table No. (3) shows the results of the one-way analysis of variance (ANOVA) test to study the significance of the differences in the mean amount of color change ΔE among the four groups studied in the research sample.

Table No.3

The studied variable	Calculated F value	Significance level value	The significance of the differences
Amount of color change ΔE	8.627	0.000	There are significance differences

It is noticed in the above table that the value of the significance level is much smaller than the value 0.05, that is, at the 95% confidence level, there are statistically significant differences in the average amount of color change $E \Delta$ between at least two of the four studied groups (Bis Acryl crowns polished with diamond paste, Bis Acryl crowns polished with alumina oxide, PMMA crowns with CAD/CAM polished with diamond paste, PMMA crowns with CAD/CAM polished with Alumina oxide) in the research sample, and to know which groups differ substantially in the amount of change values Chromatography ΔE Binary comparison was made using LSD (Least Significant Difference) method to study the significance of binary differences between each pair of the four studied groups as follows:

4.3.2 Results of the binary comparison using LSD method

Table No. (4) shows the results of the binary comparison using LSD method to study the significance of the binary differences in the average amount of color change ΔE between the four groups studied in the research sample.

Table No.3

The studied variable = The amount of color change ΔE					
Group (I)	Group (J)	The difference between the two averages (I-J)	Standard error of the difference	Significance level value	The Significance of the difference
Bis-acryl crowns polished with diamond paste	Bis-acryl crowns polished with alumina oxide paste	-0.60	0.65	0.367	There are no significant differences
	PMMA crowns with CAD/CAM polished with diamond paste	1.64	0.65	0.016	There are significant differences
	PMMA crowns with CAD/CAM polished with alumina oxide paste	2.29	0.65	0.001	There are significant differences

The studied variable = The amount of color change ΔE					
Group (I)	Group (J)	The difference between the two averages (I-J)	Standard error of the difference	Significance level value	The Significance of the difference
Bis-acryl crowns polished with alumina oxide paste	PMMA crowns with CAD/CAM polished with diamond paste	2.24	0.65	0.002	There are significant differences
	PMMA crowns with CAD/CAM polished with alumina oxide paste	2.88	0.65	0.000	There are significant differences
PMMA crowns with CAD/CAM polished with diamond paste	PMMA crowns with CAD/CAM polished with alumina oxide paste	0.64	0.65	0.367	There are no significant differences

It can be seen in the above table that the significance level value is less than 0.05 when comparing the average color change amount ΔE Between each of the range of crowns made of Bis Acryl which polished with diamond paste, PMMA crowns with CAD/CAM which polished with diamond paste and PMMA crowns with CAD/CAM which polished with alumina oxide separately, also when comparing the mean ΔE between the Bis Acryl crowns which polished with alumina oxide, the PMMA crowns with CAD/CAM which polished with diamond-paste, and the group of crowns made of PMMA with CAD/CAM technology and polished with alumina oxide paste separately, that is, at the confidence level of 95%, there are binary differences with statistical significance in the average amount of color change ΔE between the groups mentioned in the research sample and since the algebraic sign of the differences between the averages is positive we conclude that the average amount of color change ΔE in both the Bis Acryl and diamond paste crowns and the Bis Acryl crowns group and Polished alumina paste was larger than the crowns which made from PMMA with CAD/CAM and polishing with diamond paste and the crowns which made from PMMA with CAD/CAM and polishing with alumina oxide separately in the research sample.

As for the rest of the studied binary comparisons, it is noted that the significance level value is much greater than the value 0.05, that is, at the 95% confidence level, there are no statistically significant binary differences in the average amount of color change ΔE between the group of crowns made of Bis Acryl and polished with diamond paste and the group of crowns which polished with alumina oxide. There were no significant binary differences in the mean amount of color change ΔE between the PMMA crowns with CAD/CAM which polished with diamond paste and the group of PMMA crowns with CAD/CAM technology and polished with Alumina oxide paste in the research sample.

5. Discussion

In recent times, temporary compensation is no longer seen as a temporary compensation only, but has become with distinct objectives and functions. It must be available in the cosmetic aspect, as we face the problem of discoloration. Temporary restorations must not only provide a preliminary match with the color chosen from the color guide [4], but also maintain on the aesthetic appearance over the course of its application [12], since the change in the color of the restoration leads to dissatisfaction of the patient and therefore additional costs in order to replace it with new temporary restorations and increase the expenses [13].

The temporary compensation Bis-acryl in A2 color was from the Vita Classical color guide. This color is one of the most used colors in frontal restorations [29] and preferred by prosthodontists [30].

In addition, light materials are significantly more susceptible to discoloration than dark materials [31].

Coffee has been adopted as a color solution because it is nowadays considered one of the most important drinks in our daily lives [32], in addition to its high coloring ability of resins [27].

The samples were immersed in the coffee solution in an incubator at a temperature of $(37\pm 1)^\circ\text{C}$ degrees Celsius for a period of 7 days. It is estimated that the average time for consuming one cup of coffee is 15 minutes, and the daily rate of coffee consumption for regular coffee drinkers is 2-3 cups per day. For this reason, 7 Days which is similar to 7 months of temporary compensation use [27], [33].

Several studies have considered that immersion for seven days is sufficient to cause color changes [34].

The solution was changed daily to keep the solution fresh and avoid spoilage or growth of microorganisms in addition to avoiding the formation of sediment in the solution [24], [27].

The Vita Easyshade V was used to calculate the color change ΔE for Bis-acryl crowns, a high-accuracy digital instrument. Dozić found the Easyshade to be the most reliable colorimetric tool for clinical and laboratory situations [35].

Studies comparing traditional and digital methods have shown better results for digital devices compared to traditional ones [36].

Studies have also found that the use of digital colorimeters may increase measurement accuracy compared to traditional colorimetric methods [37].

5.1 Color change values

Seghi and colleagues found that the color differences were not perceptible at the value of $(1 > \Delta E)$, and if the value of $(\Delta E < 2)$ the color differences were clinically acceptable. Incorrect judgments appeared when the value of $(2 < \Delta E < 3)$, the values of color change were observed correctly measured by 100% of observers at a value of $(\Delta E > 3)$, the color differences were clear and not clinically acceptable at a value of $\Delta E > 3.7$ [38].

Compared with the PT (perceptibility threshold), the researchers recorded that color differences were accepted by 50% of the observers when the varesearc $(1.7 < \Delta E < 3.3)$ [39].

Therefore, the value of $(\Delta E > 3.3)$ was considered to be a clinically unacceptable color change in many previous studies [15].

Therefore, the clinically acceptable value $(\Delta E = 3,3)$ was adopted in our current study.

5.2 Discussing the effect of temporary compensation material type on color stability

This study concluded that bis acryl samples showed greater color change than PMMA samples.

This may be due to the ideal industrial conditions under which the PMMA solidification process has taken place, which ensures that there are no or minimal residual unreacted monomers and less porosity [19].

Also, the Bis acryl material used in the research is a self-hardening material and it is possible for a chemical discoloration of the material itself (intrinsic discoloration), which is because of the oxidation of the polymer template or the oxidation of unreactive double bonds [18].

In addition to the different chemical composition of the two materials and the quantity, size and distribution of the filler particles included in their composition, in addition to the polarity of bis acryl polymers is superior to PMMA towards water and other colored liquids, and thus contributes to greater absorption of materials that affect color stability [40].

□ Also agreed with Elagra Marwa and her colleagues in 2017 study that examined the color stability and fringing fit of temporary crowns, and concluded that the Bis acryl composite resin based transient group showed more clinically significant color changes for the PMMA methacrylate based translocation group, and the synthetic PMMA samples were CAD/CAM method has shown the best borderline fit and the highest color fastness [15].

□ Also agreed with the study of researcher Sherine Bader Youness Bader and her colleagues in 2021, who studied the color change and fracture resistance of temporary compensations made of PMMA by CAD/CAM and made manually from other temporary materials, including Bis acryl and PMMA. PMMA by CAD CAM has chromatic stability and higher fracture resistance than the rest of the research samples [41].

□ The results of this study differed with the study of Gaurav Gupta in 2011 to evaluate the color stability of four temporary materials when immersed in different coloring solutions (tea, coffee, Pepsi and turmeric drink) with artificial saliva. Revotek GC (photo-hardening composite resin) based material showed the highest color stability, followed by bis-acryl composite resin based samples and then polymethyl methacrylate (PMMA) based samples [20].

This may be due to the researcher's use of the manual mixing mechanism when preparing research samples based on polymethyl methacrylate and his use of an injection cooler that depends on automatic mixing in order to prepare resin-based samples provided by the manufacturer of these materials, which reduces the amount of air entrapment and porosity, which leads to an increase in color stability [13].

5.3 Discussing the effect of the type of polishing material used on color stability

This study concluded that there are no statistically significant differences between aluminum oxide and diamond in the chromatic stability of the studied temporary compensation.

This may be explained by the unification of the conditions of the polishing process for both materials while adhering to the manufacturer's instructions and following a standardized automated polishing protocol with neutralizing the interference of human hands and approaching the rate of hardness of aluminum oxide grains (9 on the Mohs scale) than diamond grains (10 on the Mohs scale) [42], where [43] indicated in his study that, regardless of the polishing material, the effectiveness of the polishing materials does not differ significantly in terms of surface roughness and chromatic stability of the temporary compensation materials if appropriately applied with each technique, which corresponds to the size and hardness of the surface grains of the surfactant which used in polishing material [42], [43].

□ The results of this study agreed with the study of Seema sathe [9] and her colleagues in 2019 for the effect of three polishing materials, which are pumice powder, aluminum oxide polishing paste and diamond paste, on the chromatic stability of bis_acryl temporary compensation, where statistically significant differences were found between pumice paste and each of the aluminum oxide paste and diamond paste, There was no significant difference between aluminum oxide paste and diamond paste ($P=0.985$), and polishing using pumice powder had the lowest degree of color change for the studied temporary compensation.

□ The results of our study differed with that of [33] and his colleagues in 2005 to evaluate the effect of different polishing procedures for polishing materials, which included pumice powder, diamond polishing paste and Sof-Lex polishing discs interspersed with aluminum oxide particles on the chromatic stability of bis-acryl resins, photo-hardening composite resins and methyl methacrylate resins, where it was found that

the highest percentage of color change values in the groups was for those polished with Sof-Lex polishing disc system, and the groups that used diamond paste were more color stable.

This may be due to the researcher not following a unified polishing protocol for all the research sample, in addition to the researcher's dependence in his study of aluminum oxide polishing material in the form of discs and diamond powder material in the form of a paste, as the polishing discs adopt the double-surface technique (the presence of a solid substance that works to dissolve a softer material So that the stranding particles are in constant contact with the reactant), while polishing pastes adopt the tri-surface technique (the flocculating particles are free in the middle between the surface of the sample and the polishing applicator, so that the surfactant is applied to roll over the polishing substrate) [44] in addition to the physical properties. The material of the tool used to hold the flaking material plays a role in the effectiveness of the finishing and polishing [42].

6. Conclusions

Within the limits of this study, we draw the following conclusions:

- 1- All studied samples showed a clinically unacceptable color change ($\Delta E > 3,3$) regardless of the type of temporary compensation material and the polishing material used.
- 2- PMMA with CAD/CAM technology was superior to Bis acryl with a statistically significant difference in achieving chromatic stability for temporary compensation crowns.
- 3- The type of polishing substance did not affect the color stability of the temporary compensations.

7. Recommendations

- 1- It is recommended to choose PMMA manufactured by CAD/CAM method instead of Bis acryl material directly in cases where the use of temporary compensation may be prolonged.
- 2- Both polishing materials can be used equally, as there is no difference between them to maintain color stability.
- 3- It is recommended to avoid drinking a lot of coffee due to the great effect of this substance in causing the color change of temporary compensation.

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