Tikrit Journal
for
Dental Sciences
https://tjo-ds.com

Estimate the Self-Adhesive Resin Effect on the Bonding Strength in a New Technique for Artificial Scleral Construction

Souad Hassan Ali [1]
Akhlas Zeid Abood [2]

[1,2] Department of Prosthetic Dental Technology, College of Health and Medical Technology, Middle Technical University, Iraq

Article Info:
-Article History:
-Received: 5/2/2021
-Accepted: 1/3/2021
-Available Online:
Jun, 2021

Keywords: Artificial Scleral, self-adhesive, Clear Acrylic, IPS E-max, Shear bond.

Corresponding Author:
Name: Name: Akhlas Zeid Abood
E-mail: aklasaltaaai@gmail.com
Tel: 07815862778
Affiliation:
(1) Postgraduate student in Prosthetic Dental Technology.
(2) Asst. Prof., Department of Prosthetic Dental Technology.

Abstract

Background. The Eye is the most noticeable features of the person face, the causes of ocular trouble may be congenital anomaly or acquired, Prosthetic rehabilitation attempts to restore these disfigurements to improve esthetic, function and psychic statue of the patient. Objective of this in vitro study were to estimate the effect using of various resin cements on the shear bond strength between (Heat Clear Acrylic Resin with Heat Clear Acrylic Resin) and (Heat Clear Acrylic Resin with E-max Heat Press Veneer) for construction of artificial scleral as a new technique. Material and Methods Clear heat cure acrylic resin and Lithium disilicate ceramic ingots (IPS E-max Heat Press Veneer) using for construction samples study, total number are (50) samples rectangle shape for shear bond strength test and using two types of adhesives the conventional Glass ionomer cement and Breeze self -adhesive resin cement for linked process. Results. One-way ANOVA test was used to analyze the results, there was a high statistically significant difference between the groups. Conclusion the use of E-max heat press as a new technique for construction of artificial scleral provide acceptable shear bond strength when using Breeze self- adhesive resin.

Introduction:

The dental prosthesis that includes the replacement of damaged or lost parts of the patient's face who suffers from birth defects or incompetence due to illness or trauma, is named as a maxillofacial compensation [1-3]. An example for such a device is the ocular substitute (synthetic eye), it is used to replace a lost eye due to congenital or acquired reasons, but not to improve the vision of the patient who suffered from complete blindness and monocular vision, the outer appearances of the synthetic ocular is a nearly convex shell. The heat polymerized acrylic is the most material that used to fabricated this device [4-6]. Ocular prosthesis is made of Polymethylmethacrylate (PMMA) produced in (1930), a medical criterion

PMMA was fast followed by dentists as a higher alternate to rubber vulcanite from denture bases that made at the time, dental technicians in Royal Navy British they first investigator the utilize of PMMA for made ocular prosthetic as substitution of German eye glass that became un professional use on Second World War. PMMA appear a more durability material than glass material [7,8] .The characteristics of any material that used to construct the ocular substitute are the aesthetics appearance, biocompatibility as much as possible, binary stability and solid, but not causing an irritation of the peripheral eye socket. The hot acrylic resin is a deem as the widely material that used for construction the scleral section of artificial eye that mixed with a white color of oil paints during fabrication the scleral section of ocular prosthesis to get a color similarity as the patient's natural eye [9]. Have a new method to construction an ocular substitute by integration of a veneer ceramic scleral, the material was IPS E-max heat Press technique Scleral Veneer (lithium-disilicate or lithium-orthophosphate) this type of ceramic contain of glass based ceramics, these material has accurate mechanical properties such as a greater fracture resistance, durability and high flexural strength than the traditional glass ceramics that enable the IPS E-max to use as dental restoration materials the high translucency and physical properties (best wear reluctance and reluctance to crack prevalence) that provide by crystalline volume and reactive index of IPS E-max press ceramic [10,11].Dental cement material is used to prevent the restoration to be dislodgement during function like mastication, the most characteristics of dental cement is improved mechanical properties, low solubility, decreased microleakage, low incidence of marginal staining, ability to bond to multiple substrates and high durable bond strength, which is required for successful restorative treatment [12,13] . Recently used the IPS E-max veneer as a new technique for construction of artificial scleral adhere to clear heat cure acrylic resin substructure scleral by using special resin cement material, this material has simplified cementation procedure and not require to addition surface treatment to the substructure surface or veneer surface, this study was designed to estimate the construction of artificial scleral by new technique and the effect of using different adhesive types of cement on the shear bond strength between groups (Clear heat cure acrylic resin with Clear heat cure acrylic resin) and (Clear heat cure acrylic resin with E-max Heat Press Veneer).

Materials and Methods

Sample Preparation

In this study, (50) rectangle shape (12mm length× 4mm width ×4mm height) for shear bond strength test [14-16], each sample have two part, the first part (substructure) with dimension (9mm length × 4mm width ×4mm height) and the second part (veneer) with dimension (3mm length × 4mm width ×4mm height) as shown in Fig. (1), were divided into five groups, (10) samples of (clear heat cure acrylic resin linked with clear heat cure acrylic resin) without using adhesive material, (20) samples of (clear heat cure acrylic resin as substructures with clear heat acrylic resin as veneer) and (20) samples of (clear heat cure acrylic resin as substructures with IPS E-max veneer) joined by using Breeze self -adhesive resin and or conventional Glass ionomer cement. Fifty substructure wax patterns and twenty veneer wax patterns have been prepared by using melt modeling wax and poured in to the silicon mold, all substructure part and veneer part made of clear heat cure acrylic resin(Rodex dental product, Hamburg), the conventional flasking technique used for preparation of the mold, Clear heat cured acrylic was mixed according to manufacturer's instructions (3:1) by volume and adding (1ml) white oil paint acrylic paint to liquid monomer to get white color [9], and mixed it gently then slow addition of powder to liquid. The process of curing was carried out by the placement of clamped flask in a bath of water with (74 ºC of heat for about a 1hour and 30 minutes. The temperature was then increased to the boiling point for 30 minutes according to [17-19]. when curing process is terminated kept the hot

flask to cool overnight for deflasking process, to get rid all the flashes of substructure samples can be used an acrylic bur and for standardization the substructure acrylic resin surface of each sample was leveled and flatted by using the grinder/polisher device with using the aluminum oxide abrasive papers (800,1200) grit for (10)seconds under water then cleaned with distilled water [20]. Custom made holder was fabricated from cold cure acrylic resin to facilitate handling the sample during the process of polishing [21,22], the final measurements of substructure part sample was (9mm length× 4mm width ×4mm height) and veneer part was (3mm length × 4mm width ×4mm height). Twenty veneer wax patterns were prepared for construction veneer part made of IPS E-max ceramic(LTA1, Ivoclar Vivadent), four wax pattern was sprued and investing according to manufacturer's instructions, using IPS silicon ring 100g after setting of the investment material remove the ring gauge from the investment ring and positioning the investment ring in the preheating furnace at (900 0C/1650 0f), when the preheating process is finished take out the hot ring from the machine then enter the cold IPS E-max ingot into the ring and place the cold Ips Alox plunger at the end of the ring that acts as a stopper, places the hot ring in the center position of the hot furnace press machine (Ep3010, Ivoclar Vivadent) and pressing program is selected dependence on the IPS E-max ingot with a weight of investment ring, at the end of the pressing procedure removing the investment ring from the furnace press machine and placed it on the grid to cool, divesting the investment ring and cutting the sprues with diamond disc, using wet grit aluminum oxide (600- 1200) to polishing the veneer sample from one side under continuous and abundant water cooling at speed 500 rpm [23], handling the sample by the acrylic holder during the process of polishing [21,22], the dimension of IPS E-max veneer (3mm length × 4mm width ×4mm height). To obtain the first group of shear bond strength samples (clear heat cure acrylic resin linked with clear heat cure acrylic resin) without using adhesive material, were linked ten veneer wax pattern with dimension (3mm length × 4mm width ×4mm height) to ten Clear heat acrylic resin substructure, this veneer part made of clear acrylic, the mold preparation, construction method and polishing process like that mentioned in preparation of substructure part and veneer part, the final measurement of each sample (12mm± 0.1 length× 4mm width ×4mm height).

Cementation Process

The cementation process of the two-part shear bond Samples (substructure and veneer) joint by using two types of adhesive, first Breeze self -adhesive resin cement (Breeze Pentron Clinical,Technologies, USA),second Glass ionomer cement(Promedica Dental Material GmbH, German) as showed in Table (1) presents the characteristics of the adhesive cement materials used according to manufacture (Breeze Pentron clinical technologies and Promedica dental material). Twenty shear bond samples (clear acrylic substructure with clear acrylic veneer) and (clear acrylic substructure with IPS E-max veneer) the two part linked by using Breeze self -adhesive resin packaged in double barrel syringe with auto mix tips ,working and setting time according to manufacture instruction, attach the mixing tip to the adhesive syringe then gently pot the cement directly in to the disposable syringe then applied (0.3 ml) on the bonding dry surface of each part of shear bond sample to linked it then subjected all the sample to a force of 50 gm by using modified G-clamp holder [24],as shown in Fig. (2), require 4 minute for setting time according to manufacture constriction, excess cement was removed.Final measurements of each sample (12mm length ±0.3× 4mm width ×4mm height), as shown in Fig. (3). The Glass ionomer cement used to linked twenty samples (clear acrylic substructure with clear acrylic veneer) and (clear acrylic substructure with IPS E-max veneer), this adhesive has packaged in two bottles consist of powder(35 g) and liquid(15 ml), mixing one drop of liquid for one level measuring scoop of powder

(powder/liquid ratio=3.0:1g/g) according to manufacture constriction, using a solid cement spatula the mixing time is 30 second and working time 3 minute, then pull the mixing mass by disposable syringe after that applied (0.3 ml) on the bonding dry surface of each part of the shear bond sample to link the two part of each sample to gather, all samples subjected to a force of (50g) by using modified G-clamp holder [24], as shown in Fig. (2), for (5-7 min setting time) according to manufacture constriction, the excess cement was removed, the final measurements of each sample (12mm± 0.3 length × 4mm width ×4mm height), as shown in Fig. (4).

Shear Bond testing

Fifty shear bond samples measuring by using Instron-1195 testing machine (H3166,England) as shown in Fig. (5), the each sample was placed in a sample holder and secured to lower jaw tightly and parallel to horizontal plane during the application of the load which was (100 kilogram (kg) Shear bond force was exerted vertically to the bonding interface between the edge of the substructure acrylic and veneering ceramic) with a stainless steel chisel rod at a constant crosshead speed of (0.5 mm/ min) and mounted on the universal testing machine until fracture occurred [16,24,25].The shear bond strength (megapascal (MPa) was calculated by formula:

Shear bond strength (MPa) = Maximum force (newton (N)/ bonding area (mm2)

Examined fractured shear bond samples under the stereo- microscope (20X) to determine the mode of bonding failure [16,23,26],failure modes were classified into(cohesive, adhesive and mixed) as shown in Fig. (6).

Result

IBM SPSS statistics program Version 21 used for done the statistical analysis of the current study [27] and Microsoft Excel 2010 for doing graphics presentation.

Table (2) and Fig. (7) Shows the means (M) and standard deviations (SD) of the Shear Bond Strength (MPa) for the three groups, with highly significant difference (t-test: P=0.00, P<0.01) between test groups. LSD test (P-value) in the table (3) showed multiple comparisons that there was a highly significant difference at (P=0.00, P<0.01) between the test groups. Table (4) and Fig. (8) represent the values of the shear bond strength test varied according to the type of adhesive used, and statistical analysis represents the highly significant difference (t-test: P=0.00, P<0.01) with tested groups. The table (5) showed multiple LSD test (P-value) comparisons that there was a highly significant difference at (t-test: P=0.00, P<0.01) between the test groups. In Table (6) explain a Comparison study between shear bond strength test (MPa) varied according to type of veneer (Clear heat cure acrylic resin and or IPS E-max ceramic) that are used with Glass ionomer cement adhesive used, shows the means (M) and standard deviations (SD) of the Shear Bond Strength (MPa) for the two groups with a significant difference (t-test: P=0.029, P<0.05) with tested groups. In Table (7) explain a Comparison study between shear bond strength test (MPa) varied according to type of veneer (Clear heat cure acrylic resin and or IPS E-max ceramic) that are used with Breeze self-adhesive resin, shows the means (M) and standard deviations (SD) of the Shear Bond Strength (MPa) for the two groups with a highly significant difference (t-test: P=0.00, P<0.01) with tested groups, Table (8) shows that the mode failure for five study groups.

Discussion

The shear bond strength test was selected in this study because of its simplicity of use, ease of sample preparation and simple test protocol [26]. Shear strength is the maximum shear stress which a material is capable of sustaining, the most important determinant of the shear strength of acrylic materials is the degree of polymerization exhibited by the material. As the degree of polymerization increases the shear strength of the resin also increases[28]. The bonding between resin cements and ceramic substrates can be obtained mechanically by surface interlocking and also chemically [29,30]. According to the

results in Tables (2), (4) and fig. (7)and(8), measurements in this in vitro study, there is a highly significant difference between the conventional method when joint (Clear heat cure acrylic resin substructure with Clear heat cure acrylic resin veneer) that has a high mean value and different types of adhesive used to jointed (Clear heat cure acrylic resin substructure with Clear heat cure acrylic resin veneer) and (Clear heat cure acrylic resin substructure with IPS E-max veneer ceramic)by using Glass ionomers cement and or Breeze self-adhesive resin, this result primarily attributed to mechanism of the chamical adhesion between Clear heat cure acrylic resin with Clear heat cure acrylic resin by using heat cured method only with absence using any adhesive material ,and the most important which increase of the shear strength is the degree of the polymerization this agree with AL-Ghabban et al., 2009 when they concluded the most important which increase of the shear strength is the degree of the polymerization exhibited by the material [25]. Whereas the different types of adhesive Glass ionomers cement and or Breeze self-adhesive that used to jointed two part of the sample, showed a low mean value of shear bond strength test, this could be related to using the adhesive material that apply on the external surface on the Clear heat cure acrylic resin part and or IPS E-max part (veneer)of specimens incorporation to the Clear heat cure acrylic resin part substructure which not provide bonding like the bond between the Clear heat cure acrylic resin to Clear heat cure acrylic resin without using any adhesive material. In Tables (3) and (5) show highly significant difference for shear bond strength when using conventional Glass-ionomer cement and or Breeze self-adhesive resin to joint (Clear heat cure acrylic resin with Clear heat cure acrylic resin) and linked (IPS E-max ceramic with Clear heat cure acrylic resin) this result related to mechanical properties to the type adhesive material , the characteristic of the self-adhesive resin is provide best merits such as a low solubility, high bonding strength, high compressive strength and high tensile strength, because of these properties they can be used in status with the anxiety of retention or with weak and esthetic restorations, addition to that, its low pH and high hydrophilicity at early stages after mixing, as the hydrophilic and acidic monomers are consumed by the chemical reactions in situ ,the cement becomes more hydrophobic, which is highly desirable in a fully set resin cement to minimize water sorption, hygroscopic expansion, and hydrolytic degradation, but the Glass-Ionomer cement are a low tensile strength, a low bonding to ceramic core or to tooth, a temperate compressive strength, moisture sensitivity during setting and predisposition to moisture contamination and desiccation that may happen when exposure to water and saliva pollution during the initial setting period ,and this influenced to increase the solubility and decrease the eventual hardness, and this agree with (Paul, 2015, Manso and Carvalho, 2017) who concluded that, the Self-adhesive resin cements are considered as alternative luting cements with multiple applications in modern dentistry and are current popular luting materials with advantages over traditional luting cements [29,30]. In Table (6) the result showed the a significant difference of shear bond strength the highest mean value of shear bond strength was obtained in (Clear heat cure acrylic resin with IPS E-max ceramic) while the (Clear heat cure acrylic resin with Clear heat cure acrylic resin) showed less shear bond strength, this could be related to the indications of Glass-Ionomer cement that cementable the all ceramic restoration crowns, bridges ,inlays, onlays ,pins, postsand orthodontic bands according to manufacture construction and not mention using for acrylic resin material. From Table (7) appear a highly significant difference of shear bond strength the highest mean shear bond strength value was related in (Clear heat cure acrylic resin with IPS E-max ceramic) and the lowest mean was related in (Clear heat cure acrylic resin with Clear heat cure acrylic resin) that may be related to the indications of Breeze self -adhesive cement that cementable all-ceramic restoration, alloy (crown, bridge), inlay,onlay, cementation of fiber-

reinforced composite restoration, titanium, titanium alloy, stainless steel and zirconia posts according to manufacture construction and not mention using for acrylic resin material, but in vitro study the Breeze self -adhesive cement appear can provide acceptable linked Clear heat cure acrylic resin with IPS E-max ceramic and this will increase the advantage of self-adhesive resin cement. The quality of the bond not depend on nominal values of bond strength, but also depend on failure mode analysis of the deboned surfaces which provide valuable information regarding the performance of the materials under forces experienced clinically [16], the Mode of Failure in Table (8) appear the cohesive failure in(Clear heat cure acrylic resin with Clear heat cure acrylic resin) without using adhesive was (20%) and a high percentage mixed failure (adhesive/ cohesive), which suggests the conventional method to the bonded interface without using adhesive was stronger than anther subgroups study because the mechanism of the chemical adhesion between (Clear heat cure acrylic resin with Clear heat cure acrylic resin) by using heat cured method only with absence using any adhesive material, and the mode failure for Subgroup(Clear heat cure acrylic resin with ISP E-max ceramic)and (Clear heat cure acrylic resin with Clear heat cure acrylic resin) linked by using Breeze self-adhesive resin and or conventional Glass ionomer cement appear the high percentage has primarily occurred in the adhesive failure (100%), this may be related to weak bond between the groups which the bond depended on the adhesive material only .

Conclusions

In the present study, the use of IPS E-max heat press as a new technique for the construction of artificial scleral this method provides acceptable shear bond strength, especially the using of Breeze self-adhesive resin they provide best shear bond strength between subgroups (Heat Clear Acrylic with Heat Clear Acrylic) and (Heat Clear Acrylic with IPS E-max ceramic) than the Glass ionomer resin cement.

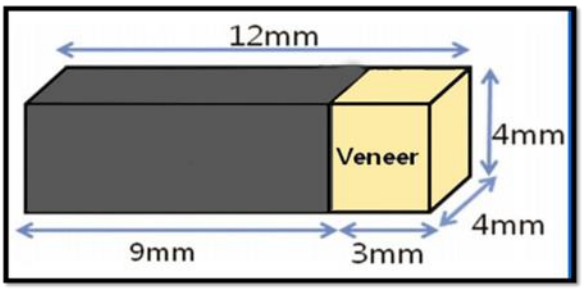

Fig. (1): Dimension of shear bond strength test sample

Fig. (2): Modified G-clamp holder

Fig. (3): Shear bond samples linked by using Breeze self -adhesive resin

Fig. (4): Shear bond samples linked by using Glass ionomer cement.

Fig. (5): Instron-1195 testing machine, the sample in holder and mounted in a universal testing machine.

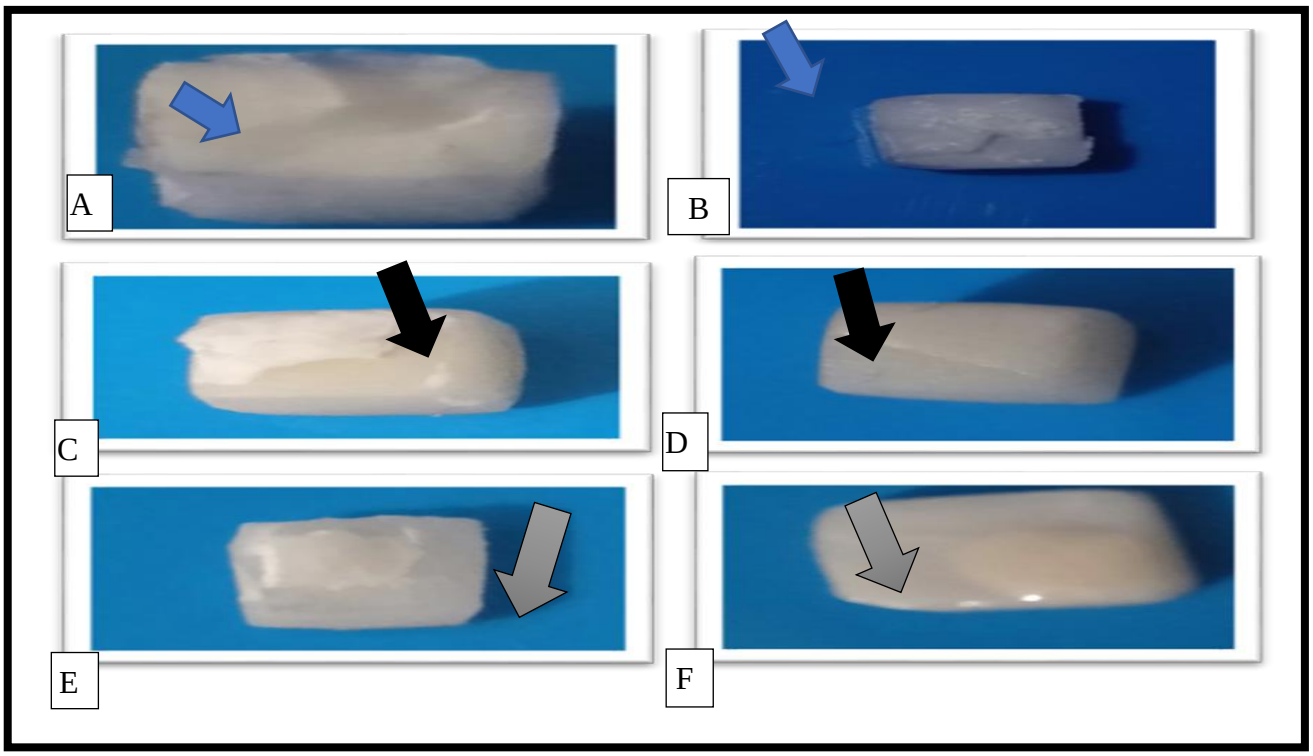

Fig. (6): Types of bond failure: A, B-mixed failure (Adhesive and cohesive failure) in clear heat cure acrylic resin to clear heat cur acrylic resin without using adhesive , C-adhesive failure in ISP E-max ceramic to clear heat cure acrylic resin using breeze self-adhesive resin, D- adhesive failure in ISP E-max ceramic to clear heat cure acrylic resin using glass ionomer cement, E-adhesive failure in clear heat cure acrylic resin to clear heat cur acrylic resin using breeze self-adhesive resin ,F- adhesive failure in clear heat cure acrylic resin to clear heat cure acrylic resin using glass ionomer cement.

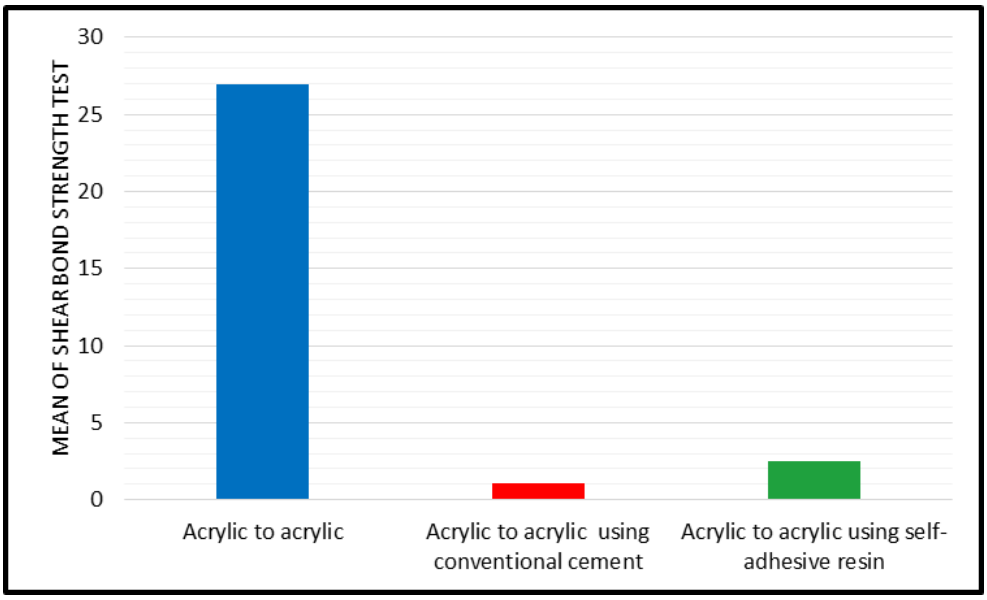

Fig. (7): A Bar chart illustrate of mean value of shear bond strength test (MPa) among studied group

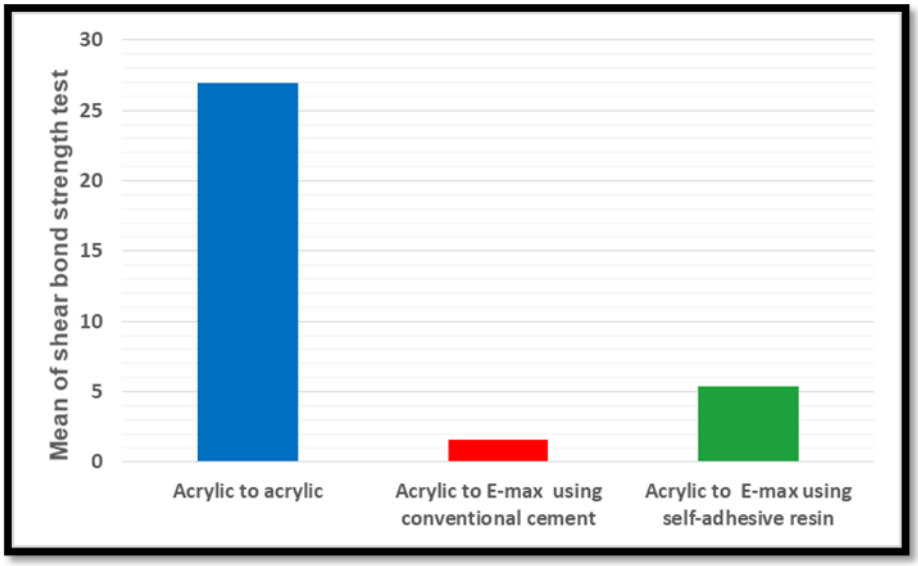

Fig. (8): A bar chart illustrate of mean distributions of shear bond strength test (MPa) among studied groups

Table (1): Adhesive material used in present study according to manufacture (Breeze Pentron clinical technologies and Promedica dental material).

Type of adhesive material	**Main composition**	**Delivery system**	**Worki-ng time / setting time**	**Shades**	**Manufact-ure**
I-Breeze self - adhesive resin cement	-bisphenol-A-diglycidyl methacrylate -urethane dimethacrylate - hydroxyethyl methacrylate, -methacryloxyethyl trimellitic acid -silane treated barium glass, - silica (amorphous), Ca-Al-F-silicate	Paste/paste dual syringe; direct dispensing through a mixing tip	1minute/4 min	Transluc-ent	Breeze Pentron Clinical Technologies,Wallingford, CT, USA
II-Glass ionomer cement (glass polyalkenoate cement)	-polyacrylic acid -fluoro alumino silicate Bases-parabens	35g Powder / 15 ml liquid	3 min/ 5-7min	Translucent	PROMEDICA Dental Material GmbH, German

Table (2): mean value and Stander Deviation of Shear bond strength test (MPa) among studied groups

Studied Groups(Shear bond strength test)	N	Mean	Std. Deviation	Std. Error	Range		t-test(P-value)
					Mini.	Maxi.	
Clear heat cure acrylic resin with Clear heat cure acrylic resin without using. adhesive material	10	26.957	1.823	0.576	24.43	30.68	P=0.00 Highly sign. (P<0.01)
Clear heat cure acrylic resin with Clear heat cure acrylic resin using Glass inomer cement	10	1.090	0.160	0.051	0.74	1.29	
Clear heat cure acrylic resin with Clear heat cure acrylic resin using Breeze self-adhesive resin	10	2.494	0.447	0.141	2.08	3.33	
Total	30						

Highly Significant at P<0.01

Table (3) less significant difference (LSD test) for shear bond strength among studied groups.

Studied groups (Shear bond strength test)		LSD test(P-value)
Clear heat cure acrylic resin with Clear heat cure acrylic resin without using adhesive material	Clear heat cure acrylic resin with Clear heat cure acrylic resin using Glass inomer cement	P=0.00 Highly sign. (P<0.01)
	Clear heat cure acrylic resin with Clear heat cure acrylic resin using Breeze.self-adhesive resin	P=0.00 Highly sign. (P<0.01)
Clear heat cure acrylic resin with Clear heat cure acrylic resin using Glass inomer cement	Clear heat cure acrylic resin with Clear heat cure acrylic.resin.using Breeze.self-adhesive resin	P=0.001 Highly sign. (P<0.01)

Highly Significant at P<0.01

Table (4): Mean value and Stander Deviation of Shear bond strength test (MPa) among studied groups

Studied groups (Shear bond strength test)	N	Mean	Std. Deviation	Std. Error	Range		t-test(P-value)
					Mini.	Maxi.	
Clear.heat.cure.acrylic resin to Clear heat cure acrylic resin without using adhesive materil	10	26.957	1.823	0.576	24.43	30.68	P=0.00 Highly sign. (P<0.01)
Clear heat cure acrylic resin to IPS E-max ceramic using Glass inomer cement	10	1.612	0.242	0.076	1.29	2.09	
Clear heat cure acrylic resin to IPS E-max using Breeze self- adhesive resin	10	5.359	0.443	0.140	4.90	6.19	
Total	30						

Table (5): Less significant difference (LSD test) for shear bond strength among studied groups

Studied groups (Shear bond strength test)		**LSD test(P-value)**
Clear heat cure acrylic resin with Clear heat cure acrylic resin without using adhesive material	Clear heat cure acrylic resin with IPS E-max ceramic using Glass inomer cement	P=0.00 Highly sign. (P<0.01)
	Clear heat cure acrylic resin with IPS E-max ceramic using Breeze self-adhesive resin	P=0.00 Highly sign. (P<0.01)
Clear heat cure acrylic resin with IPS E-max ceramic using Glass inomer cement	Clear heat cure acrylic resin with IPS E-max ceramic using Breeze self-adhesive resin	P=0.00 Highly sign. (P<0.01)

Highly Significant at P<0.01

Table (6): Comparison study between shear bond strength test (MPa) among studied groups

Studied groups (Shear bond strength test)	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**Range**		**t- test (P-value)**
					Mini.	**Maxi.**	
Clear heat cure acrylic resin with Clear heat cure acrylic resin using Glass inomer cement	10	1.090	0.160	0.051	0.74	1.29	P= 0.029 Sign. (P<0.05)
Clear heat cure acrylic resin with IPS E-max ceramic using Glass inomer cement	10	1.612	0.242	0.076	1.29	2.09	
Total	20						

Significant at P<0.05

Table (7): Comparison study between shear bond strength test (MPa) among studied groups.

Studied groups (Shear bond strength test)	**N**	**Mean**	**Std. Deviation**	**Std. Error**	**Range**		**t- test (P-value)**
					Mini.	**Maxi.**	
Clear heat cure acrylic resin with Clear heat cure acrylic resin using Breeze self-adhesive resin	10	2.494	0.447	0.141	2.08	3.33	P=0.00 Highly sign. (P<0.01)
Clear heat cure acrylic resin with IPS E-max ceramic using Breeze self-adhesive resin	10	5.359	0.443	0.140	4.90	6.19	
Total	20						

Highly Significant at P<0.01

Table (8): types of Failure in study groups

Study groups	Cohesive	Adhesive	Mixed(cohesive and adhesive failure)
clear heat cure acrylic resin with clear heat cure acrylic resin without using adhesive	20%	0	100%
Clear heat cure acrylic resin with ISP E-max ceramic using Glass inomer cement	0	100%	0
Clear heat cure acrylic resin with ISP E-max ceramic using Breeze self-adhesive resin	0	100%	0
Clear heat cure acrylic resin with Clear heat cure acrylic resin Glass inomer cement	0	100%	0
Clear heat cure acrylic resin with Clear heat cure acrylic resin using Breeze self-adhesive resin	0	100%	0

References

1-Sethi T, Kheur M, Haylock C, Harianawala H. Fabrication of a custom ocular prosthesis. Middle East African journal of ophthalmology, 3; 271; 2014.

2-Deepthi VS. Maxillofacial Prosthetic Materials-An Update. Journal of International Medicine and Dentistry,1;2-11; 2016.

3- De Caxias, F. P., Dos Santos, D. M., Bannwart, L. C., De Moraes Melo Neto,C. L. & Goiato, M. C. Classification, History, and Future Prospects of Maxillofacial Prosthesis. International Journal of Dentistry , Vol. 2019; 7, 2019.

4- Doshi PJ, Aruna B. Prosthetic management of patient with ocular defect. The Journal of Indian Prosthodontic Society, 1;37, 2005.

5- Timmermann, C. & Anderson, J. Devices and designs: medical technologies in historical perspective, chap.1, Springer,7,2006.

6- Raizada, K. & Rani, D. Ocular prosthesis. Contact Lens Anterior Eye. Elsevier,3;152-162, 2007.

7- Pine KR, Sloan BH, Jacobs RJ. Clinical ocular prosthetics. vol.10, chap. 1, Berlin, Germany: Springer International Publishing, 1-23. 2015.

8- Gupta, R.K., Dunderdale, G.J., England, M.W. and Hozumi, A. Oil/water separation techniques: a review of recent progresses and future directions. Journal of Materials Chemistry A, 31, pp.16025-16058; 2017.

9- Kati FA. Translucency of clear acrylic resin influenced by oil paints. Iraqi Dental Journal. 1:11-4; 2018.

10- Da Costa GC, Aras MA, Chalakkal P, Da Costa MC. Ocular prosthesis incorporating IPS e-max press scleral veneer and a literature review on non-integrated ocular prosthesis. International journal of ophthalmology. 1: 148, 2017.

11- Upadhyaya V, Arora A, Singhal J, Kapur S, Sehgal M. Comparative analysis of shear bond strength of lithium disilicate samples cemented using different resin cement systems: An in vitro study. The Journal of Indian Prosthodontic Society. 3:240;2019.

12- Hill EE, Lott J. A clinically focused discussion of luting materials. Australian dental journal. 56:67-76; 2011.

13- Lee Y, Kim JH, Woo JS, Yi YA, Hwang JY, Seo DG. Analysis of self-adhesive resin cement microshear bond strength on leucite-reinforced glass-ceramic with/without pure silane primer or universal adhesive surface treatment. BioMed research international. 2015, 18;2015.

14-Choi BK, Han JS, Yang JH, Lee JB, Kim SH. Shear bond strength of veneering porcelain to zirconia and metal cores. The journal of advanced prosthodontics. 3:129; 2009.

15- Sreekala L, Narayanan M, Eerali SM, Eerali SM, Varghese J. Comparative evaluation of shear

bond strengths of veneering porcelain to base metal alloy and zirconia substructures before and after aging–An in vitro study. Journal of International Society of Preventive & Community Dentistry. 2: 74; 2015.
16- Mohammed, I. & Alwahab, Z. N. An evaluation of the effect of artificial saliva with different ph on shear bond strength of veneering ceramic to metal and zirconia substructure (in vitro study). World Journal of Pharmaceutical Research. 17:107-120;2017;
17- ASSOCIATION, A. N. S. A. D. ANSI/ADA Specification no. 12-1975 Denture Base Polimers. Council on Scientific Affairs ADA, Chicago 1999.
18- Al-Taie, A.Z., Al-Nakkash, W.A. and Salman, F.D., Evaluation of olive oil as a separating medium and its effect on some physical properties of processed acrylic resin denture base (A comparative study). Part one. Journal of Baghdad college of dentistry, 3:40-49; 2015.
19- Aziz HK. Changes in the Transverse Strength of Heat-Cured Acrylic Denture Base by Using Diodes Laser as Surface Treatment. Changes.4: 103-111;2016.
20- Tornavoi DC, Agnelli JA, Lepri CP, Mazzetto MO, Botelho AL, Soares RG, Dos Reis AC. Assessment of surface hardness of acrylic resins submitted to accelerated artificial aging. Minerva Stomatol. 6:283; 2012.
21- Akgungor G, Akkayan B, Gaucher H. Influence of ceramic thickness and polymerization mode of a resin luting agent on early bond strength and durability with a lithium disilicate–based ceramic system. The Journal of prosthetic dentistry. 3:234-241; 2005.
22- Kim, B., Zhang, Y., Pines, M. and Thompson, V.P., Fracture of porcelain-veneered structures in fatigue. Journal of dental research, 2:142-146; 2007.
23- Hasan, S. F. & Abood, A. Z. Evaluation the effect of hydrofluoric acid and grinding treatment on shear bond strength of IPS E. max press with ceramic veneer material (an in vitro study). World journal of pharmaceutical research, 15:1-23;2017.
24- Roy AK, Mohan D, Sunith M, Mandokar RB, Suprasidh S, Rajan S. Comparison of Shear Bond Strengths of Conventional Resin Cement and Self-adhesive Resin Cement bonded to Lithium Disilicate: An in vitro Study. The journal of contemporary dental practice. 10:881; 2017.
25- Al-Ghabban, R. M. J., Al-habeeb, S. S. & Al–berqdar, F. A. Evaluations and comparison of some mechanical properties of the self and hot–cure–acrylic denture base materials under different pressures modality. Journal of Kerbala University,1: 224-235; 2009.
26- Hussain AM, Al-Azzawi AK. Shear bond strength between lithium disilicate ceramic and different luting cements. J Genet Environ Resour Conserv. 3:212-217;2015.
27- Lu Y, Fang JQ, Tian L, Jin H, editors. Advanced medical statistics. Vol.5,chap.2, World Scientific,21; 2015.
28- Mohammed B, Afram B, Nazar Z. An evaluation of the effect of different surface treatment on hardness and smoothness of pressable ceramic (in vitro study). IOSR Journal of Dental and Medical Sciences. 14:84-89; 2015.
29- Paul J. Dental Cements-A review to proper selection. International Journal of Current Microbiol and Applied Sciences. 2: 659-669; 2015.
30- Manso, A. P. & Carvalho, R. M. Dental cements for luting and bonding restorations: self-adhesive resin cements. Dental Clinic North America, Elsevier. 4:821-834; 2017.