EGYPTIAN
DENTAL JOURNAL
www.eda-egypt.org

Vol. 71, 3267:3278, October, 2025

Print ISSN 0070-9484 • Online ISSN 2090-2360

Fixed Prosthodontics and Dental Materials

Submit Date : 10-07-2025 • Accept Date : 20-08-2025 • Available online: 01-10-2025 • DOI : 10.21608/edj.2025.402766.3548

EFFECT OF DIFFERENT CEMENTATION TECHNIQUES AND CURING MODES ON SHEAR BOND STRENGTH OF CAD/CAM OCCLUSAL VENEERS TO TOOTH STRUCTURE

Mai Samy Sheta *, Asma Abubakr Rashed ** *and* Radwa Eldessouky***

ABSTRACT

Objectives: The current study intended to assess the effect of different cementation techniques and curing modes on shear bond strength of CAD/CAM occlusal veneers to tooth structure.

Materials &methods: 42 Extracted upper premolars were collected and after disinfection standardized tooth preparations were done by precision saw. Lithium disilicate glass ceramic (IPS e.max CAD) occlusal veneers were prepared then cemented to teeth preparations. Specimens were allocated into two groups (n=21) according to cementation technique: Group I: total-etch resin cement (Duo-link) and Group II: self-adhesive resin cement (Biscem). Then each group was subdivided into three subgroups (n=7) regarding different curing modes: conventional, high energy and ramp curing modes. All the specimens were thermo-cycled before testing of shear bond strength by universal testing machine. Inspection of failure mode pattern was carried out by stereomicroscope. One way ANOVA test was utilized for comparing between subgroups then multiple comparison Tuckey test. The independent t-test was utilized to compare the studied groups at each subgroup.

Results: Both groups while utilizing high energy curing mode demonstrated significantly lower bond strength than other curing modes. In comparison to self-adhesive resin cement, total-etch resin cements recorded significant improvement in bond strength while utilizing conventional or soft curing mode. While there was no significant difference between them when high cure mode was used.

Conclusion: Higher bond strength can be attained while utilizing conventional and ramp cure compared to high curing mode for. Total-etch resin cement proved its superior bonding to tooth structure in comparison to self-adhesive resin cement.

KEYWORDS: Occlusal veneer, CAD/CAM, Shear bond strength, cementation techniques, curing modes

* Lecturer, Dental Biomaterials Department, Faculty of Dentistry, Tanta University, Tanta, Egypt.
** Lecturer, Restorative Dentistry Department, Faculty of Dentistry, Tanta University, Tanta, Egypt.
*** Lecturer, Fixed prosthodontics Department, Faculty of Dentistry, Tanta University, Tanta, Egypt.

INTRODUCTION

Among the primary goals of contemporary restorative dentistry is to achieve acceptable cosmetic outcomes while preserving biological features. Restorative procedures have become easier, more predictable, and capable of producing satisfactory aesthetic and functional outcomes[1,2]. Tooth wear, erosion, or caries can lead to enamel degradation and exposing the underlying dentin creating occlusal defects[3,4]. The therapy of these defects is difficult and might be treated by dental inlays, onlays, or crowns[5,6], yet they could be quite invasive[5]. Minimally invasive treatments are being promoted because of the continued advancement of adhesive bonding technologies as they give many benefits like conservation of tooth structure, preservation of pulp vitality and diminished postoperative sensitivity[7-9]. All ceramic occlusal veneers are increasingly used for treatment of severely worn teeth[10]. Highly worn teeth show unequal deterioration, including flaws on the occlusal surface[11]. For correcting those flaws, occlusal veneer's designs could be altered[12-16]. Numerous variables impact the lifetime of all ceramic restorations, including the type of the ceramic material, occlusal stresses, and bonding quality [17,18].

Recently, computer-aided design/computer-aided manufacturing (CAD/CAM) systems have been extensively utilized for production of dental prostheses [19]. Occlusal veneers are a viable and successful prosthetic treatment option because CAD/CAM ceramic products can be manufactured in thin disks while maintaining acceptable mechanical features and better bonding capabilities. The development of lithium disilicate, IPS e-max, substantially improved the ceramic restorations. It has been extensively established as a strong and etchable ceramic, resulting in improved bonding potential and more durable restorations [20].

Optimal adhesion between ceramic and tooth material is required for ceramic restorations to operate properly [21]. Resin cements were chosen because they had better mechanical [22] and adhesive qualities than typical luting agents [23]. They demonstrated great marginal integrity and minimal microleakage [24]. Application of resin cements creates an appropriate stress distribution, that prevents cracking start [25].

Etch-and-rinse techniques established an effective bonding with enamel[26]. However, it has been shown that bonding to exposed dentin was reduced [27]. As a result, self-etching primers were employed to make bonding technique more simple and enhance bonding to dentine [28]. They seem to have a promising role in obtaining a long-term connection to dentin[29]. Considering enamel, bonding by self-etch primers is surrendered in comparison to phosphoric acid etching due of their low etching capacity [30].

Self-adhesive resin cements are comprised of filled polymers that bind to tooth tissues with no use of an additional adhesive or etchant. They have a hybrid composition which combine elements of composite resin, self-etch adhesives, and, in certain instances, dental cements. Their main advantage appears to be ease of application. But there has been little independent investigation of their therapeutic effectiveness [31].

There are numerous curing modes used for lowering polymerization stresses. In uniform continuous curing, composite resin is exposed to a constant light intensity for a set amount of time. The high-energy pulse cure treatment employs exceptionally high energy (1000-2800 mW/cm^2), three to six times the typical light intensity for a short period of only ten seconds. Considering ramp curing mode, light is delivered at a low intensity then gradually raised over time to high intensity levels. This permits slow curing of the composite, lowering polymerization stresses since it may flow during polymerization. Additionally, this action is intended to minimize polymerization shrinkage [32]. The null hypothesis of this study was that neither cementation technique nor curing mode would impact the shear bond strength of CAD/CAM occlusal veneers to tooth structure.

MATERIALS AND METHODS

Sample selection

Fourty two extracted caries-free and intact human maxillary premolars were gathered from Oral and Maxillofacial surgery department, Faculty of Dentistry, Tanta University. The sample size for this investigation was determined based on a prior study [33]. The significance threshold was 50% and the power of the sample size was greater than 80% for this investigation with a confidence range of 95% and an actual power of 96.67%. The effect size was1.299867. The sample size was estimated using a computer application G power version 3.1.9. The purpose of the present study was explained to the patients and informed consents were obtained to use their teeth in the research according to the guidelines on human research adopted by the Research Ethics Committee, Faculty of Dentistry, Tanta University (**#R-BIO-2-25-3185**). Teeth were extracted for orthodontic purpose and having average dimensions of 7.5±0.5 mm mesio-distal, 9.7±0.5 mm bucco-lingual, and 9.3±0.5 mm occluso-cervical.

Sample preparation and grouping

After removal of calculus deposits and tissues from teeth by an ultrasonic scaler, they were kept in a 0.1% thymol solution to disinfect. Cleaning of teeth was performed by a rubber cup with a fine pumice water slurry then they were preserved in distilled water at 37˚C±1 C in the incubator (BTC, Model: BT1020, Cairo, Egypt). Throughout this study, water was replaced every five days. Every tooth was submerged vertically in self-cure acrylic resin (Acrostone, cold cure, Egypt), While its cemento-enamel junction (CEJ) is two millimeters above the resin. Using a digital caliper to measure 4mm occlusal to CEJ, the remaining coronal portion was sectionally removed perpendicular to the tooth's long axis, exposing core dentin and peripheral enamel. Standardized tooth preparations imitating a worn occlusal table were completed utilizing diamond saw accompanied by water-cooling (Isomet® 5000 Linear Precision S, BuehlerLtd, Bluff, IL) **(Fig. 1)**. A guided notch was made on the occluso-mesial side of each specimen to aid in the precise placing of the veneers during cementation **(Fig. 2)**.

TABLE (1) Materials, brands, chemical composition and manufacturers and batch number:

Materials	Brand	Chemical composition	Manufacturer	Batch number
Lithium disilicate glass ceramics	IPS e.max CAD	SiO_2, Li_2O, P_2O_5, K_2O, ZrO_2, ZnO, other oxides, pigments	Ivoclar Vivadent, Liechtenstein	Z01SBP
Total-etch dual-cure resin cement	Duo-link UNIVERSAL	Dimethacrylate, Inorganic fillers, Catalysts, Pigments.	Bisco, Inc., Schaumburg, IL, USA	2300110416
Self-adhesive dual-cure resin cement	BisCem	Bis (hydroxyethyl methacrylate) phosphate, tetraethylene glycol dimethacrylate, glass fillers	Bisco, Inc., Schaumburg, IL, USA	2300110416
Phosphoric acid gel etchant	HV® Etch w/BAC	35% phosphoric acid , Benzalkonium Chloride	Bisco, Inc., Schaumburg, IL, USA	2400001658
Ceramic etching gel	Bisco's Porcelain Etchant	4 % hydrofluoric acid gel	Bisco, Inc., Schaumburg, IL, USA	2300110359
Universal Adhesive	BISCO's All-Bond Universal	Bisphenol A diglycidyl methacrylate, MDP, ethanol ,2-hydroxyethyl methacrylate	Bisco, Inc., Schaumburg, IL, USA	2400013035
Silane coupling agent	BISCO's porcelain primer	Silane methacrylate	Bisco, Inc., Schaumburg, IL, USA	2400015149

A diamond bur was used to standardize notch specifications of 1 mm in depth, width, and height. The teeth were visually checked for disqualifying features such as pulpal exposure or cracks.

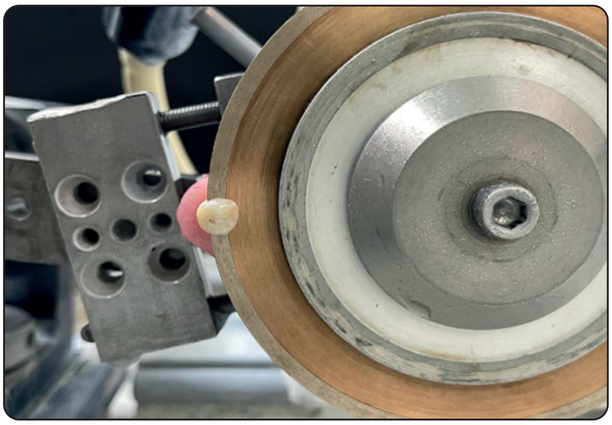

Fig. (1) Standardized tooth preparation by water cooled diamond saw.

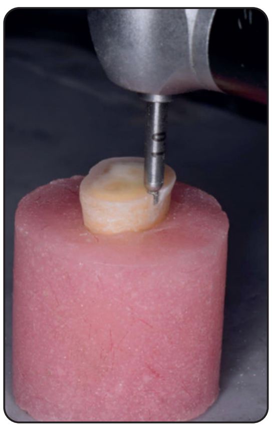

Fig. (2) Standardized notch dimension preparation by a diamond bur.

Fourty two prepared teeth were randomly distributed into 2 main groups (n = 21) according to the cementation techniques: **Group I**: Total-etch resin cement **(Duo-Link)** and **Group II**: Self-adhesive resin cement **(BisCem)**. Each group was then separated into three subgroups(n=7): according to curing modes into:

- **Subgroup A**: conventional light cure with uniform continuous curing output of for 20 seconds
- **Subgroup B**: high energy cure which employs a short (10-second) pulse with exceptionally high energy (2300 mW/cm2),
- **Subgroup C**: ramp cure with gradual increase in light intensity to during the first 5 seconds then keep the output (1000mW/cm2) steadily for the remainder 15 seconds.

Occlusal veneers production

Lithium disilicate ceramic (IPS e.max CAD) occlusal veneers were produced by CAD/CAM technology utilizing CAD software (Exocad Dental CAD, exocad GmbH, Germany). The prepared tooth surface was scanned using CAD scanner (Medit i 700, Medit, Korea). Standardization of the restorations' thickness was carried out using the program by rising and lowering the occlusal surface virtually in the fissure region till the required thickness was reached. The restorations were milled from E max blocks in a CAD/CAM 5-axis dental milling CNC machine (UP3D P52 5 axis, UP3DSystem, China)

Adhesive cementation techniques.

The occlusal veneers were checked for proper fit and ultrasonically cleaned by 99% isopropanol for five minutes. All teeth were scrubbed by pumice and completely washed by water. The fitting surface of each occlusal veneer was etched using a 4% hydrofluoric acid gel for twenty seconds, then sprayed by water for sixty seconds then dried by oil-free air. Then, silane coupling agent was painted to the fitting surface of each occlusal veneer utilizing a micro-brush. After 60 seconds, air was utilized to evenly disseminate it and create a thin coating. Another layer was added and thinned by air in accordance with the manufacturer's guidelines. For **Group I**, the teeth surfaces were etched by phosphoric acid gel, which was administered first to the enamel borders then to dentin. This allowed etchant to etch enamel for thirty seconds and dentin for only fifteen seconds. The etchant was then completely washed off all surfaces by a spray of water for at fifteen seconds and the etched occlusal surface was dried with gauze (i.e., avoid over drying). The adhesive will be applied using bond brush to etched enamel and dentin, thinned then light cured for 20s. The sealed surfaces were then covered by glycerin gel to avoid the creation of an oxygen-inhibited layer, followed by additional ten seconds of light curing. The glycerin layer was then rinsed. Total-etch resin cement (Duo-link) was applied to fitting surface of the veneer and to prepared occlusal surface as well using auto-mix tip. While for **Group II**, no etching or priming steps were needed. Self-adhesive luting agent (Biscem) was placed directly from the auto-mix tip onto the fitting surface of the veneer as well as the tooth surface.

For both groups, occlusal veneers were placed on their relevant prepared surfaces by static finger pressure then a uniform static vertical seating load of 1 kg was applied over each luted specimen using specially designed handmade static loading cementing device under universal testing machine to remove excess cement. The excess cement will be removed within 1 min by cotton pellet and margins were coated by glycerin gel. Then, the cement was light polymerized at five millimeters from each restoration surface. Each subgroup (n=7) was subjected to a specific curing mode according to the following, subgroup A: conventional cure., subgroup B: high cure and subgroup C: ramp cure. This was accomplished by different curing programs using Light curing pen (Eighteeth, Changzhou Sifary Medical technology Co, Ltd). To ensure standardized light curing intensity, radiometer used before and after light curing.

Thermo-cycling

Thermo-cycling of all specimens (n = 42) was carried out for 5000 cycles (SD mechatronik thermocycler, Germany), equivalent to roughly six months of clinical service prior to shear bond strength testing. They were cycled between 5 and 55◦C ± 2 with a immersion duration of 5 s and a 5 s transition between each bath, following ISO 11405 (International Standards Organization) standards. After that, all specimens were thoroughly examined by an optical microscope to look for cracking or debonding.

Shear bond strength testing:

Following thermocycling, all specimens underwent a shear bond strength (SBS) testing by using a universal testing machine (Model3345; Instron Industrial Products, Norwood, USA) by a 5KN load cell. For shear testing, a compressive loading at the dentine ceramic interface **(fig 3)** was applied by a mono-beveled chisel-shaped metallic rod with a cross-head speed at 0.5 mm/min. Maximum load values were recorded in newtons (N) and SBS was determined as follows: S=L/A, where S is the SBS (MPa), L is the failure load (N) and A is the adhesive area (mm^2). The occlusal surface of each specimen was scanned using an intraoral scanner to create standard tessellation language (STL) files. The scanned data set will be transmitted to a CAD manipulation software tool, where the peripheral of occlusal surfaces will be recognized and digitally refined as required. The surface area of each preparation will be calculated using the CAD software package **(fig4).**

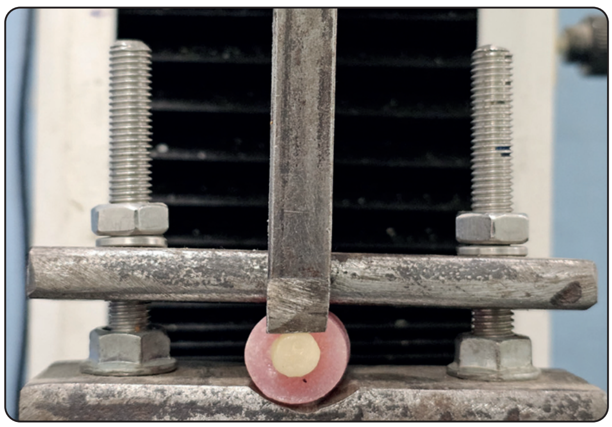

Fig. (3) Shear bond testing by a mono-beveled chisel shaped metallic rod using universal testing machine.

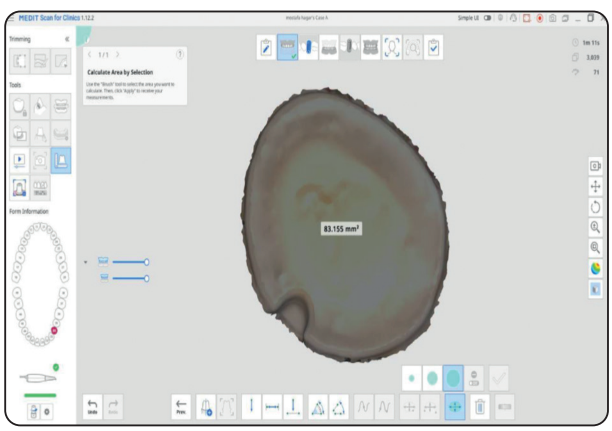

Fig. (4) Computing surface area of each preparation by using the CAD software program.

Failure mode inspection

After shear bond test, specimens in the tested groups were viewed by a stereomicroscope (SMXX, Carl Zeiss-Jena, Germany) and images were taken and inspected for determining the failure mode pattern. According to this categorization: adhesive failure (at the ceramic cement interface or at the dentine cement interface), cohesive failure (occurring either within the ceramic or within dentin), and mixed failure (combination of adhesive and cohesive failures occurring together)

Statistical analysis:

Statistical analysis was conducted by Statistical Package for Social Sciences (IBM SPSS Statistics version 26). Numerical variables were presented as means, standard deviations and ranges. P-value <0.05 (*) indicated a significant difference. A P-value of <0.001 (**) indicated a highly significant difference. To compare the analyzed subgroups, a one-way ANOVA test was employed, followed by the Tuckey multiple comparison test. The independent t-test was performed to compare the studied groups at each subgroup.

RESULTS

Table 2 illustrated results of SBS testing of the studied groups, which were expressed using mean, standard deviation, and Range. Also showed the comparison between the subgroups in each group individually using one way ANOVA testing, then multiple comparison Tuckey test. For **Group I:** Total-etch resin cement (Duo-link), subgroup A (conventional cure) showed a highly significant increase in SBS compared to subgroup B (high cure) with p-value 0.000**. Also, SBS of Subgroup C (ramp cure) was significantly higher than subgroup B (high cure) with p-value 0.002*, while that there was no significant difference between Subgroup A (conventional cure) and Subgroup C (ramp cure) with p-value 0.240, For **Group II:** Self-adhesive resin cement (Biscem), there was a significant change between Subgroup A (conventional cure) and Subgroup C (ramp cure) with p-value 0.006*, while both of them recorded a highly significant improvement in SBS when compared to Subgroup B (high cure) with p-value 0.000**. The independent t-test was used to compare the groups studied at each subgroup, which showed no significant difference between group I and group II at subgroup B utilizing high cure mode. While for subgroups A and C, utilizing conventional and ramp cure respectively, total-etch resin cement (Group I) recorded highly significant improvement in SBS when compared to self -adhesive resin cement (Group II) with p-value 0.000**.

TABLE (2) Comparison between SBS of different tested groups

Groups	Shear bond strength				p-value
	Group I Total-etch resin cement (Duo-link)		Group II Self-adhesive resin cement (Biscem)		
	Mean ±S.D	Min--Max	Mean ±S.D	Min--Max	
Subgroup A Conventional cure	7.85±0.21 [A]	7.58—8.12	4.39±0.15[A]	4.20—4.65	**0.000****
Subgroup B High cure	4.50±1.87 [B]	1.12—6.34	3.65±0.06 [B]	3.58—3.74	**0.249**
Subgroup C Ramp cure	6.87±0.18 [A]	6.67—7.12	4.16±0.13 [C]	3.98—3.74	**0.000****
p-value	0.000**		0.000**		**--------**

(*): significant at* P-value*< 0.05, (**): highly significant at* P-value*< 0.001.
Means in the same* column *with* any Common capital letter [(A-C)] *are not significant.

Failure mode pattern:

After inspection of specimens by stereomicroscope, failure mode patterns were classified following this categorization: adhesive failure, cohesive failure and mixed failure. No cohesive failure was identified in any of the tested specimens, only adhesive and mixed failure mode were achieved (fig 5). Table 3 demonstrated different failure mode pattern % after SBS testing.

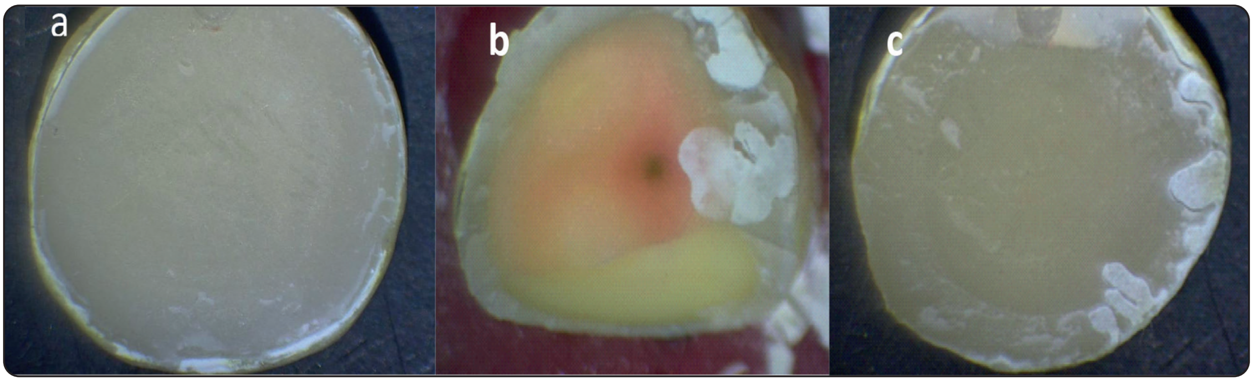

Fig. (5) Failure mode pattern analysis by stereomicroscope, a: Adhesive failure mode, b and c: mixed failure mode

TABLE (3) Percentages of failure mode patterns of different investigated subgroups

Groups	Subgroups	Failure mode %		
		Adhesive failure	Cohesive failure	Mixed failure
Group I	Subgroup A	71.42	0%	28.57
	Subgroup B	100	0%	0%
	Subgroup C	85.7	0%	14.28
Group II	Subgroup A	85.7	0%	14.28
	Subgroup B	100	0%	0%
	Subgroup C	85.7	0%	14.28

DISCUSSION

In this study, the influence of various cementation technique and curing modes on SBS of lithium disilicate (IPS e.max CAD) occlusal veneers to tooth structure was investigated. Human natural teeth were selected because of their elastic qualities, binding ability, and strength, that helped to simulate clinical settings more accurately [(2)]. They were maintained in saline until used to avoid drying subsequently their brittleness [(1)]. In this study, maxillary premolar teeth having the same dimensions were chosen, and standardized tooth preparations were carried out. All teeth preparations were conducted in dentine to replicate advanced occlusal wear, where dentine exposure is unavoidable [(34)]. The uneven occlusal structure of human natural tooth crowns renders it challenging to employ occlusal veneers with a constant thickness. In the present work, occlusal veneers were manufactured utilizing CAD-CAM technology, that allowed for exact control over thickness and anatomy throughout the production procedures. It also provides a consistent fabrication procedure, which eliminates laboratory variability[2]. Occlusal veneers, with their non-retentive design, are a more conservative treatment choice than standard onlays and full-coverage crowns. Furthermore, their preparations were confined to the occlusal surface exclusively, with no finish line continuing over the axial wall. They just cover the occlusal surface resulting into low pressures within the restorations[12,13].

E.max has different qualities and benefits such as high fracture toughness and bonding ability due to effective surface etching by applying hydrofluoric acid etchant which attacks the glass phase lithium disilicate glass ceramic to produce a retentive surface[35,36]. This rough surface increases the surface area, allows resin penetration and improves wettability[33]. Another improvement in bond ability could be attained by silane coupling agent which can create chemical bonding with both organic and inorganic substrates. This could be achieved by bonding to methacrylate groups of the resin cement and silanol group of the ceramic Furthermore, silanization could improve wettability of the ceramic surface, thereby increasing the flow of the low viscosity resins [33].

An indirect restoration's adhesion is closely connected to the luting agent and the cementation technique [37]. For cosmetic reasons, patients prefer all ceramic restorations, which have boosted the usage of resin cements. As they make adherence to both the teeth surface and the ceramic restorations more feasible [38]. Dentinal adhesion is more complicated due to the wettability, and hybrid composition of hydroxyapatite and collagen protein matrix. The fundamental concept for bonding adhesive systems to dentin is micromechanical bonding. So, traditional resin cement 's bonding efficiency was related to the quality of hybridization produced by the dentin bonding agents applied to the dentin surface [39].

Total-etch resin cements bind to the tooth using a phosphoric acid etchant and an adhesive. They recorded the maximum bond strength to tooth and superior mechanical qualities [40]. Yet, they need multiple steps, this makes application technique sensitive and may have a greater possibility of post-operative sensitivity. So, their clinical success is reliant on variable elements including operator competence, material properties, restoration design and the intra-oral environment [41].

Self-adhesive resin cement was evolved, requiring only a few cementation steps and is easy to handle [31]. These cements are made from phosphoric-acid-modified acrylates and can adhere to an untreated tooth surface without prior etching, priming, or even bonding agent application. They possess equivalent bond strength to self-etch systems, and cementation is achieved in a single step, eliminating the constraints of traditional total-etch resin cements [40]. Their bonding mechanism depends on chemical bonding and micromechanical retention with the adhesive substrate [42-44], as their acidic monomers demineralize tooth structure and chemically interact with hydroxyapatite. Their concentration should be low enough to avoid excessive hydrophilicity and sufficiently high to adhere to tooth tissues [31]. Dentine is more easily etched by their low pH than enamel. Thus, they adhere to dentine better than enamel [38].

In this study three curing modes of resin cement were utilized: conventional, ramp and high energy curing modes. Conventional curing involves applying a constant light intensity to the composite resin for a set period of time [45]. Ramp curing mode which represents soft stat polymerization technique that involves applying light at a low intensity at first and gradually increasing it to a high intensity over time. This permits the composite to cure slowly, lowering the initial stresses since it may flow during polymerization. Additionally, this action is intended to decrease polymerization shrinkage. Studies showed that polymerization by ramp curing resulted into longer chains and a more stable composite [32].

High energy pulse cure involves application of very high energy over a brief period of time resulting into bonding of dimethacrylate monomers together. It has not yet been thoroughly investigated [32].

In the present study, specimens were thermo-cycled to mimic the thermal stresses in the oral environment which develop at the adhesive interface as a result of difference in coefficients of thermal expansion of the resin cements and the tooth structure [46,47].

Different techniques were employed to evaluate the bond strength of cement to substrates, and SBS testing was conducted in this study as it is a trustworthy method that has been effectively utilized in previous investigations to determine the bonding strength of ceramics cemented to tooth structure[48–50]. The results of this investigation showed that both groups, total-etch resin cement and self- adhesive resin cement while utilizing high energy curing mode demonstrated significantly lower bond strength than other curing modes as the rapid application of energy could result in short polymer chains and a more brittle and weaker resin with higher polymerization shrinkage and more marginal gaps [32]. This was in accordance with others[51,52] who pointed out that relief of polymerization stresses through composite flow and lower polymerization shrinkage was attained with use of low intensity of light. Miyazaki et al[53] recorded improved physical properties of composite cured with lower intensity and slower polymerization versus higher intensity and faster polymerization. For total-etch resin cement, no significant difference was recorded between conventional and ramp curing as that ramp curing resulted into polymer with longer chains and a more stable resin [32]. While for self-adhesive resin cement, SBS of conventional curing was significantly higher than ramp cure. This was consistent with Friedl et al [54] who reported that soft-start mode did not enhance composite resin marginal adaptation compared to conventional low mode. Feilzer et al[55] observed that initial low intensity just slowed the polymerization rate at initial stages but resulted into the same final shrinkage as greater light intensity. Total-etch resin cements recorded significant higher SBS when compared to self-adhesive resin cement while utilizing conventional and soft curing mode. This is in accordance with Burgess et al. [40]. Regarding failure mode pattern, no cohesive failure was noticed in this study. Only adhesive and mixed failure. Mixed failure was recorded in conventional and ramp curing subgroups. This could be attributed to higher bond strength. Considering these results, the null hypothesis for this investigation was rejected.

The outcomes of this investigation were expected to be clinically relevant. But there were some limitations. Shear bond strength results could have varied due to morphological differences among extracted teeth. Laboratory studies attempt to imitate clinical situations but are rarely able to accurately represent actual clinical conditions, such as using water instead of artificial saliva throughout thermal cycling, the lack of dentinal fluids, and their potential impact on adhesive bonding. A lack of mechanical aging was another restriction. Only one thickness of occlusal veneers was tested while thickness differences exist in practical applications. Different designs, as well as other brands of resin cements, should be considered in relation to various dental bonding surface types. Controlled clinical trials are needed to predict the clinical efficacy of these cementation techniques and curing modes.

CONCLUSION

Within the constraints of this investigation, the following findings can be reached:

1. Higher bond strength can be attained while utilizing conventional and ramp curing mode compared to high curing mode for both cementation techniques.
2. Total-etch resin cement proved its superior bond ability to tooth structure compared to self-adhesive resin cement.

REFERENCES

1. Angerame D, De Biasi M, Agostinetto M, Franz oA, Marchesi G. Influence of preparation designs on marginal adaptation and failure load of full coverage occlusal veneers after thermomechanical aging simulation. J Esthetic Restor Dent 2019;31:280-9.

2. Abdurabbah WM, El Sharkawy ZR, Abdul Hameed SM. Effect of Immediate Dentin Sealing on Bond Strength of Two Ceramic Occlusal Veneers after Thermodynamic Loading. Al-Azhar Journal of Dentistry. 2024;11(1):9.

3. Lussi A, Jaeggi T. Erosion--diagnosis and risk factors. Clin Oral Investig. 2008;12:S5-13.

4. Resende T, Reis K, Schlichting L, Magne P. Ultrathin CAD-CAM ceramic occlusal veneers and anterior bilaminar veneers for treatment of moderate dental biocorrosion: a 1.5-year follow-up. Oper Dent. 2018;43:337-346.

5. Vailati F, Belser UC. Full-mouth adhesive rehabilitation of a severely eroded dentition: the three-step technique. part Eur J Esthet Dent. 2008;3:30-44.

6. Freitas AC, Jr., Silva AM, Lima Verde MA, Jorge de Aguiar JR. Oral rehabilitation of severely worn dentition using an overlay for immediate re-establishment of occlusal vertical dimension. Gerodontology. 2012;29:75-80

7. Rocca GT, Rizcalla N, Krejci I, Dietschi D. Evidence based concepts and procedures for bonded inlays and onlays. Part II. Guidelines for cavity preparation and restoration fabrication. Int J Esthet Dent. 2015;10:392-413

8. Cardoso MV, de Almeida Neves A, Mine A, Coutinho E, Van Landuyt K, De Munck J, al e. Current aspects on bonding effectiveness and stability in adhesive dentistry. Aust Dent J. 2011;56:31-44

9. Walter R, Swift EJ, Jr., Boushell LW, Braswell K. Enamel and dentin bond strengths of a new self-etch adhesive system. J Esthet Restor Dent. 2011;23:390-396

10. Maeder M, Pasic P, Ender A, Ozcan M, Benic G, Ioannidis A. Load-bearing capacities of ultra-thin occlusal veneers bonded to dentin. J Mech Behav Bio Mater. 2019;95:165-171.

11. A. Lussi, E. Hellwig, C. Ganss, T. Jaeggi, Buonocore memorial lecture, Dental erosion, Oper Dent. 2009; 34:251-262.

12. Huang X, Zou L, Yau R, Wu S, Li Y. Effect of preparation design on the fracture behavior of ceramic occlusal veneers in maxillary premolars. J Dent. 2020;97:103346.

13. Veneziani M. Posterior indirect adhesive restorations: updated indications and the morphology driven preparation technique. Int J Esthet Dent. 2017;12:204-230

14. Lierop J, Moodley D, Mulder R. Influence of ceramic thickness and cavity design optimization on fracture resistance of partial coverage restorations. The New Zealand dent J. 2019;115:13-19.

15. Magne P, Schlichting LH, Maia HP, Baratieri LN. In vitro fatigue resistance of CAD/CAM composite resin and ceramic posterior occlusal veneers. J Prosthet Dent. 2010;104:149-157

16. Zhang H, Lv P, Du W, Jiang T. Comparison of Fracture Load and Surface Wear of Microhybrid Composite and Ceramic Occlusal Veneers. J Prosthodont. 2020;29:387-393.

17. Al-Akhali M, Chaar MS, Elsayed A, Samran A, Kern M. Fracture resistance of ceramic and polymer-based occlusal veneer restorations. J Mech Behav Biomed Mater. 2017;74:245-250..

18. Magne P. IDS: Immediate Dentin Sealing (IDS) for tooth preparations. J Adhes Dent. 2014;16:594. doi: 10.3290/j.jad.a33324.

19. Emam Z, Aleem N. Influence of different materials and preparation designs on marginal adaptation and fracture resistance of CAD/CAM fabricated occlusal veneers. Egypt Dent J 2020;66:439e52

20. Elsayed S, Elbasty R. Influence of conventional versus digital workflow on marginalfit and fracture resistance of different pressable occlusal veneers after thermomechanical fatigue loading. Egypt Dent J 2021;67:597e613.

21. Ozcan M, Vallittu PK: Effects of surface conditioning methods on the bond strength of luting cement to ceramics. Dent Mater 2003;19:725-731

22. Attar N, Tam LE, McComb D: Mechanical and physical properties of contemporary dental luting agents. J Prosthet Dent 2003;89:127-134

23. Kitasako Y, Burrow MF, Katahira N, et al: Shear bond strengths of three resin cements to dentine over 3 years in vitro. J Dent 2001;29:139-144

24. Rosentritt M, Behr M, Lang R, et al: Influence of cement type on the marginal adaptation of all-ceramic MOD inlays. Dent Mater 2004;20:463-469

25. Bindl A, L¨ uthy H, M¨ ormann WH: Strength and fracture pattern of monolithic CAD/CAM-generated posterior crowns. DentMater 2006;22:29-36

26. Peumans M, Kanumilli P, De Munck J, Van Landuyt K,Lambrechts P, Van Meerbeek B. Clinical effectiveness of contemporary adhesives: a systematic review of currentclinical trials. Dent Mater. 2005;21:864-881.
27. Burke FJ. Survival rates for porcelain laminate veneers with special reference to the effect of preparation in dentin: a literature review. J Esthet Restor Dent. 2012;24:257-265.
28. De Munck J, Van Landuyt K, Peumans M, Poitevin A , Lambrechts P, Braem M, et al. A critical review of the durability of adhesion to tooth tissue: methods and results. J Dent Res. 2005;84:118-132.
29. Frankenberger R, Lohbauer U, Roggendorf MJ, Naumann M, Taschner M. Selective enamel etching reconsidered: betterthan etch-and-rinse and self-etch? J Adhes Dent. 2008;10:339-344.
30. Hikita K, Van Meerbeek B, De Munck J, Ikeda T, Van LanduytK, Maida T, et al. Bonding effectiveness of adhesive lutingagents to enamel and dentin. Dent Mater. 2007; 23:71-80.
31. Ferracane JL, Stansbury JW, Burke FJ. Self-adhesive resin cements–chemistry, properties and clinical considerations. Journal of oral rehabilitation. 2011 Apr;38(4):295-314.
32. Naveed N, Kishorekumar S. Curing Techniques of Composite Resin: Continuous or Intermittent?. Indian Journal of Forensic Medicine & Toxicology. 2020 Oct 1;14(4).
33. Graiff L, Piovan C, Vigolo P, Mason PN. Shear bond strength between feldspathic CAD/CAM ceramic and human dentine for two adhesive cements. Journal of prosthodontics. 2008 Jun;17(4):294-9.
34. Albelasy E, Hamama HH, Tsoi JK, Mahmoud SH. Influence of material type, thickness and storage on fracture resistance of CAD/CAM occlusal veneers. Journal of the mechanical behavior of biomedical materials. 2021 Jul 1;119:104485.
35. Romanini-junior JC, Hirata R, Bonfante EA, Bordin D, Kumagai RY, Fardin VP, et al. Monolithic CAD/CAM laminate veneers: reliability and failure modes. Dent Mater 2020;36:724e32.
36. Saleh AM, Al-Ani M, AlRawi T, Al-Edressi G. An in vitro comparison of fracture resistance of three CAD/CAM ceramic materials for fabricating veneer. Saudi Dental J 2021;33:745e52.
37. Hickel R, Manhart J. Longevity of restorations in posterior teeth and reasons for failure. J Adhes Dent2001; 3: 45–64.
38. Makkar S, Malhotra N. Self-adhesive resin cements: a new perspective in luting technology. Dental update. 2013 Nov 2;40(9):758-68.
39. Utku Sag B, Ozel Bektas O. Effect of immediate dentin sealing, bonding technique, and restorative material on the bond strength of indirect restorations. Braz Dent Sci 2020;2:1e12.
40. Burgess JO, Ghuman T, Cakir D. Self adhesive resin cements J Esthet Restor Dent 2010; 22: 412–419.
41. Bayne SC. Dental restorations for oral rehabilitation–testing of laboratory properties versus clinical decision making. J Oral Rehab2007; 34: 921–932.
42. De Munck J, Vargas M, Van Landuyt K, Hikita K, Lambrechts L, Van Meerbeek B. Bonding of an auto-adhesive luting material to enamel and dentin. Dent Mater2004; 20: 963–971.
43. Yang B, Ludwig K, Adelung R, Kern M. Microtensile bond strength of three luting resins to human regional dentin. Dent Mater2006; 22: 45–56.
44. Abo-Hamar SE, Hiller KA, Jung H, Federlin M, Friedl KH, Schmalz G. Bond strength of a new universal self-adhesive resin luting cement to dentin and enamel. Clin Oral Invest2005; 9: 161–167.
45. Nasim I, Neelakantan P, Sujeer R, Subbarao CV. Color stability of microfilled, microhybrid and nanocomposite resins—an in vitro study. Journal of dentistry. 2010 Jan 1;38:e137-42.
46. Anusavice KJ, Brantley WA. Physical properties of dental materials. In: Anusavice KJ, ed. Phillips' Science of Dental Materials. 11th ed. St. Louis, MO: Saunders; 2005:52-53.
47. Versluis A, Douglas WH, Sakaguchi RL. Thermal expansion coefficient of dental composites measured with strain gauges. Dent Mater. 1996;12:290-294.
48. El Mourad, A.M. Assessment of bonding effectiveness of adhesive materials to tooth structure using bond strength test methods:A review of literature. Open Dent. J. 2018, 12, 664–678. (CrossRef)
49. Aker Sagen, M.; Vos, L.; Dahl, J.E.; Rønold, H.J. Shear bond strength of resin bonded zirconia and lithium disilicate—Effect of surface treatment of ceramics and dentin. Biomater. Investig. Dent. 2022, 9, 10–19. (CrossRef)
50. Zhu, J.; Gao, J.; Jia, L.; Tan, X.; Xie, C.; Yu, H. Shear bond strength of ceramic laminate veneers to finishing surfaces

with different percentages of preserved enamel under a digital guided method. BMC Oral Health 2022, 22, 3.

51. Uno S, Asmussen E. Marginal adaptation of a restorative resin polymerized at reduced rate. European Journal of Oral Sciences. 1991 Oct;99(5):440-4.

52. Versluis A. Stress development in composite resins during polymerization. J Dent Res. 1994;73:226.

53. Miyazaki M, Oshida Y, Moore BK, Onose H. Effect of light exposure on fracture toughness and flexural strength of light-cured composites. Dental Materials. 1996 Sep 1;12(5-6):328-32.

54. Friedl K, Schmalz G, Hiller K, Markl A. Marginal adaptation of class V restorations with and without softstart polymerization. Oper Dent. 2000;25:26-32.

55. Feilzer AJ, Dooren LH, De Gee AJ, Davidson CL. Influence of light intensity on polymerization shrinkage and integrity of restoration-cavity interface. EUR J ORAL SCI. 1995;103:322-326