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E ALUATION OF MARGINAL ADAPTATION OF DIFFERENT MATERIALS AND THICKNESSES OF CAD/CAM FABRICATED OCCLUSAL ENEERS

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ABSTRACT

Statement of the problem Ultrathin eneers were introduced as a more conser ati e approach for restoration of lost occlusal tissue but limited data is present regarding its performance.

Objecti e: An in- itro study done to assess the effect of occlusal eneer thickness ariation of di erse CAD/CAM materials on the marginal adaptation of the indirect restoration.

Materials and Methods: Sixty freshly extracted premolars were gathered and prepared. CAD/CAM occlusal eneers were milled from 3 different materials: IPS e-max, ita Enamic and La a Ultimate. In two thickness 1 mm and 0.5mm thickness (n=10). Marginal gap was measured. Two way ANO A test was used to examine the effect of different ceramic materials and different thicknesses on marginal adaptation of occlusal eneer.

Results: The results showed that with the 1mm thickness, no statistically significant differences in marginal gap mean alues between different materials. On the other hand, with the 0.5mm thickness, IPS e.max CAD presented statistically significant higher mean marginal gap compared to the other groups.

Conclusion: 0.5 mm ultrathin CAD/CAM manufactured occlusal eneers showed non-Significantly higher mean marginal gap alues compared to 1mm thickness occlusal eneers. IPS e.max ultrathin occlusal eneers showed less adaptation compared to hybrid CAD/CAM eneers used in the study.

KEYWORDS: All Ceramic, Indirect composite, Hybrid Ceramic, Ultrathin Occlusal eneers, CAD/CAM,.

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INTRODUCTION

Enamel acts as an outer barrier designed to protect the underlying soft dentin against tooth wear. Enamel thickness reduction as a result of aging process is a normal biological condition, yet accelerated premature loss of enamel may occur due to effect of mechanical, chemical, biological and thermal changes in the oral en ironment. [(1)] Tooth wear may result due to prolonged physiological degradation or pathologic factors as erosion by gastric acids or diet, abrasion, attrition, or para functional habits.[(2, 3)]

Management of occlusal tooth wear includes many treatment modalities starting with consultation and monitoring stages followed by inter ention in cases of recognizable tooth loss.[(4,5)] The traditional circumferential crown preparation method has been recently substituted by occlusal eneers,[(6)] which lies within the scope of minimally in asi e dentistry to restore the missing tooth structure while perse ering as much of the remaining tooth structure as possible. [(3,7)] Hence, occlusal eneers ha e been introduced with the aim of preser ing healthy tooth structure by rebuilding its loss with minimum preparation depending on inter-occlusal space and tooth morphology and thus increasing the success and longe ity of restoration and foundation tissues.[(3,8 , 9)]

Introduction of new materials with impro ed mechanical properties allowed the reduction of occlusal eneers thickness and production of ultrathin occlusal eneers to replace the con entional ones.[(10, 11)] Thus, ser ing the purpose of minimally in asi e dentistry and increasing the possibility to bond to occlusal enamel rather than dentin to pro ide higher bond strength and increased durability of restoration. [(12)]

CAD/CAM technology are lately replacing the con entional prosthetic techniques in many clinical situations due to the fact that this technology allows better time management, higher precision [(13)] and decrease laboratory skill dependency. [(14)] In addition to the usage of a wide array of ceramic block materials to enhance the mechanical properties of restoration. [(7, 15)]

CAD/CAM designed occlusal eneers can be manufactured from wide range of bondable ceramics.[(3)] Offering a ariety of materials with different mechanical properties such as glass ceramic materials, polymer infiltrate ceramics and nano-ceramic resins. Lithium disilicate is a glass ceramic materials used in occlusal eneers due to its superior mechanical features resulting from its microstructure, which contains interconnecting needlelike crystals encased in a matrix of glass. [(16)]

Hybrid ceramics made up of a polymer that infiltrates a ceramic network, were introduced as a way to impro e mechanical properties. It holds the features of a ceramics and composites, formed of ceramic matrix that ha e pores filled with a polymer. The blocks ha e the ad antage of high mechanical strength after bonding, high degree of elasticity and ability to be milled with minimal crack formation [(17, 18)] Nano ceramic reinforced composite resin is another category of CAD/CAM blocks. It offers high bond strength to tooth structure resulting in proper stress transfer, low abrading to dental tissues which leads to enamel preser ation during repetiti e occlusal cycles as well as low elastic modulus for better absorption of functional loading stresses.

Marginal adaptation is a significant criterion for longe ity of restorations. Marginal discrepancies exposes the luting cement to oral en ironment. The larger the discrepancy, the faster the cement dissolution which might result in restoration and prosthetic failure.[(7,19)] The goal of our study is to examine the effect of the material and its thickness on the marginal quality of CAD/CAM fabricated Occlusal eneers. A null hypothesis was suggested that there would be no difference in the marginal quality of the CAD/CAM occlusal eneers of different thicknesses fabricated from lithium disilicate glass ceramic, hybrid ceramic materials and nano-ceramic resin..

MATERIALS AND METHODS

Materials:

Three types of CAD/CAM blocks, a porcelain etchant, a porcelain primer, a resin cement and a uni ersal bonding agent were used. Materials chemical composition and manufacturer listed in table 1.

Methods:

Study was accepted by the research ethics committee Faculty of Dentistry Ain shams uni ersity with appro al number FDASU-Rec ER092308

Sample size was calculated according to another study[7] as reference. Mean ± standard de iation of control group were 13.2 ± 40, while predicted mean of inter ention group is 20, with 1. 7 effect size, when the (power) is 0.8 and the Type I error probability associated with this test is 0.05 **minimally the study needed 7 specimens in each group,** Sample size calculated using Independent t test by using G. power 3.1.9.7. Total sample size was enlarged to 10 subjects to compensate the drop out per group.

Teeth selection and sample grouping

Sixty caries free human upper first premolars obtained from orthodontic department in Egyptian Russian Uni ersity were used. The selected teeth were examined for being free of cracks, erosi e lesions, hypo plastic enamel surface or restorations. The teeth were cleaned and disinfected using 15 min immersion technique in 5 % sodium hypochlorite solution. Teeth were stored in distilled water at room temperature during the testing duration to pre ent dehydration. [20]

The teeth roots were mounted along their long axis using dental sur eyor in self-cured acrylic resin *

TABLE (1) Chemical composition and manufacturer of materials used:

Material	Composition	Manufacturer
Lithium disilicate glass ceramics (IPS e-max CAD)	SiO_2 ,Li_2O,K_2O,P_2O_5 ,ZrO_2 ,ZnO,Al_2O_3 ,MgO, Pigments	I oclar i adent, Schaan, Liechtenstein
Hybrid ceramics (ITA ENAMIC)	Ceramic component: 86 wt percent. SiO_2 (58-63%), Al_2O_3 (20-23%), Na_2O(9- 11%),K_2O(4- 6%),B_2O(0.5-2%),ZrO_2 (<1%),KaO(<1%) Polymer part:14%wt (UDMA & TEGDMA)	ITA Zahnfabrik, Germany
Nano /ceramic reinforced resin composite (La a ultimate)	Nano/ceramic: 80 wt percent (silica/zirconia nano particles and zirconia / silica nano clusters) Resin matrix: 20 % wt (BisGMA, UDMA, BisEMA, TEGDMA)	3M ESPE, St. Paul, Germany
Porcelain Etchant	Hydrofluoric acid 5%	BISCO Inc, Schaumburg, USA
Porcelain primer	Mps, Ethanol, Water	BISCO Inc, Schaumburg, USA
Resin cement (Duo-Link Uni ersal)	Base formula: Bis-GMA, TEGDMA, urethane dimethacrylate, Glass filler Catalyst; Bis-GMA, TEGDMA, Glass filler	BISCO Inc, Schaumburg, USA
Bonding agent (All Bond Uni ersal)	32% Phosphoric Acid PartA: Ethanol-Na-NTolylglycine Glycidyl Methacrylate, PartB: Bisphenyldimethacrylate, Bis-GMA-2-HEMA.	BISCO Inc, Schaumburg, USA

1.0mm apical to the cemento-enamel junction using a custom-made rubber mold (35x35x20mm)[21]. Teeth were randomly allocated to three test groups according to the material. Each group was further di ided into 2 subgroups according to occlusal eneer thickness (n=10).

- **Group 1 (E):** Lithium disilicate glass ceramics: IPS e-max CAD blocks Where: (E1) and (E2) subgroups represented occlusal eneers with 1mm and 0.5 mm thickness respecti ely.
- **Group 2( ):** Hybrid all-ceramic material: ita Enamic CAD/CAM ceramics blocks. Where: (1) and (2) subgroups represented occlusal eneers with 1mm and 0.5 mm thickness respecti ely.
- **Group 3 (L):** Nano-ceramic reinforced resin composite La a Ultimate CAD/CAM ceramics blocks. Where: (L1) and (L2) subgroups represented occlusal eneers with 1mm and 0.5 mm thickness respecti ely.

Tooth preparation:

Prior to the tooth preparation a silicone index (putty &light)* (DMG Silagun, Germany) was taken for each tooth, then each index was sectioned in a bucco- lingual direction in order to control tooth reduction and ensure equal and uniform amount of reduction.

In order to standardize tooth preparation, all teeth were prepared by a single operator to create occlusal reduction of 0.5 mm &1 mm following the occlusal anatomy using tapered diamond stone with round end (Mani DIA TR-12). Occlusal preparation was finished and then polished with a fine-grit diamond stone (8846 KR 314016, KOMET) and abrasi e rubber points (9608314030,Komet) respecti ely.

Teeth were scanned using Swing 3D scanner (DOF, Korea) to get digital impressions for the samples. EXO-Cad* SW 2018 (alletta 2.2), was used after 3D-model calculation to standardized the anatomical forms gi en by the software, the bio generic anatomy was used in all designed samples.

The scanned teeth images were used to fabricate eneers which is anatomically designed in software in order to achie e homogenous thickness. The restoration thickness for each occlusal eneer was set to be 0.5mm or 1mm according to the subgroup with uniform thickness using100μm spacer thickness. Each occlusal eneer design was prepared for milling steps (Dentsply sirona InLab MCXL milling machine) after selection of the type of the block. After milling, the IPS e-max CAD occlusal eneers (group E) firing cycles were conducted in a Programat® P310 following the manufacturer construction for finishing and crystallization of E-max groups. For both ita Enamic (group) and La a Ultimate (group L) finishing and polishing followed manufacturers' instructions using recommended polishing set and without crystallization.

All the eneers were examined for any cracks or defects and their fit was e aluated. Prior to cementation, Group 1 (E.max) fitting surfaces were etched with 5% hydrofluoric acid (BISCO Porcelain Etchant , Schaumburg , USA) for timing 20 seconds, rinsed off carefully and cleaned with the use of water spray, dried with compressed air followed by application of silane coupling agent* (BISCO silane, BISCO Inc, Schaumburg , USA) to the fitting surfaces of the occlusal eneers and allowed to dry for 60 seconds after gentle drying using dispersed air to obtain a thin coat on fitting surface.

As for group 2&3,(ita Enamic & La a Ultimate respecti ely), the fitting surface of the restorations was sandblasted with AL2O3 40μm particles at 2 bars (30 Psi) (cojet system, 3M ,St. Paul, Minnesota) until the surface was dull. Cleaning with alcohol followed by drying using compressed air as recommended by manufacturer was done. Silane application as mentioned pre iously.

For surface treatment of prepared teeth, cleansing with ultrasonic cleaner was followed by dryness and application of 37.5%of phosphoric acid gel *(Scotch bond Uni ersal Etchant, 3M ESPE, St. Paul Minnesota) for 30 seconds, thorough rinsing was done for 30 seconds followed by proper dryness. Acti e application for the bonding agent was done in two separate coats (All Bond Uni ersal) each for 10-15 seconds with no light curing in between the coats. Excess sol ent was thoroughly dried with compressed air for at least 10 seconds and until no isible liquid mo ement was present. Adhesi e light curing was then performed for 20 seconds. According to manufacturer's recommendation, the resin cement (Duo-Link Uni ersal) was auto mixed and inserted onto the bonding surfaces of the prepared occlusal eneers for proper bonding and cementation.

A standardized static load 3 kg pressure was applied to the central groo e of the occlusal eneers surface using a uni ersal testing machine for proper seating and cementation. Any excess cement remnants were remo ed using micro brush, then air barrier (K-Y jelly, Johnson & Johnson) was applied to margins before final curing to pre ent formation of oxygen inhibited layer at the cement margin. Final cement curing was done using the 3M ESPE Led (3m, Minnesota, USA) of Wa elength ranges between 450-470 mm for all surfaces for ensure proper curing.

Marginal gap assessment

For marginal quality assessment, A digital microscope with built in camera (***U500x Digital Microscope, Guangdong, China***), 3 Mega pixels resolution was used. Illumination was done using 8 LED lamps with color index 95% while maintaining 90^o angle between lens axis and illumination source. Image resolution was (2272·1704 pixels) and magnification of 40X. A digital image analysis was done (Image J 1.43U, National Institute of Health, USA) to measure the gaps. System calibration was done to con ert the pixels into absolute units by comparing an object of known size (a ruler). Four equidistant landmarks along the circumference for each surface were used as references for measurements. For each point, measurement was repeated thrice while taking the mean of the measurements. Then the data were collected, tabulated and statistically analysis.

Statistical Analysis

The results were statistically analyzed using Graph Pad Instat (Graph Pad, Inc.) software for windows with statistically significant alue of P≤0.05. For Continuous ariables the mean and standard de iation were calculated. Homogeneity of ariance showed that the data was normally distributed. One-way ANO A followed by Tukey's post-hoc test was done. Paired-test was done to compare between the two tested thicknesses. Two-way ANO A compared

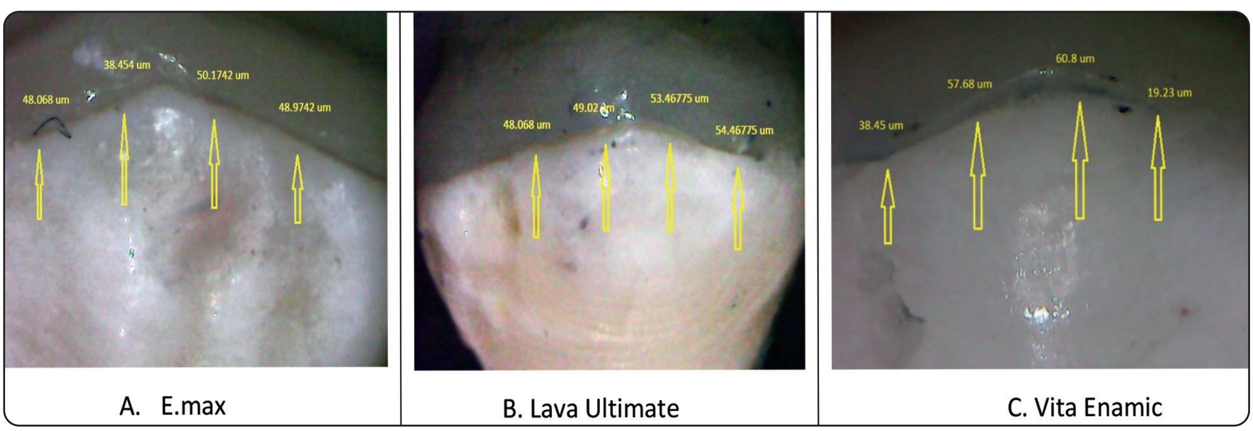

Fig. (1) Showing: 4 equidistant landmarks along the circumference for buccal surface A. E.max, B. La a Ultimate& C. ita Enamic the effect of each factor on the o erall results (material group and eneer thickness). Sample size (n=20/material – 10/thickness) was large enough to detect large effect sizes for main effects and pair-wise comparisons, with the satisfactory le el of power set at 80% and a 95% confidence le el.

RESULTS

With the minimally in asi e occlusal eneers thickness (0.5 mm) whether with ***e.max*** group, ***LU*** group or ***E*** group, the highest marginal gap mean alue was recorded with ***e.max*** (Lithium di-silicate) group (***62.1*** μm) followed by ***LU*** group(nano hybrid ceramics) (***57.64*** μm) while the lowest marginal gap mean alue recorded with ***E (Hybrid ceramics)*** group (***53.48*** μm) which was statistically ***significant*** with e-max group as indicated by one-way ANO A followed test (P=0.0054< 0.05). Pair-wise Tukey's post-hoc test showed non-significant (p>0.05) difference between (***e.max*** and ***LU***) table (2) and figure (1).

With the minimally in asi e occlusal eneers thickness (1 mm) whether with ***e-max*** group, ***LU*** group or ***E*** group. The highest marginal gap mean alue recorded with ***LU*** group (***57.35*** μm) followed by ***E*** group (***56.85***μm). Lowest marginal gap mean was present with ***e.max*** (***56.31*** μm which was statistically ***non-significant*** as indicated by one-way ANO A followed t-test (P=0.9734 > 0.05) table (2) figure (1)

As pro ed by paired t-test within ***e.max group;*** statistically ***significant*** difference was present between the two tested thicknesses (p=0.0389<0.05) where (***0.5 mm > 1 mm***) . With ***E group;*** statistically ***non-significant*** difference was present between the two tested thicknesses (p=0.4805 > 0.05) where (***1mm > 0.5 mm***). With ***LU group;*** statistically ***non-significant*** difference was present between the two tested thicknesses (p=0.9297>0.05) where (***0.5 mm > 1mm***)

Total effect of material group on marginal gap;

Regardless to occlusal eneer thickness, totally it was found that the differences between groups were statistically ***non-significant*** *as re ealed by two-way ANO A test (p=0.2378 > 0.05) where (e.max ≥ LU ≥ E).*

Effect of occlusal eneer thickness on marginal gap;

According two- way ANO A test, it was found that ***0.5 mm occlusal eneer thickness*** *recorded statistically* ***non-significant*** *higher marginal gap mean alue compared to* ***1mm thickness*** *type as demonstrated by (P=0.6488 > 0.05)*

TABLE (2) Marginal gap results (Mean alues ±SDs) for all groups with both occlusal eneer thicknesses

ariable		***Occlusal eneer thickness***						***Statistics***
		0.5 mm			***1 mm***			***t-test***
		Mean± SD	***95% CI***		***Mean± SD***	***95% CI***		
			Low	***High***		***Low***	***High***	P alue
Material type	***e.max***	$62.1^{A}\pm2.58$	59.8	64.6	$56.31^{A}\pm4.32$	52.53	60.63	0.034*
	E	$53.48^{B}\pm4.19$	49.81	57.67	$56.85^{A}\pm9.27$	48.72	66.12	0.4805 ns
	LU	$57.64^{AB}\pm2.97$	55.04	60.62	$57.35^{A}\pm6.66$	51.51	64.01	0.9297 ns
Statistics	P alue	0.0054*			0.9734 ns			

Different letters in same column indicating significant between groups (p<0.05) ****; significant (p<0.05)***

ns; non-significant (p>0.05)

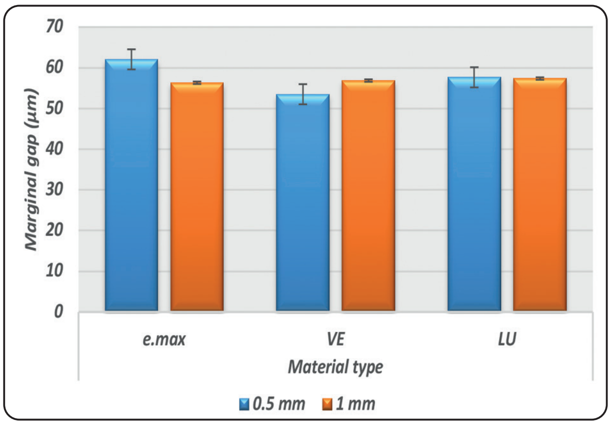

Fig. (2) Column chart of marginal gap mean alues for all groups with both occlusal eneer thicknesses

DISCUSSION

Sol ing the dilemma of abraded enamel and lost occlusal tooth structure faces dentists on regular bases. Two treatment choices are usually present nowadays; to prepare the occlusal surface and restore the lost tooth structure or to delay the restorati e inter ention with remo al of the causati e factor with regular follow ups. If the treatment decision was to interene, it is recommended by many authors to be as conser ati e as possible and to follow the minimally in asi e approach[22] with three main treatment modalities being most commonly used; direct/indirect composite restoration, occlusal eneers and partial crowns. The introduction of occlusal eneer idea was proposed in 2010 with a much more conser ati e preparation of 1.2 mm thickness [23]. The idea was based on the high strength all ceramic materials which enabled replacement of enamel in thin sections.[15] With further inno ations in the material science a 0.6 mm thickness was suggested as an ultra-thin occlusal eneer[15] The idea was based on imitating anterior eneers in anterior teeth using ceramic materials with impro ed mechanical and biological properties to withstand occlusal loads in the posterior oral region.

Success of occlusal eneers is based on material strength to withstand occlusal loads and proper bonding to underlying tissues [24] Inno ations in adhesi e technology helped to impro e bond strength of the final restoration in addition to preser ation of residual tooth structure.[25] Good marginal adaptation is another crucial factor for occlusal eneers success to maintain thin cement line since most dental cements are susceptible to water sorption and dissolution by. [26,27]. The presence of a wide marginal gap could negati ely affect the restoration response to repeated loading and thereby, affect restoration longe ity[28] A marginal gap ranging from 50-200 microns ha e been reported repeatedly in arious researches with no definite alues for maximum acceptable alues. [29,30,31] Upon considering fabrication process, con entional methods including multiple clinical and laboratory procedures resulted in increased marginal discrepancy [32, 33]. With the introduction of CAD-CAM system and its comparison with con entional methods, a new goal was high lightened, CAD-CAM manufacturers aimed to produce accurately fitting indirect restorations with marginal gaps ranging between 25-40 microns.[34] It was stated by Boitelle et al that the CADCAM systems can produce restoration with marginal gaps less than 80 microns. [35]

Lithium disilicate CAD-CAM glass ceramic blocks ha e established high sur i al rates and aesthetics o er long term studies[36] Their high mechanical properties allowed them to ser e well intra-orally but on the other hand, their milling procedure is time and bur consuming[37] with a high possibility of cracking and edge chipping during the milling procedure[38] and the need of post milling recrystallization process for the partially crystalized block at 850 C for 10 minutes[39]. On the other hand, resin containing CAD-CAM blocks were introduced in the market to ser e the purpose of easier milling. They ha e the ad antage of smoother final surface which results in reduced abrasion of opposing natural teeth, lower elastic modulus which produce a shock absorbing action compared to other non-resin containing ceramics [40]

In addition to absence of post milling firing cycle and consequently fewer manufacturing steps.[37,38] Resin ceramic blocks are manufactured by either dispersing nano sized ceramic particles in a polymer or infiltrating a pre-existing ceramic network with resin. Different ceramic/resin combinations result in a ariety material with high flexural strength, reduced chipping and fractures[41] due to the resin content which act as a shock absorber phase within the material [42] Two resin containing ceramic blocks were used in this study to prepare occlusal eneers; ita Enamic which is a polymer infiltrated ceramic network with a history of good clinical performance in thin sections (minimum thickness of 0.2 mm) in a non-prep occlusal eneer[43] The material as stated before shows high degree of elasticity, ability to be used in thin sections with the ad antage of high strength after its bonding to tooth structure [44] La a ultimate material share many ad antages with ita enamic due to the resin content of both materials.

Human teeth were used to mimic as much as possible the clinical situation regarding bonding ability and elastic characteristics [45] and were stored in solution to pre ent their drying out and increased brittleness .[46]

The use of CAD/CAM technology has increased drastically in prosthetics manufacturing with many ad antages including a significant reduction in the oids, cracks and flaws resulting in the final prosthesis due to con entional laboratory techniques. [47] In the following study, the use of CAD/CAM enabled the control of many factors including the thickness and anatomical preparation of the restoration in addition to production of standardized marginal fit in the final occlusal eneers. In addition to eliminating many operator ariables including those of dental laboratory technician skill and discrepancies occurring in se eral steps of the classical fabrication process. [48]

For the assessment of marginal gaps, many techniques ha e been utilized; the direct iewing techniques using either stereomicroscope, scanning electron microscopes and optical microscopes with those being repeatedly utilized by many authors. [49-53] Also the impression replica technique.[54] Computerized x-ray tomography [55] 3 dimensional laser scanner [56] are other ways to assess marginal gap in addition to the cross sectioning technique and weight technique.[57] In the present study, stereomicroscope was used to assess the marginal gap; which is a standard method used by many authors.[7,28] Measuring ertical marginal gap as assessed in the present study using image analysis system in combination with stereomicroscope has been reported to reduce chances of error that usually result in more complicated, multistep of specimen preparation present with other methods. [28]

Based on results obtained from this study, all mean marginal gap recorded in all groups were within clinically acceptable gap alues (>120 Um). The material factor showed no significant difference among tested groups regarding gap formation. On the other hand, the occlusal eneer thickness ariable showed higher gap formation among 0.5mm thickness group though not statistically significant. Also the interaction between the two ariables in one of the materials (e-max group) showed statistically higher gap formation in 0.5 mm thickness occlusal eneers. And thereby, the null hypothesis was partially rejected in this study.

In this study, lithium disilicate showed statistically significant better adaptation in the 1 mm thickness compared to 0.5 mm thickness which could affect the durability of occlusal eneers. This result were in agreement with Albelasy, et al. 2020 [58] who stated that lithium disilicate showed better results at a thickness of 0.7–1.0 mm. The lower marginal adaptation among lithium disilicate glass could be attributed to dimensional changes occurring during the post milling crystallization stage.[59,60] Hence, the IPS e-max CAD is expected to ha e more shrinkage after heat treatment due to the increased density within ceramic material and thus increasing the marginal gap. This could be more announced with the ultrathin occlusal eneer as reported in the results in the present study due to lower resistance to dimensional changes accompanying the ultrathin section of the material. This could also explain why the two other composite blocks that do not need crystallization after milling showed better fit with absence of firing cycle. This came in accordance with other studies that showed that milling resin containing ceramic blocks results in better marginal integrity than glass ceramics which ha e clinical rele ance in thin structures (eneers) (38,61,62) .

In 1mm thickness occlusal eneers, no significant differences were found among different materials tested. This was agreed upon by Daniele et al., 2018 (46) and Zeinab et al. 2020(7) who in estigated similar materials categories with similar measuring technique for gap assessment. The present results were in accordance with other authors, (35,63) Also with another study comparing lithium disilicate and hybrid ceramics with lithium disilicate showing highest marginal gaps within all tested groups(64).

Although both resin containing ceramic materials used in this study showed non-significant differences in both occlusal eneer thickness groups, still the E showed lower mean gap alues in both groups with more pronounced lower results in the 0.5 mm thickness. This could be attributed to the difference in the resin composition, the size and type of the particles within the material (66).

Regarding the interaction between material and eneer thickness, both e-max and E materials showed higher sensiti ity to thickness changes compared to LU group. This could be attributed to the fact that LU material has higher resin content within the material reaching 20 wt%. The high resin content might ha e enabled it to adapt better to the surface due to its lower modulus of elasticity (~12.77GPa) compared to the high modulus of elasticity of e-max material (~95GPa) and ita enamic (~30GPa). Though specimens were not subjected to occlusal loads in the present study and gaps were measured immediately after specimen preparation, ultrathin (0.3 - 0.6 mm) lithium disilicate and La a Ultimate resin nano-ceramic occlusal eneers showed similar endurance rates to composite occlusal eneers (1.2-1.5mm)(23,66) and (0.6 - 1.2 mm) (67).

Most of the data obtained from many studies are in itro studies such as present study; this could be credited to the exceptionally high rate of inno ated materials released in the market place. The short term in itro studies being the alternati e to randomized clinical long term studies with the closest approximation to the clinical reality of the later. The present study shows many limitations including the lacking factor of en ironmental oral conditions and cyclic loading, in addition to absence on intra-pulpal pressure which could ha e an influence on the bonding quality to dentin. So, for more accurate data regarding the clinical performance of tested materials in ariable thicknesses, controlled clinical trials are needed.

CONCLUSION

In the limitation of the current in- itro study, the next could be concluded:

1. All marginal gaps recorded with all tested groups were within the acceptable range of marginal gaps described in literature.
2. With limited occlusal space and more conser ati e occlusal preparation, ultrathin eneers are recommended to be manufactured from resin containing material rather than glass ceramics to obtain better marginal adaptation
3. RCTs are further required to alidate and compare the clinical outcome of ultrathin occlusal eneer compared to its counter classical occlusal eneer.

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