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Clinical Evaluation of Fracture and Color Changes of All Ceramic Laminate Veneers Prepared With Modified Gull Wing versus Conventional Technique (Randomized Controlled Clinical Trial)

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ABSTRACT

Objective: To evaluate the fracture resistance and color changes of ceramic laminate veneers prepared with modified gull wing and conventional preparation.

Material and Methods: Twenty -four ceramic laminate veneers were fabricated for maxillary anterior teeth. The patients were divided into two groups according to the preparation technique Group 1(control group) **conventional preparation technique** and group 2 (intervention group**) gull wing preparation technique** . Standardized the same incisal preparation with butt joint design and chamfer finish line located supra gingival were performed for all the teeth. The veneers surfaces were treated and silanated according to the manufacture instruction of each ceramic and enamel surfaces were etched where total etch adhesive protocol was obeyed using BISCO.

Fracture resistance and color change for both groups were evaluated according to United States public health services (USPHS) criteria. **Results**: Fracture resistances and color change were evaluated according to the criteria of USPHS and we found there is no significant difference as both groups scaled zero score. **Conclusion**: Both preparation techniques of laminate veneers revealed high successful clinical performance in terms of fracture resistance and color stability.

Keywords: Ceramic Laminate Veneers, modified gull wing, conventional technique, fracture ,color changes, Lithium Disilicate, USPHS, RCT.

INTRODUCTION

Ceramic laminate veneers have become the widely used as a restoration of choice because of their esthetic appeal, biocompatibility and adherence to the concept of minimal invasive dentistry. They have proven to be welcomed by the patients and the clinician as a durable and satisfying treatment modality for esthetic rehabilitation cases [1]**.**

These thin restorations are bonded using adhesive resin cements which establishes a chemical bond between the ceramic and the tooth structure using standard hydrofluoric acid etching and silane application. Once properly cemented, ceramic veneers become an integral part of the tooth structure and share part of the applied loading stresses during masticatory cycle [2]**.**

The term, gull wing preparation for veneer, in this study is “used to describe this style of preparation, which is continued to the lingual aspect of the cervical part of tooth to break

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the contact partially on one or both sides, However, increased clinical longevity may be obtained by extending the prepared margins into the proximal contact areas to maximize the functional and aesthetic potential of veneers . **[3] .**Besides the esthetic advantages, the resistance to fracture should be increased at the proximal prepared surfaces, as the bulk of porcelain is oriented parallel to the axial wall to resist displacement stresses. Furthermore, the bond strength to the proximal prepared surface would be increased by developing bonds at right angles to the direction of displacement. Thus, a gull wing veneer may have the additional benefit of greater retention, resistance, and improved longevity [3]**.**Long-term success of ceramic laminate veneers could be influenced by several factors, such as type and depth of preparation, type and thickness of the ceramic, type (enamel or dentin) and surface area of the adhesion surface, type of the resin cement and dental adhesive, tooth morphology, as well as functional and parafunctional activities [4]**.**The most common failure type for laminate veneers was reported to be fractures.

The greatest shortcoming of ceramic materials is their low ductility that is an inherent problem yielding to crack formation that can be induced during laboratory and technician adjustments or even during machining especially when used in thin restorations as laminate veneers. Also, polymerization shrinkage of the luting composite may create stress concentrations at the adhesive interface [5]**.** Other types of failure may be represented by microleakage, color change and debonding of restoration [6]**.**

It was found that in case of glass ceramics laminate veneers (feldspathic, leucite based and lithium silicate-based ceramics) fracture of the ceramic is the most frequent reason for failure (44.83%). The second reason for failure was cracks in the ceramic veneer (27.59%). Chipping and debonding occurred in 10% of all failure cases [7]**.**For the patient's comfort, ceramic restorations should have smooth surface. It is also important for esthetic and biological reasons. So, polishing of ceramic surfaces is mandatory after removal of excess cement or after occlusal adjustments [8]**.**

MATERIALS AND METHODS

Ethical considerations and approval:

This randomized clinical trial was conducted in the Department of Fixed Prosthodontics in Faculty of Dentistry, Cairo University. The ethical approval for the study was obtained from the Ethics Committee of Scientific Research - Faculty of Dentistry – Cairo University (approval no: 18230). Participation in the study was voluntary and informed consent was obtained from all of them before starting the treatment regarding treatment sequence, publishing of their images and results.

Registration:

This trial was registered at the Clinical Trials.gov registry under registration number NCT03321474 on October 24, 2017.

Study design:

This study was a double blind randomized controlled clinical trial with a 1:1 allocation ratio.

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Sample size estimation:

Based on data from previously published studies by Beier et al., 2012 the fracture in conventional arm is 45%, the fracture in intervention arm is expected to be 10% we will need to study 10 in each group to be able to reject the null hypothesis that the exposure rates for case and controls are equal with probability (power) 0.8. The Type I error probability associated with this test of this null hypothesis is 0.05. This number is to be increased to 12 to compensate for losses during follow up (25% more than the calculated). Sample size calculation was achieved using PS: Power and Sample Size Calculation software Version 3.1.2 (Vanderbilt University, Nashville, Tennessee, USA .

Participant's selection:

All participants fulfilled the following inclusion criteria, age range from 18-40 years old with healthy physical status, good oral hygiene and motivation. Patients with normal occlusion, having an upper anterior teeth indicated for laminate veneer and no active periodontal, pulp or apical lesions were recruited from the Fixed Prosthodontics Department outpatient clinic, Faculty of Dentistry, Cairo University, Cairo, Egypt. Screenings of patients were carried out until target number was reached. This study ended on November 2019. All patients were requested to provide a full medical and dental history.

Allocation concealments:

In each group, a number for each member was written on a white paper and placed inside an opaque sealed envelopes from inside and nothing is coded from outside.

Implementation:

The candidate under supervision was responsible of all procedures, patient selection, preparation, shade selection, try in and bonding.

Randomization:

Randomization was carried out using computerized sequence generation (https://www.randomizer.org) in the Center of Evidence Based Dentistry, Cairo University. Participants were assigned in two groups (1 or 2) according to the technique of preparation. Each participant received a sealed opaque envelope with their randomized number. Group (1) received conventional preparation while group (2) modified preparation (gull wing) (Table I): Sample grouping

Group(I) Control group	**Group(II) Intervention group**	**Total number of laminate veneers**
(n=12)	(n=12)	(n=24)

Blinding:

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The outcome assessors (prosthodontics colleagues) and the participants were blind (double blinding) to the material while the operator (the researcher) will not due to the difference in restorative material presentation and application protocol.

Intervention:

In conventional preparation of veneer it circumvents the contact areas and extends palatal in the incisal third of the tooth only. The preparation thickness is defined by a 0.5 mm facial and 1.5–2.0 mm incisal reduction with the proximal finish lines placed facially to the proximal contacts [3].

Gull wing (dog leg) preparation is the inciso – proximal extension of porcelain laminates veneer margin more palatally. The preparation thickness is defined by a 0.5 mm facial and 1.5–2.0 mm incisal reduction with the proximal finish lines extend beyond the contact [3]. This preparation design helps to hide the restoration margin when viewed from an angle, especially in discoloration cases and mal position cases. The preparation finished at the gingival margin and extended towards the papilla to finish the interproximal elbow preparation. All treatment procedures were performed by the same clinician. The prosthodontics procedures were performed into 3 visits in the clinics of Fixed Prosthodontics Department, Faculty of Dentistry, Cairo University, Cairo, Egypt.

Visit 1:

It started with taking personal, medical and dental history followed by clinical examination for assessment of remaining tooth structure, occlusal scheme, periodontal condition, oral hygiene, dental caries and parafunctional habits. Scaling and polishing were performed for each patient in order to improve the oral hygiene level and allow accurate shade selection. Intra-oral pre-operative photographs were taken for documentation of the cases. Two pairs of alginate impressionsfor upper and lower arches were taken using stock trays, poured with type IV dental stone. One pair of impression was used for making diagnostic cast and the other for the study cast. The diagnostic casts were mounted on a simple hinge articulator to assess horizontal and vertical overlap (overjet and overbite) between maxillary and mandibular incisors in order to preserve the anterior guidance. Following careful analysis of the diagnostic models, minimal veneer preparation was performed for the teeth to be restored with veneers. Diagnostic wax up was fabricated on diagnostic model in order to establish the appropriate tooth proportion, incisal edge positions, correction of minor tooth rotations and measuring the spaces in the hope of creating a more natural appearance. The color of the teeth was recorded visually using VITA 3D-Master and Vita Classic shade guide system under natural day light and confirmed in the incandescent light to avoid metamerism with the help of another prosthodontic colleague.The color of the tooth was recorded respectively in accordance to the contra-lateral/ adjacent tooth under different light conditions.

Visit 2: Sample grouping:

The study population consisted of 6 patients. There were 5 women and 1 men, ranging in age from 19 to 35 years (Table 2). The 6 patients had been provided with 24 ceramic veneers. A total of 24 ceramic laminate veneers were divided into two main groups according to preparation technique .

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Group (I): Control group conventional preparation

Group (II): Intervention group modified preparation (gull winge)

Table (2) Age and gender of patients receiving porcelain laminate veneers

Age(ys)	Men	Women	Total
19	1	1	2
20	-	1	1
23	-	2	2
35	-	1	1
Total	1	5	6

Tooth preparation phase

A putty silicon[1] was used to obtain index for each patient using condensation silicon impression material. Each index was vertically cut at the mid of central, lateral, and canine of each side to assess the amount of preparation of incisal and labial surfaces respectively Another putty silicon index was fabricated on the diagnostic wax up model which was used later for temporization.

The labial reduction was started with horizontal orientation grooves using depth cutter wheels in order to accommodate veneers of equal thickness **Fig.(1).** Final depth of the preparation was marked and accentuated with a pencil **fig (2).** Then the remaining island of the enamel was removed till the depth of original grooves to uniformly reduce the labial surface using a tapered diamond stone with around end of 0.5mm diameter. Labial reduction was 0.3 mm at the cervical third and 0.5 mm at the middle and incisal thirds to ensure even preparation thickness. The preparation was carried out in two different planes following the contour of the labial surface. Then the preparation was verified with the silicon index to check the amount of labial preparation**. Incisal preparation:** Vertical orientation grooves were done on the incisal edge of the tooth ensuring not to penetrate more than the diameter of the stone visually **Fig. (3).** The tapered stone with round end diamond stone was placed parallel to the incisal edge to remove the projection between grooves resulting in 1 mm butt joint incisal preparation. The 24 teeth were finished and smoothed with 1 mm incisal reduction (Butt joint preparation design). Then each preparation was verified vertically with the silicone index to check the amount of incisal reduction. **Fig. (4)** .The chamfer finish line was created supra-gingivally along the free gingival margin. The margin of the preparation was ended by a chamfer finish line 0.3mm diameter using a tapered diamond stone with a round end. proximal reduction**:** For the first and second group it was done using the tapered diamond stone with round end. The end of the proximal reduction was placed just beyond the mesio-labial and disto-labial line angles and extended just in the interproximal contact areas. For the intervention group dog leg or gull wing or Elbow design: **Figure (6)**The bur is held at an angle of almost 60º towards the palate. Once the exact depth has been achieved, the bur was held in an upright position to finish the interproximal preparation, diamond bur is used to extend the margin lingally The operator view the margin from a 45° angle to be sure that it is hidden.

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Finishing the preparation**:** All sharp line angles that might serve as a focal point for stress concentration were rounded using tapered round end diamond stone particularly at the junction of the incisal angle to both the labial and proximal surfaces **.** Final impression was taken using addition silicon in stock trays. Two step impression technique was done, first putty viscosity was taken then light viscosity was applied. Application of light using automatic mixing tips and dispensing with impression gun which produced complete homogenous mix. The silicon index that was fabricated on the waxed up cast was used for provisional restoration construction. Once the dental laboratory received the final impression, master casts were poured with a type IV dental stone and **Veneer fabricated .**The fabricated veneers were examined for cracks or excessive thickness .Each veneer was trial seated with water soluble viscous media and assessed for colour, fit, contact and contour. Also at the try in stage the colour of the luting cement was selected ,

The veneer was placed on unetched enamel with the resin cement of the selected shade. the uncured resin cement could be readily removed from the veneer by using acetone or alcohol. At this point the patient consulted for any needed correction.

Visit 3:

After veneers have been tried in, they were cleaned with alcohol, rinsed with water and then the following regime for preparing the fitting surface of the veneers was carried out. The fitting surface of the ceramic veneers were etched for 20 seconds with 9.5% hydrofluoric acid. The veneers were rinsed with water for 20 seconds then dried with air by using three-way syringe. Following this protocol, the veneers surfaces appeared clean and had a similar appearance to etched enamel. A single coat of the ceramic primer was then applied to the bonding surface of the veneers and left for 1 minute then air dried. Tooth surface preparation: In order to remove remnants of provisional cements that may cause a significant decrease in the bond strength of the luting agent, a Prophylaxis paste and polishing brush mounted in low speed contra angle was used for cleaning the tooth surfaces prior to bonding. 37% Phosphoric acid etchant was applied to enamel for 15 seconds . and then rinsed and dried until enamel appeared frosty. Finally, surfaces were dried gently for 5 seconds. A fully saturated brush tip of Single bond 2 was used to apply two coats of adhesive. Luting resin cement was applied to the tooth and fitting surfaces of the veneers using a mini brush. The veneers were placed to the teeth in position from the midline starting from the midline and moving laterally. Excess cement was removed using sharp explorer after 2 seconds of preliminary light polymerization and the veneers were then completely light polymerized with an energy density of 480 mW\cm for at least 20 seconds from each aspect of the tooth. A waxed dental floss was used inter dentally for complete removal of excess cement in between veneers, and articulating paper was used to check for any occlusal interferences after complete curing.

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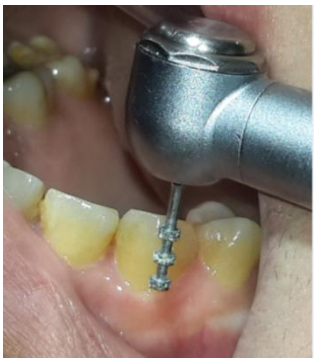


Figure (1) : Using 3 wheels depth cutters to create horizontal grooves in two planes

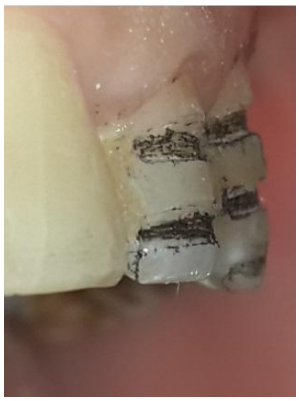


Figure (2): Horizontal grooves marked by a pencil

Fig. (3) Vertical orientation grooves on the incisal edge of the teeth

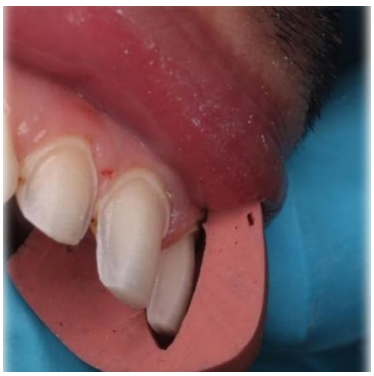


Figure (4): Verified silicon index with Incisal preparation

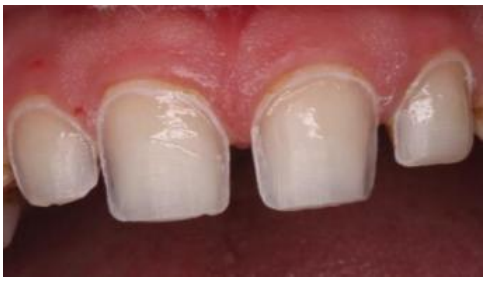
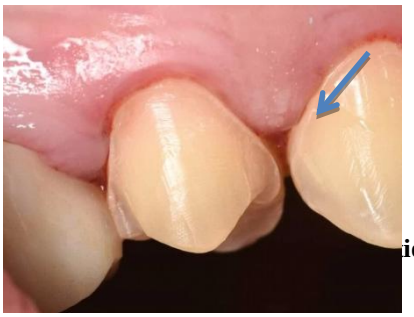


Figure (5): conventional preparation



ion

Postoperative instruction and care: Patients were instructed to perform brushing and flossing regularly and to use non-abrasive fluoridated tooth paste. They were informed to avoid the excessive stresses, avoid bite on fingernails. The patients returned to the clinic after 1 week to permit a final examination of aesthetics, phonetics and occlusion.

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Follow up sessions:

The total duration time of the study was 1 year. Follow up sessions were done every two months for each patient pre-operatively, post cementation (Base-line), 2, 4, 6, 8,10 and 12 months. using operator vision to evaluate the fracture and color change . Follow up done according to USPHS grades (United States Public Health Service) .

Outcome name, measuring device & measuring unit

	Outcome	Measuring device	Measuring unit
Primary Outcome	**Fracture of restoration**	**(MUSPHS)** [1]	**Discrete** [1] **(scores)** 0= no fracture 1= minor cracks line over the restoration 2= minor chipping of the restoration (1/4). 3= moderate chipping of the restoration (1/2) sever chipping of the restoration (3/4) =4 5= complete fracture
Secondary outcome	**Color Match**	**(MUSPHS)** [1]	**Discrete** [1] **(scores)** 0 - Very good color match 1- Good color match 2- Slight mismatch in color or shade 3 -Obvious mismatch, outside the normal range 4 -Gross mismatch .

No Patient attrition:

During follow up period, all patients attended in the control group and the intervention group.

Data were recorded, tabulated then statistically analyzed.

Statistical methods

All Data was collected, checked, revised, tabulated and entered into the computer. They were analyzed using IBM SPSS advanced statistics (Statistical Package for Social Sciences), version 23 (SPSSInc, Chicago,IL). Categorical data were described as numbers and percentages. Comparisons between categorical variables will be performed using the fisher exact test. A p-value less than or equal to0.05s considered statistically significant. All tests were two tailed.

RESULTS

In this study, the fracture and color change of laminate veneers produced with different types of preparation were analyzed. The mean and standard deviation values were calculated for each group in each test. Data were analyzed using IBM SPSS advanced statistics (Statistical Package for Social Sciences), version 23 *(SPSS Inc., Chicago, IL).* The frequency of fracture in the 2 groups was compared using the Fisher's exact test. Differences

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between the 2 groups were assessed for statistical significance with the log-rank test. A p-value 40 less than or equal to 0.05 was considered statistically significant.

A) Fracture:

Descriptive statistical analysis presented in **table (4) fig. (7)** revealed the following: According to USPHS criteria for fracture evaluation:

a) Group I (conventional preparation):

There was no statistically significant difference between (Base line), (After 2 months), (After 4 months), (After 6 months), (After 8 months), (After10 months) and (After 12 months) where (p=1).

Zero score was recorded for all the veneers at all the intervals of evaluation.

b) Group II (modified gullwing preparation) :

There was no statistically significant difference between (Base line), (After 2 months), (After 4 months), (After 6 months), (After 8 months), (After10 months) and (After 12 months) where (p=1).

Zero score was recorded for all the veneers at all the intervals of evaluation.

Relation between both groups:

There was no statistically significant difference between (Group I) and (Group II) both groups showed zero scoring in all time periods.

Table (4): The frequencies of different scoring for different groups for fracture

Variables	Fracture				
	Conventional preparation		Modified gull wing preparation		P value
	N	%	N	%	
Baseline	12	100 %	12	100%	1
	0	0%	0	0%	
	0	0%	0	0%	
	0	0%	0	0%	
	0	0%	0	0%	
	0	0%	0	0%	
After 2 months	12	100 %	12	100%	1
	0	0%	0	0%	
	0	0%	0	0%	
	0	0%	0	0%	
	0	0%	0	0%	
	0	0%	0	0%	
After 4 months	12	100 %	12	100%	

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		0	0%	0	0%	1
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
After 6 months		12	100 %	12	100%	1
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
After 8 months		12	100 %	12	100%	1
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
After 10 months		12	100 %	12	100%	1
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
After 12 months		12	100 %	12	100%	1
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
		0	0%	0	0%	
p-value		1		1		

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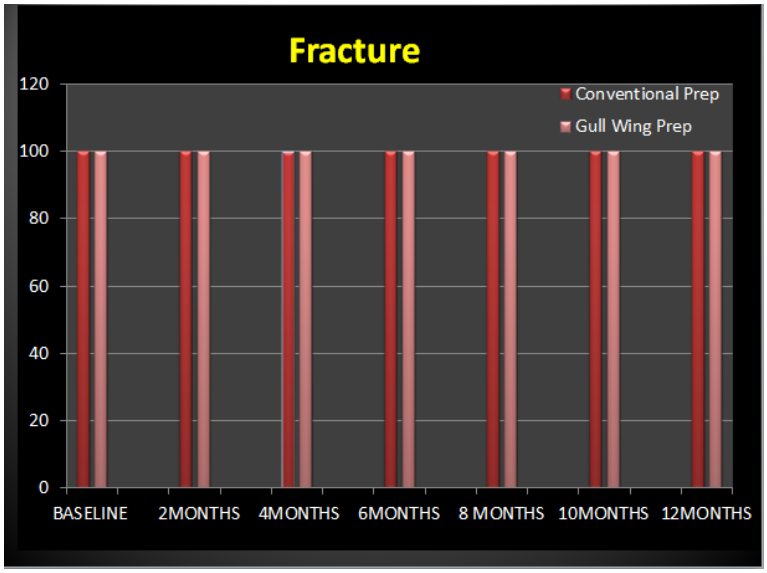
Figure(7): Bar chart representing fracture criterion



B) color change :

Descriptive statistical analysis presented in **Table (5) ,fig. (8)** revealed the following: According to USPHS criteria for color change evaluation:

Group I (conventional preparation): There was no statistically significant difference between (Base line), (After 2 months), (After 4 months), (After 6 months), (After 8 months), (After10 months) and (After 12 months) where (p=1). Zero scoring was recorded for all the veneers at all the intervals of evaluation.

b) Group II (modified gull wing):

There was no statistically significant difference between (Base line), (After 2 months), (After 4 months), (After 6 months), (After 8 months), (After10 months) and (After 12 months) where (p=1). Zero grading was recorded for all the veneers at all the intervals of evaluation.

Relation between both groups:

There was no statistically significant difference between (Group I) and (Group II) both groups showed (100%) zero grade in all time periods

Table(5): The frequencies of different scoring for different groups for color change

Variables		Color change				
		Conventional preparation		Modified gull wing preparation		P value
		N	%	N	%	
Base	0	12	10	12	10	1

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line			0%		0%	
	1	0	0%	0	0%	
	2	0	0%	0	0%	
	3	0	0%	0	0%	
	4	0	0%	0	0%	
After 2 months	0	12	100%	12	100%	1
	1	0	0%	0	0%	
	2	0	0%	0	0%	
	3	0	0%	0	0%	
	4	0	0%	0	0%	
After 4 months	0	12	100%	12	100%	1
	1	0	0%	0	0%	
	2	0	0%	0	0%	
	3	0	0%	0	0%	
	4	0	0%	0	0%	
After 6 months	0	12	100%	12	100%	1
	1	0	0%	0	0%	
	2	0	0%	0	0%	
	3	0	0%	0	0%	
	4	0	0%	0	0%	
After 8 months	0	12	100%	12	100%	1
	1	0	0%	0	0%	
	2	0	0%	0	0%	
	3	0	0%	0	0%	

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	4	0	0 %	0	0 %	
After 10 months	0	12	100%	12	100%	1
	1	0	0 %	0	0 %	
	2	0	0 %	0	0 %	
	3	0	0 %	0	0 %	
	4	0	0 %	0	0 %	
	5	0	0 %	0	0 %	
After 12 months	0	12	100%	12	100%	1
	1	0	0 %	0	0 %	
	2	0	0 %	0	0 %	
	3	0	0 %	0	0 %	
	4	0	0 %	0	0 %	
p-value		1		1		

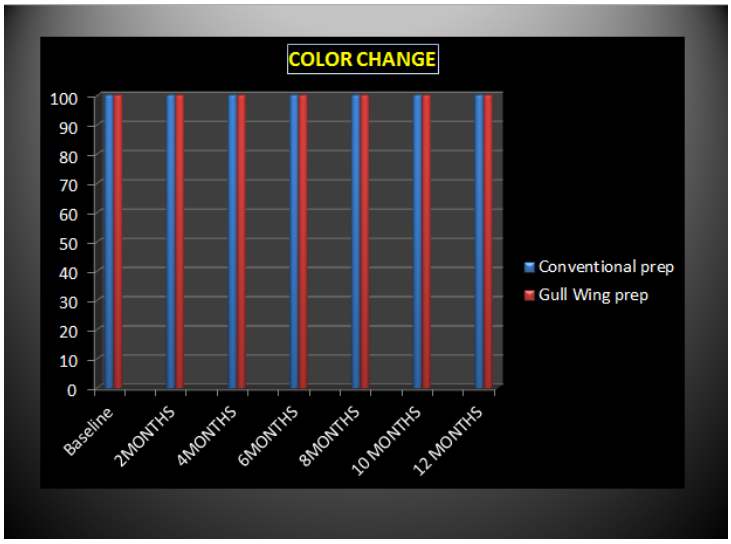

Figure (8): Bar chart representing color change criterion

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DISCUSSION

The aim of this study is to evaluate the fracture resistance and color changes of pressable glass ceramic laminate veneers prepared with two different preparation designs conventional and modified gull wing .Due to the actuality and more frequent use of veneers in everyday clinical practice, it is necessary to clearly define the type of preparation that will achieve better aesthetic and mechanical properties of fixed-prosthetic [9]. Laminate veneers are more conservative than crowns and maintain the biomechanics of the original tooth with a similar stress distribution and a success rate of approximately 93% over 15 years of clinical [10] . Ceramic laminate veneers are considered a conservative modality that provides excellent potential for esthetic enhancement. Veneer preparation preserve sound tooth structure which is the ultimate goal of veneer preparation . For clinically successful dental restorations, four distinct properties should be existing: marginal adaptation, biocompatibility, esthetics and mechanical strength **[11]**.Overall, understanding the clinical performance and causes of failure modes of ceramic laminate veneers was absolutely necessary before the results of in-vitro studies to be considered clinically [12].the specimens used for testing dental ceramics in the lab sometimes differ significantly in both size and structure from the restorations they represent clinically.

Thus, clinical studies are needed for evaluating the performance of restorative materials because certain intraoral conditions could not be reproduced in the laboratory environment. These conditions include the application of multiple, intermittent, cyclic forces while chewing, grinding, and clenching, constant exposure to a moist, bacteria-rich environment, ingestion of hot or cold liquids and acids and heavy tooth brushing. In vivo evaluation has clear basis for establishing criteria for acceptable veneers.

Also in vitro studies did not have the same value as in vivo studies, as there were few studies of the clinical performance of ceramic veneers available to date whereas, several papers dealing with in-vitro studies of the system have been published [13]. In the present study all teeth included were anterior teeth. It was restricted to non-carious teeth which prevented the size and sites of disease or restorations from influencing the preparations carried out. Anterior incisors were chosen as they are the most commonly restored teeth with ceramic laminate veneers. This is due to their presence in the esthetic zone, the most visible teeth in dental arch and to standardize bonding area and forces of all restorations . This study investigated two preparation designs using the same ceramic materials for porcelain laminate veneers. Conventional and current popular practice for conservative laminate veneers preparation is to remove 0.5 mm of tooth structure to create room for the placement of 0.5 mm of ceramic. It has been suggested that a maximum of 0.5 mm thickness to be done at the cervical region of labial veneer preparation **[2]**. This is due to the enamel thickness in the anterior teeth . the enamel thickness of extracted anterior teeth was 1.0 to 2.1 mm at the incisal third, 0.6 to 1.0 mm at the middle third and 0.3 to 0.5 at the gingival third, therefore, minimal preparation is advisable. All the preparations were confined within the enamel. This not only produces a highly predictable and stable bond, but also the enamel provides stiffness to the tooth. In the absence of surface enamel, the tooth may be more prone to flexure during loading which may cause fatigue and eventual fracture of laminate [10]. In order to standardize our preparation design three-wheel depth cutter was used to have minimum depth cutting. Then, silicon index was performed for checking final preparation depth and design. This procedure ensured uniform reduction and preserved tooth structure [14]. Type of preparation is a critical factor for the fulfillment of all ceramic laminates veneers; many in vitro studies linked the survival rate of porcelain laminates veneers to the type of preparation.

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Preparation design and restoration techniques are important for fracture resistance of laminate veneers [14]. In the present study preparation design for all teeth was with chamfer finish line labially, interproximal extension and butt joint incisally. The finish line was located supra gingival . Butt-joint preparation showed better stress distribution to the tooth body, suggesting that the forces had to be sustained to a greater extent by the veneer itself. Butt joint incisal configuration still permits the preservation of peripheral enamel layer around all margins. This was in agreement with **Mirra et al (2009)** who measured fracture strength and microleakage of laminate veneers with different designs and found the highest fracture load in teeth prepared with 2 mm incisal reduction without palatal chamfer. Many authors recommend preparation design where incisal edge is reduced. Considering the delicate and fragile nature of the restorations [15]**.**All labial preparation of all teeth was prepared with chamfer finish line, located 1mm supragingival labially to make sure that all margins were within enamel, thus enhancing the bond between enamel and adhesive resin cement which will decrease the chances of marginal microleakage and deteriorations [16].

Regarding proximal preparation . In dog-leg (gull wing) technique the preparation is finished at the gingival margin and then extended towards the papilla to finish the interproximal elbow preparation. This is important especially when dealing with discoloration **Galip Gürel (1999).** If the depth of preparation is not corrected the connection between the dark-colored tooth and the light-colored porcelain will be visible when seen from an angle which is clearly not aesthetically pleasing [17]**.** So Gull wing technique for veneers preparation were advocated for its esthetic advantage, in addition the increased clinical longevity may be obtained by extending the prepared margins beyond the proximal contact area cervically areas to maximize the functional potential of the restoration

The clinical and laboratory advantages of cervically extended veneer preparations for anterior teeth may prevail over the disadvantage of increased tooth structure removal.

Besides the esthetic advantages, the resistance to fracture should be increased at the proximal prepared surfaces, as the bulk of porcelain is oriented parallel to the axial wall to resist displacement stresses. Furthermore, the bond strength to the proximal prepared surface would be increased by developing bonds at right angles to the direction of displacement. Thus, a gull wing veneer may have the additional benefit of greater retention, resistance, and improved longevity.

It was shown that the modified gull wing preparation is a significant factor affecting the final esthetic especially in rotated or discolored teeth. approximately 60% of conventional preparation showed veneer failure in terms of color change [18]. The final impression was taken with addition silicon impression material since it has low dimensional change, relatively short setting time and with moderate to high tear resistance. As there are no by products to the polymerization reaction, impressions are dimensionally stable and can be poured at the convenience of the operator [16].Provisionalization was an integral part of the treatment process to imagine the final shape. The provisional restorations were fabricated using Self-curing methacrylate composite resin material that have several advantages: good marginal adaptation, more comfortable for patient, high esthetic appearance and easy for polishing and finishing. The provisional restorations were temporary cemented using non-eugenol, acrylic-urethane polymer based temporary cement [13].In this study ceramic laminate veneers were fabricated from Lithium disilicate ceramic (e.max press) which have high mechanical properties [16].

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Lithium disilicate was chosen as the restorative material in this study, as it is documented in literature as asuccessful restoration& biocompatible material and high esthetic .lithium disilicate glass-ceramic ingots through which lithium oxide crystals are dispersed. Which has a needle-like crystal structure that provides excellent durability and strength along with outstanding optical properties. The LD restorations are chemically stable and show excellent compatibility with surrounding periodontal tissues. In addition, due to their excellent optical properties, LD-based aesthetic rehabilitations also enhance the patient's self-esteem .The adhesion of ceramics to dental structure with resin luting materials increases the fracture resistance of the restoration and tooth itself. It also minimizes microleakage, which may be the determining factor in the success or the failure of the treatment. The main purpose of using adhesive bonding cements was to reinforce the weakened dental structure and support the enamel and dentine tissue underneath. We mainly used light cure adhesive cement hardened with light, developed for anterior region laminate veneers.a proper cement material would absorb the stress caused by the force of chewing and be effective in preventing fractures and adhesive type breaking [19].

Laminate veneers in this study were treated with hydrofluoric acid, as the microstructure of the ceramic is changed by hydrofluoric acid attack of the glassy phases of dental ceramic. This phase is dissolved preferentially to create micro pores which result in an appropriate microstructure for bonding. Because the ceramic has components bondable to silane such as silica, the bonding process can be enhanced by application of silane coupling agent. These agents are capable of forming chemical bonds between the inorganic phase of the ceramic and the organic phase of the resin. Surface treatment of the prepared tooth structure was also essential to enhance the bonding process). Proper selection of cement plays an effective role in the success of ceramic laminate veneers. The cement can affect the final color by changing the optical properties of the ceramic [20].

In our study Bisco Choice 2 resin cement was used. Light-curing cements have a polymerization mechanism that only allows material setting in the presence of a light source that activates photo- initiators to start the polymerization reaction. The advantages of light cure resin cement were: controlled setting time by the operator and the unlimited working time. [21]. light-curing and the dual-curing cements reached comparable degree of conversion between 0.6 and 1.5 mm. However, the lightcuring resin showed a higher degree of conversion and micro hardness [22].

Regarding the results of this study:

The result of this clinical study showed that conventional and gull wing preparation designs did not alter the fracture nor the color , there were no statistical difference between the conventional preparation group and gull wing preparation group.

The null hypothesis of this research would be no difference between all ceramic laminate veneers restorations prepared with modified gull wing and conventional preparation regarding fracture and color changes was accepted .Fracture results: The most common failure type for laminate veneers was reported to be fractures. Different factors are responsible for crack development in all-ceramic restorations of all forms. The greatest shortcoming of ceramic materials is their low ductility that is inherent problem yielding to crack formation. Also, polymerization shrinkage of the luting resin cements may create stress concentrations at the adhesive interface. In-vivo strength degradation of restorations based on dental ceramics may occur in oral environment as a consequence of masticatory and

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parafunctional forces more than 200 N. Flaws of different magnitudes may be introduced to the restorations depending on the chewed food and associated mastication force. In addition, damage may occur during the adjustments of ceramic restorations by the technician or the clinician prior to or during their placement in the mouth [23].

According to literature the most frequent failure modes associated with laminate veneers are fracture and debonding. Fractures of laminate veneers represented 67% of the total failures of such restorations over a period of 15 years of clinical performance [10].

Type of preparation is a critical factor for the fulfillment of all ceramic laminates veneers; many in vitro studies linked the survival rate of porcelain laminates veneers to the type of preparation. Preparation design and restoration techniques are important for fracture resistance of laminate veneers [14]. In this study, Zero score was recorded for all veneers during all the follow- up sessions. Additionally, there was no statistically significant difference between the two groups.

It was found by Mirra et al (2009) that butt joint design with 2 mm incisal preparation presented the highest fracture resistance and least microleakage of laminate veneers with different designs. Gresnigtet al (2013) performed a randomized controlled split-mouth clinical trial to evaluate the short-term survival rate of indirect resin composite and IPS Empress ceramic laminate veneers with no fractures in the ceramic veneers group which is similar to the results of this study.

COLOR CHANGE

Patient be satisfied with restoration mimic the surrounding natural teeth, so color bear in mind one of the maximum parameter affect restoration quality. A considerable element in esthetic restorations is the color match to the dentition The final color of CV is determined through a combination of translucency, opalescence, fluorescence, surface texture, number of firing, thickness of the restoration, cement [20]. In this study there was no statistically significant difference between (Group I) and (Group II) both groups showed (100%) zero grade in all time periods .

Different methods have been used for clinical assessment .Clinical evaluation of restorative procedures requires (a) choices of clinically relevant criteria, (b) assessment using simple nominal scales, (c) calibration of evaluators, (d) two independent evaluations, and (e) nonparametric statistic analysis that recognizes the patient (and not the restoration) as the independent variable. Only portions of those procedures are being preserved in current clinical investigations.

USPHS criteria continue in use until today as part ofroutine clinical evaluation and as components of standards programs such as the ADA acceptance program. However, in addition, USPHS-like criteria have been appended over the years to produce “modified USPHS guidelines.” These additional criteria include parameters such as postoperative sensitivity, fracture, interproximal contact, occlusal contact, and others. The combination of the original and modified USPHS criteria now have been accepted worldwide.This evaluation system was also known as the “Ryge criteria,” of which the original categories were color match, cavosurface marginal discoloration, anatomic form, marginal adaptation, and caries.The USPHS guidelines exist as a “system of clinical evaluation steps” that (a) defines key intraoral events to be measured for any clinical trial, (b) describes or ranks the

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key clinicalstages of change, and (c) provides a calibration system for evaluators who might be involved in clinical trials using the system. the authors suggest that the system could have many applications including assessment of the work of dental students [or] comparing two different dental materials or two different dental procedures involving the same patient Stephen C. Bayne (2005). Long term clinical success of laminate veneers is determined by marginal adaptation of the veneer restoration, design of preparation, functional and morphological condition of the abutment tooth. The colour of the underlying tooth structure or restorative foundation material, shade and thickness of the resin luting cement used and ceramic material selected widely attribute to the superior optical properties, biocompatibility, increased translucency and exceptional aesthetic outcome of the final restoration.

However, research and investigations emphasising the impact of cement shades on the final colour of ceramic restorations remains limited and the effect of resin cement thickness remains controversial. [24]. The thickness and the translucency of lithium disilicate affected its final color.

Limitations:

Further long term studies with more sample size and longer follow up period are required to evaluate clinical performance and patients' satisfaction of both Both ceramic laminate veneers prepared with modified gull wing and conventional technique

CONCLUSION

Within limitations of this study, the following conclusion could be drawn as follows Both ceramic laminate veneers prepared with modified gull wing and conventional technique revealed high successful clinical performance in terms of fracture and color changes

RECOMMENDATIONS

- Further investigation is recommended to investigate the effect of bonding protocols in terms of accuracy, color changes, fracture and longevity of laminate veneers .
- Investigate the fracture, color changes, taking in consideration the presences of saliva and oral variables .
- Further randomized clinical studies should be implemented to evaluate the clinical survival rate of the laminate veneers with different materials for more prolonged follow up periods.
- future research on the clinical color matching of ceramic veneers with different resin cement types .
- further studies to compare the effect of coffee, tea and/or soft drink consumption and color change

CLINICAL IMPLICATIONS

- It is advisable for clinician to use modified gull wing preparation technique for fabrication of laminate veneers.
- For longevity of restoration, strict case selection and proper preparations design must be maintained and regular follow up visits.

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REFERENCES

1. Shetty, A., Kaiwar, A., Shubhashini, N., Ashwini, P., Naveen, D. N., Adarsha, M. S., and Meena, N. (2011): Survival rates of porcelain laminate restoration based on different incisal preparation designs: An analysis. Journal of conservative dentistry: JCD, 14(1), 10
2. Vanlioglu, B.A. and Kulak-Özkan, Y. (2014): Minimally invasive veneers: current state of the art. Clinical, cosmetic and investigational dentistry. 6: 101.
3. Lin T, Liu P, Ramp LC, et al. Fracture resistance and marginal discrepancy of porcelain laminate veneers influenced by preparation design and restorative material in vitro. *J Dent*. 2011;40(3):202-209. doi:10.1016/j.jdent.2011.12.008
4. Öztürk, E., and Bolay, Ş. (2014): Survival of porcelain laminate veneers with different degrees of dentin exposure: 2-year clinical results. Journal of Adhesive Dentistry. 16(5)
5. Gresnigt, M., Kalk, W. and Özcan, M. (2013): Clinical longevity of ceramic laminate veneers bonded to teeth with and without existing composite restorations up to 40 months. Clinical oral investigations. 17.3: 823-832.
6. Alghazzawi, T. F., Lemons, J., Liu, P.-R., Essig, M. E. and Janowski, G. M. (2012): The failure load of CAD/CAM generated zirconia and glass-ceramic laminate veneers with different preparation designs. J. Prosthet. Dent. 108, 386–93
7. Beier US, Kapferer I, Burtscher D, Dumfahrt H. Clinical performance of porcelain laminate veneers for up to 20 years. *Int J Prosthodont*. 2012;25(1):79-85. doi:10.1016/S0022-3913(12)60047-X.
8. Flury, S., Lussi, A., and Zimmerli, B. (2010): Performance of different polishing techniques for direct CAD/CAM ceramic restorations. Operative dentistry,35(4), 470-481
9. Katerina Zlatanovska1, Ljuben Guguvcevski2, Risto Popovski3, Cena Dimova1, Ana Minovska1, Aneta Mijoska2 Fracture Resistance of Composite Veneers with Different Preparation Designs Balk J Dent Med, 2016; 20(2):99-103
10. *Abeer Gh. Abdul Khaliq, B.D.S. (1) Inas I. Al-Rawi, B.D.S., M.Sc. Fracture strength of laminate veneers using different restorative materials and techniques (A comparative in vitro study* Restorative Dentistry Vol. 26(4), December 2014,
11. Arif, R., Dennison, J. B., Garcia, D. and Yaman, P. (2019): Retrospective evaluation of the clinical performance and longevity of porcelain laminate veneers 7 to 14 years after cementation. The Journal of prosthetic dentistry. Mar 15.
12. Magne, P., Kim, T. H., Cascione, D., and Donovan, T. E. (2005): Immediate dentin sealing improves bond strength of indirect restorations. Journal of Prosthetic Dentistry. 94(6), 511-519.

Annals of R.S.C.B., ISSN:1583-6258, Vol. 25, Issue 6, 2021, Pages. 16230 - 16249
Received 25 April 2021; Accepted 08 May 2021.

13. Fradeani, M., Redemagni, M., and Corrado, M. (2005): Porcelain laminate veneers: 6- to 12-year clinical evaluation - A retrospective study. Int J Periodontics Restor Dent.25(1) 62-Fa G De. Clinical performance of porcelain laminate veneers. :56-59.
14. Ghaffari T, Rad FH, Fakhrzadeh V. Marginal adaptation of Spinell InCeram and feldspathic porcelain laminate veneers. 2016.
15. Smales RJ, Etemadi S. Long term survival of porcelain laminate veneers using two preparation designs: A retrospective study. *Int J Prosthodont*, 2004; 17:323-326
16. Al-Akhali M, Chaar MS, Elsayed A, Samran A, Kern M. Fracture resistance of ceramic and polymer-based occlusal veneer restorations. *Journal of the mechanical behavior of biomedical materials*, 2017, 74: 245-250.
17. Cp L, Wh D, Sl E. P redictable and precise tooth preparation techniques for porcelain laminate veneers in complex cases. 1999;9(1)
18. Alhekeir DF, Al-sarhan RA, Mashaan AF Al. Porcelain laminate veneers : Clinical survey for evaluation of failure. *Saudi Dent J*. 2014;26(2):63-67. doi:10.1016/j.sdentj.2014.02.003
19. Mustafa Duzyol1,*, Esra Duzyol2, Nilgun Seven3, Fracture Resistance of Laminate Veneers Made with Different Cutting and Preparation Techniques, *International Journal of Dental Sciences and Research, 2016, Vol. 4, No. 3, 42-48*
20. Masoumeh Hasani Tabatabaei1,3, Fatemeh Matinfard2, Ladan Ranjbar Omrani3, Farzaneh Sadeghi Mahounak3 and Elham Ahmadi Evaluation of the Final Color of Ceramic Veneers with Different Self-Adhesive Resin Cements DOI: 10.2174/1874210601913010203, 2019, *13*, 203-208
21. Bayne, S. C., and Schmalz, G. (2005): Reprinting the classic article on USPHS evaluation methods for measuring the clinical research performance of restorative materials. Clinical oral investigations. 9(4), 209-214.
22. Scotti, N. *et al.* Effect of Lithium Disilicate Veneers of Different Thickness on the Degree of Conversion and Microhardness of a Light-Curing and a Dual-Curing Cement. *Int. J. Prosthodont.* 29, 384–388 (2016).
23. Coldea, A., Swain, M. V. & Thiel, N. In-vitro strength degradation of dental ceramics and novel PICN material by sharp indentation. J. Mech. Behav. Biomed. Mater. 26, 34–42 (2013).
24. Shereen A Nossair*the effect of thickness and degree of translucency on the final color of lithium disilicate veneers, gyptian dental journal vol. 65, 2911:2920, july, 2019