EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 70, 2471:2476, JULY, 2024
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
FIXED PROSTHODONTICS AND DENTAL MATERIALS
Submit Date : 06-03-2024 • Accept Date : 18-03-2024 • Available online: 10-07-2024 • DOI : 10.21608/EDJ.2024.275089.2974

EFFECT OF DIFFERENT TOOTH SURFACE FINISH ON MARGINAL ADAPTATION OF LAMINATE VENEERS (AN IN VITRO STUDY)

Mohamed Mahmoud Gomaa*, Marwa Mohamed Wahsh**, Reham Said Elbasty*** *and* Mohamed Samy Zaky****,

ABSTRACT

Aim: Assessment of marginal adaptation of laminate veneers after using three different diamond grit abrasives on natural teeth in sequence blue, blue and yellow, blue yellow and polishing tips in three groups.

Methodology: Natural sound incisors were collected from Ain shams oral and maxillofacial surgery undergraduate clinic. Specimens were cleaned using ultrasonic scaler and low speed polishing tips. Teeth were then prepared using silicone index for standardization purposes to receive a butt joint veneer preparation; then secondary impression was taken for all the specimen then designed on EXOCADGMBH and milled using a ROLAND 5 axis milling machine. Afterwards lithium disilicate e.max processed in a Programat IVOCLARVIVADENT (P710) porcelain furnace. Veneers were then seated on the die using glycerin and placed on the measuring grid of digital microscope for measurement and statistically tabulated.

Results: statistically significant difference between three tested groups showing improved marginal adaptability. Blue showed the highest marginal gap, yellow was second lowest and white polish group was lowest.

Conclusion: Fine Polishing showed improved vertical marginal gap distance and marginal adaptation of laminate veneers.

KEYWORDS: Vertical margin gap distance , Natural teeth , Polishing

* MSc Student, Fixed Prosthodontics, New Giza University , October
** Professor of Fixed Prosthodontics, Faculty of Dentistry Ain Shams University
*** Associate Professor of Fixed Prosthodontics, Faculty of Dentistry Cairo University, Head of Fixed Prosthodontics Division New Giza University
**** Lecturer of Fixed Prosthodontics, Faculty of Dentistry. Ain Shams University

INTRODUCTION

With such an ever-growing patient awareness and demands regarding minimally invasive and conservation of their dentition, partial coverage restorations are constantly gaining popularity.

Tooth Surface preparation would be ideally reproduced using blue coded adhesives as it remains the benchmark in almost all fixed prosthodontics preparations [(1)] all the work in porcelain laminate veneers is within the enamel.[(2)(3)]

Surface finish and comparing grit sizes of dental abrasives is generally under researched in fixed prosthodontics and has been stagnant for the past decade with next to no updates.[(1) (2)]

Marginal Adaptation:

When it comes to success of a restoration, many debated a lot of factors regarding finish line designs, whether its an continuity, even thickness and smoothness however the major part of the overall success rate of the restoration was how closely the margins are adapted over said finish line.[(4)(5)]

When it comes to marginal adaptation and accuracy, both long term success and survival rate depend on how small the gap is to decrease the saliva and lactic acid entry to prevent future discoloration, caries recurrence, restoration debonding and fracture of the veneer due to eventual dissolution of cements. So, margins remain of critical importance for the long-term success and is the sole reason why some dental restorations live for twenty years and others don't.

Aim of the Study

The aim of this invitro study was to assess:

1) Mesh quality.
2) Internal fit
3) Marginal adaptation of laminate veneers using 3 surface finish steps as a polishing protocol:
   a) Blue color-coded tapered stone with round end.
   b) Blue color-coded tapered stone with round end followed by yellow color-coded finishing stone with round end.
   c) Blue color-coded tapered stone with round end followed by yellow color-coded finishing stone with round end followed by rubber tips.

Null Hypothesis

There would be no difference in the mesh quality, internal fit and marginal gap values between the three tested groups.

MATERIALS AND METHODS

Teeth selection:

a) ***Inclusion criteria***

Extracted sound central incisors with intact enamel.

b) ***Exclusion criteria***

Heavy discoloration, amelogenesis imperfecta, dentino-genesis imperfecta, badly broken-down teeth, heavily cracked teeth, teeth with fused crowns, geminations, teeth with cervical decay, teeth with deep carious lesions near the margins.

Sample grouping

Teeth were divided into 3 groups according to the planned surface finishing procedure as follows: (Table 1)

TABLE (1) Sample grouping.

Finishing protocol	(B)	(BY)	(BYW)	
Number of Samples	N=8	N=8	N=8	24
Total	8	8	8	N=24

Group B: Teeth prepared with blue grit diamond abrasives (tapered diamond stone with round end/ size 13).

Group BY: Teeth prepared with blue grit diamond abrasives followed by yellow grit diamond abrasives (tapered diamond stone with round end/ size 13).

Group BYW: Teeth prepared with blue grit diamond abrasives followed by yellow grit diamond abrasives (tapered diamond stone with round end / size 13) followed by white rubber tips for polishing then souflex discs for super polishing of the preparation).

Sample preparation:

Teeth were cleaned using ultra sonic scaler* and polished to remove any stains and remaining discolorations leaving fresh enamel. Teeth were stored in distilled water .Rubber index was made before tooth preparation to assess even amount of reduction. All of the procedures were carried out by the same operator for standardization and a fresh new stone was used for each new sample.

Construction of ceramic laminate veneers:

i) Data acquisition Phase (Scanning):

Scanning of the prepared teeth was done using the Medit i500**.STL files were obtained from the scanner.

ii) Designing Phase:

For the designing of the veneers, First, STL files were exported to an open-source software (EXOCAD GMBH)*** (Rijeka 3.1) and virtual models were created. The veneers were designed setting the parameters according to the manufacturer's instruction, cement space was set to 70 microns. (Figure 1)

* Acteon, Paris France
** Medit, Korea.
*** EXOCAD GMBH, Germany

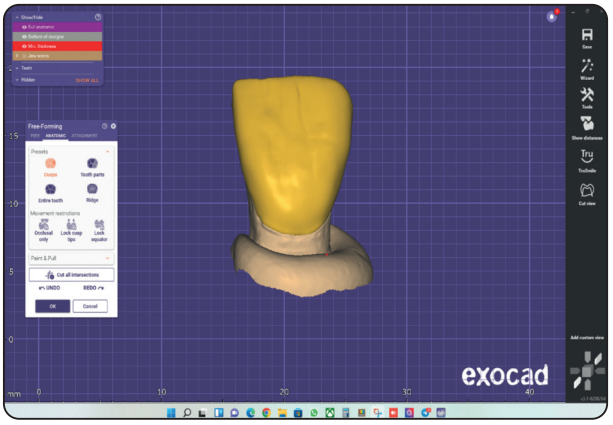

Fig. (1) Dental EXOCAD GMBH design.

A) Digital microscopy:

Images of the samples were captured using digital microscope after applying glycerin over the preparations to properly seat it, which was visually confirmed afterwards.

Dinolite digital microscope lens has preset magnifications, and it can measure by using a grid placed beside the samples. Magnification was preset to 45 X magnification and a scaling grid was placed on the tabletop of the precision stand then the images were captured. Multiple readings were taken over proximal, incisal, cervical margins.

Each side predetermined for measurement was adjusted to the light and gauged over it. Where the proximal surfaces were evaluated for five equidistant points. Cervical margin was measured for three equidistant points and the incisal portion was measured near the butt margin at four equidistant points from the palatal view.

Images captured were presented on an image J**** application for surface measurements and then evaluated. (Figure 2, 3, 4)

**** Image J, USA.

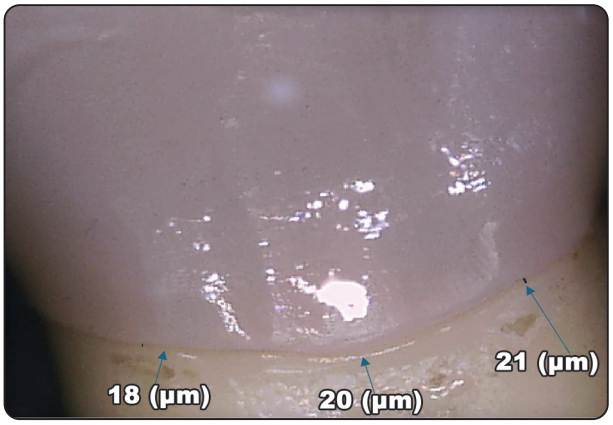

Fig. (2) Cervical margin measurement.

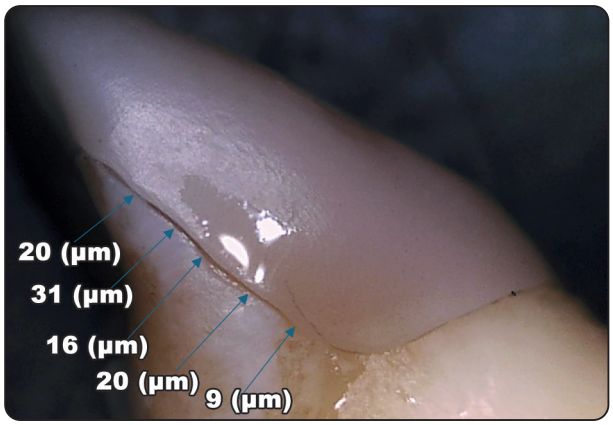

Fig. (3) Proximal margin measurement.

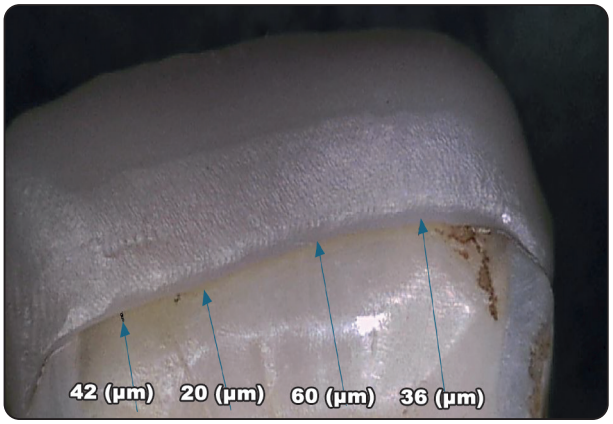

Fig. (4) Butt margin measurement.

RESULTS

Statistical analysis:

Numerical data were presented as mean and standard deviation (SD) values. They were explored for normality by checking the data distribution and using Shapiro-Wilk test. Data showed parametric distribution and were analyzed using one-way ANOVA followed by Tukey's post hoc test. The significance level was set at $p<0.05$. Statistical analysis was performed with R statistical analysis software version 4.3.1 for Windows*.

A-Digital microscopy:

Vertical marginal gap distance intergroup comparisons, mean and standard deviation (SD) values of marginal adaptation (μm) are presented.

There was a significant difference between different groups ($p<0.001$). The highest value was found in blue group "(B)" (50.49±4.28), followed by yellow group "(BY)" (32.25±1.56), while the lowest value was found at white group "(BYW)" (20.71±2.23). All post hoc pairwise comparisons were statistically significant ($p<0.001$). (Figure 5)

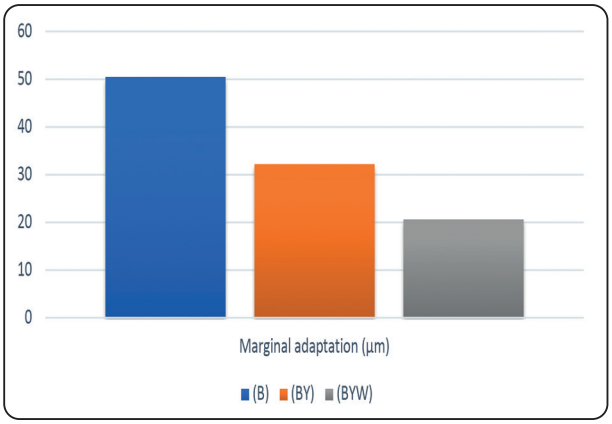

Fig. (5) Bar chart for average margin measurement per group.

* R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. URL https://www.R-project.org/.

DISCUSSION

Marginal adaptation is of critical importance as its directly affecting the seal of the restoration – tooth complex to prevent future decay, sensitivity and hence long term success of the restoration.[6]

Perks of digital microscopy is being noninvasive and the presence of scaling grid for identical placement of the samples/index/restoration. This is in turn plays a critical role in being repeatable, feasible and ease of trouble shooting.[7][8]

Statistically significant differences were found between the three groups regarding the marginal adaptation of laminate veneers via digital microscopy.

This was in accordance with Tamam et al. (2022) who concluded that marginal adaptation is directly proportional to the surface finishing protocol depending on the grit size of the abrasive. which can be attributed to the improved readability by the scanner, easier and clearer dentist-technician lab communication. More predictable milling phase with less foreseeable complications. ([9]

This was also in agreement with Li et al. (2012), who concluded that having low grit abrasives improved marginal adaptation and internal fit of produced restorations due to smoother model. [10]

We are also in agreement with Ayad etal 1996 who concluded that having smooth teeth preparations resulted in better and higher internal adaptation of full coverage restorations due to a smoother dental laboratory model hence easier steps of fabrication.[11]

According to the previous discussion, the null hypothesis statement that there would be no difference in the internal fit and vertical marginal gap distance values and mesh quality between the three tested groups; was denied as all above deemed relevant and statistically significant.

CONCLUSION

Within limitations of the study, the following points can be drawn:

1. Fine Polishing showed improved vertical marginal gap distance.
2. Taking the extra steps to do a well-polished preparation is important in improving the overall marginal adaptation of laminate veneers.

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