https://doi.org/10.5272/jimab.2018242.2002

Journal of IMAB
ISSN: 1312-773X
https://www.journal-imab-bg.org

Journal of IMAB - *Annual Proceeding (Scientific Papers).* 2018 Apr-Jun;24(2)

Original article

LONG TERM FUNCTIONAL STABILITY OF CERAMIC VENEERS

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SUMMARY:

Aim of the study: The aim of the study is long term evaluation according to ADA standard criteria of ceramic adhesively bonded veneers.

Material and Methods: One hundred fifty two patients with 283 ceramic veneers were involved in our study. They were divided into two experimental groups and one control group. The pre-treatment of enamel surface of the first experimental group was with 37% phosphoric acid. In the second experimental group, the pre-treatment was provided with laser ablation. The pre-treatment in the control group involved three step adhesive system.

Results: After a period of nine years, modified USPHS criteria of the ADA were used to assess the quality of the veneers. We observed one cohesive fracture in ceramics, six marginal discolorations and one loss of marginal adaptation in the first experimental group. We found two marginal discolorations in the second experimental group, one loss of marginal adaptation and one marginal discoloration in the control group.

Conclusion: Laser ablation is a minimally invasive method which provides retentive enamel surface and ensures long term functional stability of ceramic veneers.

Keywords: ceramic veneers, clinical criteria, laser ablation, long term evaluation.

INTRODUCTION

The minimally invasive ceramic prosthetic restorations of the anterior teeth (ceramic veneers) represent a conservative alternative to the crowns to improve the aesthetic appearance of the teeth. During the last decades, they have been widely used in aesthetic dentistry [1, 2, 3, 4]. There is a tendency to use metal-free restorations in prosthetic dentistry. Patients' increased aesthetic requirements lead to a serious challenge to clinicians for treatment with aesthetic, biologically tolerable and long-term restorations [5, 6, 7, 8]. The opportunity of painless treatment options of contemporary laser systems had increased interest of dentists [9, 10, 11].

The importance of the problem is determined by the opportunity of performing the minimally invasive and painless treatment option with a high aesthetic effect.

MATERIAL AND METHOD:

Depending on the clinical procedure and the pre-treatment of enamel surface, the patients were divided into two experimental and one control groups.

1. The first experimental group included 49 patients (32%) in which the enamel surface was treated with 37% phosphoric acid, and the veneers were cemented with self-etching adhesive cement – MaxCem Elite (Kerr Corporation, Orange, USA).

2. In the second experimental group, 52 patients (34%) were involved. The enamel surface was treated with the Waterlase MD Er, Cr: YSGG laser system (Biolase Technology Inc., San Clemente, CA, USA) operating mode: 30 Hz, 1 W, 10% water/ 15% air (10). The laser energy was delivered through a fiber optic system to a sapphire tip measuring 600 μm in diameter and 6 mm in length and self-etching adhesive cement – MaxCem Elite (Kerr Corporation, Orange, USA).

3. The remaining 51 patients (34%) were a control group. The enamel surface was treated with 37% phosphoric acid, followed by adhesive and composite cement - Variolink Veneer (IvoclarVivadent, Schaan Liechtenstein).

After a period of nine years, modified USPHS (United States Public Health System) criteria of the American Dental Association (ADA) were used to assess the quality of the veneers.

Statistical analyses were performed by one-way ANOVA with a Tukey post hoc test. The statistical analysis of the results obtained was conducted using a significance level of 5% ($p \leq 0.05$). Descriptive evaluation methods were applied - absolute and relative frequencies. Statistical data processing was performed using IBM SPSS Statistics 20 (IBM - USA).

RESULTS:

The distribution of veneers of the patients in studied groups is presented in Table 1.

Table 1. Distribution of veneers according to the pre-treatment of the enamel surface for adhesive cementation.

Groups \ Age	20 - 30 age	31 - 41 age	Total (%)
1	37	52	89 (31,45%)
2	46	50	96 (33,92%)
3	47	51	98 (34,63%)

Legend:

1. Pretreatment of the enamel tooth surface with 37% phosphoric acid and application of self-adhesive composite cement.

2. Pre-treatment of the enamel tooth surface with the following laser ablation mode and application of self-adhesive composite cement.

3. Pretreatment of the enamel tooth surface with 37% phosphoric acid and application of adhesive and composite cement.

Slight marginal staining was found in six of the ceramic veneers in the first experimental group (Figure 1). In this group, loss of marginal adaptation was observed in one of the veneers.

Fig. 1. Marginal discoloration in mesial margin of upper lateral incisor.

In the clinical evaluation of ceramic veneers in the first experimental group, the main failure was associated with cohesive fracture of ceramic veneer (Figure 2). Pretreatment of the enamel tooth surface in this group included etching with 37% phosphoric acid and application of Maxcem Elite adhesive cement (Kerr Corporation, Orange, USA).

Fig. 2. Fractured porcelain veneer.

In the second experimental group, we observed two marginal discolorations, one loss of marginal adaptation. One marginal discoloration was found in the control group. We established color matching and patient satisfaction. This study was not detected any secondary caries or need for root canal treatment.

The results of the clinical criteria assessment of the ceramic veneers are presented in Table 2.

Table 2. Evaluation by standard clinical criteria of minimally invasive adhesively bonded ceramic veneers.

Clinical criteria	Evaluation	Experimental groups		
		1 group	2 group	3 group
Marginal adaptation	1	n=89	n=96	n=97
	2			
	3			n=1
	4			
Marginal discoloration	1	n=85	n=94	n=97
	2			
	3	n=6	n=2	n=1
	4			
Anatomical form	1	n=88	n=96	n=98
	2			
	3			
	4	n=1		
Surface roughness	1	n=89	n=96	n=98
	2			
	3			
	4			
Color match	1	n=89	n=96	n=98
	2			
	3			
	4			
Presence of caries	1	n=89	n=96	n=98
	2			
	3			
	4			
Fracture of restoration	1	n=88	n=96	n=98
	2			
	3	n=1		
	4			
	5			

The p-value corresponding to the F-statistic of one-way ANOVA is lower than 0.05 which strongly suggests that one or more pairs of treatments are significantly different (Table 3).

Table 3. Results of the F-statistic of one-way ANOVA

	SS	**df**	**MS**	**F statistic**	**p-value**
Between groups	0,2928	2	0,1464	3,6599	0,0270
Within groups	11,1984	280	0,04		
total	11,4912	282			

df- degrees of freedom; SS- sum of squares; MS- mean square; F- F statistic;

We present below color coded results (red for insignificant, green for significant) of evaluating whether *Qi,j>Qcritical* for all relevant pairs of treatments (Table 4).

Table 4. Post-hoc Tukey HSD test results.

treatments pair	Tukey HSD Q statistic	Tukey HSD p-value	Tukey HSD inferfence
A vs B	3,3186	0,0512351	insignificant
A vs C	3,3555	0,0480004	* p<0.05
B vs C	0,0209	0,8999947	insignificant

Statistical analysis of the tested experimental groups demonstrated a significant difference only between the first and the third group. There was observed the statistically significant difference between the first experimental group and the control group. The second experimental group has a statistically insignificant difference with the control group.

DISCUSSION:

In the first experimental group, we observed the highest failure rate. Slightly marginal staining was observed in 6 of the veneers, a possible cause of which was smoking. With finishing diamond burs, it was removed.

The absence of more cases with marginal discoloration is explained by the better color stability of light-polymerizing composite cement.

The result of our research shows that the most common cause of failure is the discoloration of restorations, which is consistent with previous studies [12, 13, 15].

This means that, despite the advantages of materials and techniques, there are other factors that determine the long-term functional stability of the restoration. In this study, after five-years of function cohesive fracture affected the veneer of the upper lateral incisor, where the restoration included a minimal incisal overlap. The occlusal factors, according to our study are fundamental to this failure. Dental ceramics are fragile materials with a relatively high compressive strength but with low tensile and bending strengths. Their strength is largely due to the adhesive bonding of the composite cement to enamel surface and to the fluorocarbon-etched ceramic surface.

CONCLUSION:

Ceramic veneers can successfully and long-term restore aesthetics of the anterior teeth. Laser ablation is a minimally invasive method of pre-treatment of the enamel surface which provides retentive enamel surface and ensures long term functional stability of ceramic veneers. The laser ablation of the enamel can successfully substitute acid etching.

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Please cite this article as: Kazakova S, Kirov D. Long term functional stability of ceramic veneers. *J of IMAB.* 2018 Apr-Jun;24(2):2002-2006. DOI: https://doi.org/10.5272/jimab.2018242.2002

Received: 02/03/2018; Published online: 04/06/2018

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