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The Effect of Modified Carisolv Gel on Surface Roughness of two Different Types of Ceramic Materials Using Light Polarizing Microscope

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Abstract

This in vitro study evaluated the influence of chemomechanical caries removal solution on the surface topography of metal-ceramic feldspar porcelain (MAJOR ceramic) and All-ceramic feldspar porcelain (Vita Alpha) using light polarizing microscope. Forty specimens of MAJOR ceramic and forty specimens of Vita Alpha ceramic of (12mm diameter & 3mm height) were prepared .All specimens were polished with silicon polishing burs, cleaned, autoglazed and stored in 37°C before exposure to Carisolv. Thirty specimens of each material randomly exposed to Carisolv gel for 5, 10 and 20 minutes respectively, other ten specimens were not, to act as control group. All specimens were subjected to surface roughness test by profilometer and evaluated using light polarizing microscope. ANOVA and student t-test were used to analyze the surface roughness values.

Different exposure times of modified Carisolv gel showed highly significant difference compared to control ($P<0.001$).Surface treatment with modified Carisolv gel for 20 minutes resulted in the highest surface roughness. Metal-ceramic feldspar porcelain (MAJOR ceramic) showed high surface roughness than all ceramic feldspar porcelain (Vita Alpha), however, the difference is statistically not significant ($P>0.05$).

Different exposure times of modified Carisolv gel affect the surface roughness of dental ceramic materials differently. This study showed major influence on surface topography after exposure to modified Carisolv gel for 20 minutes on dental ceramics MAJOR and Vita Alpha.

Key words: Carisolv, Ceramic, Surface roughness, light polarizing microscope

Introduction

Ceramic crowns and bridges are commonly applied in fixed prosthodontics because of their excellent biocompatibility and superior aesthetic qualities. The surface roughness of the ceramic materials is a key factor for longstanding dental restorations because it directly influences the cleanability and the microbes retention [(1)].

Modified Carisolv gel consists of 0.5% NaOCl that is mixed with a gel containing three different amino acids (glutamic acid, lucine and lysine) and has a PH of 11.0[(2)].

The effect of Carisolv on oral hard tissues has been studied and it was found that Carisolv did not influence the surface topography of neither healthy enamel nor dentine [(3)].Carisolv

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gel may affect other restorative materials, such as earlier restorations of different ceramics, composites and metals, when it comes in direct contact with them.

In general, dental ceramics are associated with good aesthetics, wear resistance, chemical inertness, and low thermal conductivity. However, it has earlier been observed that ceramic materials will be grossly affected by high PH agents as these will induce a breakdown of the glassy matrix [(4)]

The effects of surface deterioration might be a loss of surface gloss and increased surface roughness, both of which may result in an increased risk for plaque adhesion and discoloration, furthermore, the mechanical strength of the restorative material may possibly be negatively affected[(5)]

The purpose of this study was to clarify whether there is a risk for material deterioration when using chemomechanical caries removal system for patients with earlier ceramic restorations

Materials and Methods

Forty specimens of MAJOR ceramic (metal ceramic feldspar porcelain) shade B1 and Vita Alpha (all ceramic feldspar porcelain) shade B1 were prepared.

Fabrication of ceramic specimens:

Forty specimens of each material were fabricated using a specially designed syringe of 12mm internal diameter and 3mm height. The porcelain powder was mixed with its liquid into a smooth consistency on a glass slab. The mould was filled with porcelain mixture and gently vibrated by hand to eliminate air bubbles, and excess moisture was removed with drying tissues. The specimens were then introduced into the furnace to be fired according to the manufacturer firing chart for each material. All specimens were polished with silicon polishing burs using low speed hand piece at 35 000 rpm for 10 seconds [(6)].The hand piece was mounted on surveyor for standardization of polishing. The test specimens were finally cleaned with distilled water and autoglazed following firing schedule.

To simulate the clinical situation the ceramic specimens were stored in 37°C before exposure to Carisolv.

Sample grouping

Ten specimens of each material were not exposed to Carisolv gel to act as control group; other 30 specimens of each material were divided into three groups with different exposure times of Carisolv gel (Mediteam company, Sweden)

regarded to be relevant from a clinical point of view, namely 5, 10, and 20 minutes [(2)].Carisolv gel was applied on the surface layer of the specimen using insulin syringe followed by washing with air-deionized distilled water for 2 minutes [(7)]. Specimens were stored separately in air at room temperature until tests were done [(8)].

Samples were photographed by special orthoplane camera using light polarizing microscope to evaluate the surface alteration before and after application of Carisolv using magnification power of 50X

Surface roughness test

The average values of surface roughness (Ra-µm) of all specimens was measured by means of a profilometer .The profilometer measured each specimens at 3 areas in various locations with a maximum traveling distance of 11 mm .The average value was recorded.

Results

The mean, standard deviation, minimum and maximum values in μm for all groups are illustrated in table (1).

Statistical analysis of data by using the analysis of variance "ANOVA" revealed that there was a highly significant difference among the different exposure times for both material A metal-ceramic and material B all ceramic materials (table 2 & table 4)

Further investigation using student-test showed that there was a highly significant difference between groups not treated with Carisolv and groups exposed to Carisolv at different times(table3&table5)

Using student t-test, there was no significant difference between metal ceramic and all ceramic groups at different exposure times of Carisolv (table 6)

Discussion

Carisolv gel resulted in significantly higher surface roughness for dental ceramic material increasing with exposure time. This might be attributed to the fact that, the Carisolv gel used containing NaOCl and having a high alkaline pH value (pH=11.0) was suspected to be able to cause a breakdown of the silica framework in silicate –based ceramics. Aqueous media of high pH values (pH>9-10) are well known for their potential of Si-O bond breakage [(4)].

Furthermore, pH will influence degradation and erosion processes taking place at the surface or within dental ceramics leading to higher ion leakage and higher surface deterioration affecting the surface topography[(9)].

In this study, only the chemical effect of the Carisolv gel was of interest and therefore the mechanical part of it was not involved, because if the Carisolv hand instruments had been used as well it would not have been possible to distinguish mechanical effects from chemical ones. Though, Carisolv gel affects the dental ceramics in away that increases the risk of scratching when the instruments are used.

Furthermore, rough surface due to superficial defects such as voids and microcracks on the subsurface of porcelain are within the same scale as the size of many proteins and it has earlier been found that corrosion of ceramic may increase the absorption of salivary and plasma proteins to the ceramic surface [(10)].

The results presented in this study indicated that Carisolv gel possibly causes differences in roughness of the cervical margin of the ceramic restorations if it gets in direct contact with it leading to colonization of bacteria, plaque accumulation and initiation of gingivitis.

Conclusion

Under the limitation of this in vitro study, the following conclusions were drawn:

1- The surface roughness of dental ceramic materials was increased with increasing the exposure time of Carisolv gel.
2- The highest surface roughness was obtained when Carisolv applied for 20 minutes.
3- Major ceramic yielded surface roughness higher than that of Vita-Alpha ceramic, however, the difference was non significant.

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Fig. (1): Bar chart showing mean of surface roughness values in µm for metal-ceramic groups

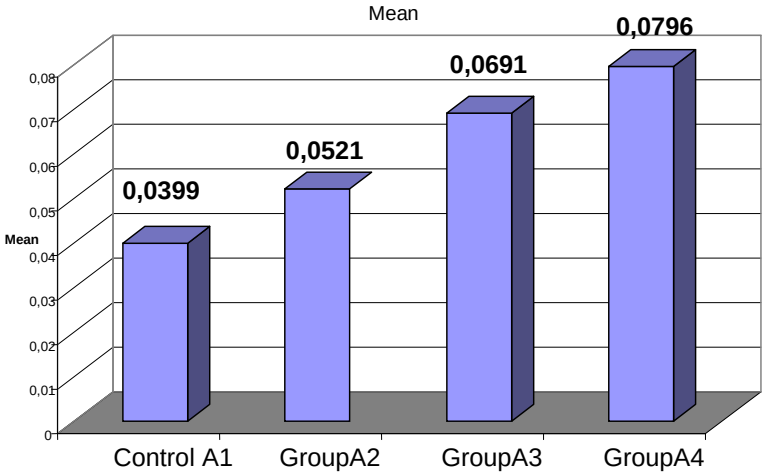

Fig. (2): Bar chart showing mean of surface roughness values in µm for all-ceramic groups

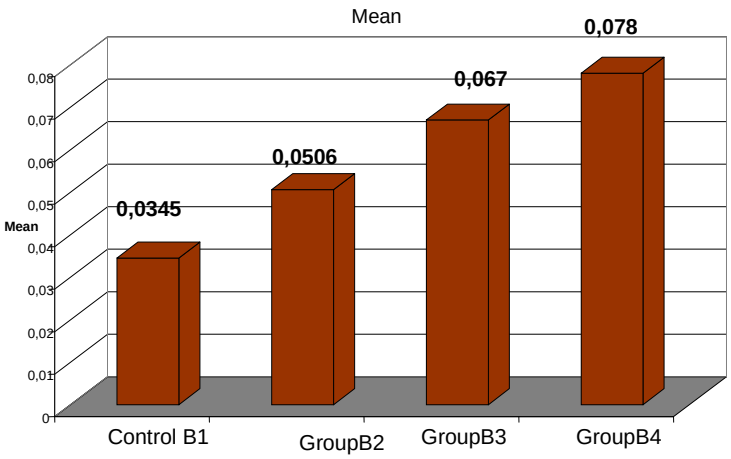

Fig.3: Polarized light microscope figure of metal-ceramic sample before Carisolv application

Fig.4: Polarized light microscope figure of metal-ceramic sample after Carisolv application for 20 min

Fig.5: Polarized light microscope figure of all-ceramic sample before Carisolv application

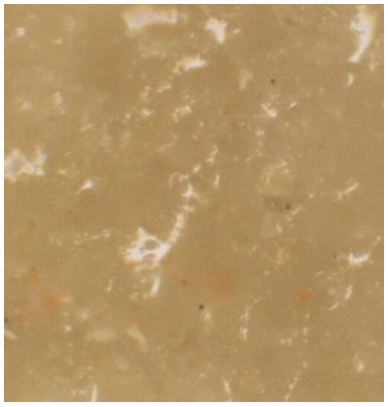

Fig.6: Polarized light microscope figure of all-ceramic sample after Carisolv application for 20 min

Table (1): Descriptive statistics of surface roughness values in μm for all groups

	Groups	N	Mean	SD	Min. Value	Max. value
A	***A1**	10	0.0399	0.0047	0.032	0.046
	A2	10	0.0521	0.0035	0.048	0.058
	A3	10	0.0691	0.0028	0.065	0.073
	A4	10	0.0796	0.0049	0.074	0.087
B	***B1**	10	0.0345	0.0025	0.031	0.04
	B2	10	0.0506	0.0036	0.045	0.055
	B3	10	0.067	0.0025	0.062	0.07
	B4	10	0.078	0.0051	0.071	0.086

* Control Group

Table (2): ANOVA test comparison among (A) groups

Groups	Mean	SD	df	F	Sig.
A1	0.0399	0.0047	3	185.691	HS
A2	0.0521	0.0035			
A3	0.0691	0.0028			
A4	0.0796	0.0049			

Table (3): Student t-test among (A1, A2, A3, A4) groups

Groups	Mean Difference	t-value	df	Sig.
A1&A2	0.0122	7.882	9	HS
A1&A3	0.0292	16.278	9	HS
A1&A4	0.0397	19.577	9	HS
A2&A3	0.017	18.031	9	HS
A2&A4	0.0275	13.975	9	HS
A3&A4	0.0105	5.599	9	HS

Table (4): ANOVA test comparison among (B) groups

Groups	Mean	SD	df	F	Sig.
B1	0.0345	0.0025	3	283.04	HS
B2	0.0506	0.0036			
B3	0.067	0.0025			
B4	0.078	0.0051			

Table (5): Student t-test among (B1, B2, B3, B4) groups

Groups	Mean Difference	t-value	df	Sig.
B1&B2	0.0161	10.517	9	HS
B1&B3	0.0325	33.945	9	HS
B1&B4	0.0435	23.124	9	HS
B2&B3	0.0164	14.298	9	HS
B2&B4	0.0274	12.443	9	HS
B3&B4	0.011	6.522	9	HS

Table (6): comparison between metal-ceramic and all ceramic materials with different Carisolv exposure times

Exposure times	Groups	Mean Difference	t-value	Sig.
Control	A1	0.0054	3.163	NS
	B1			
5 min	A2	0.0015	2.577	NS
	B2			
10 min	A3	0.0021	3.260	NS
	B3			
20 min	A4	0.0016	3.00	NS
	B4			