Effect of different fluoride desensitizers on ceramics: An in vitro SEM and EDS Analysis

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Abstract

For a variety of reasons, patients with ceramo metal restorations may be treated with fluoride preparation to inhibit caries, for the treatment of hypersensitivity, decalcification and plaque accumulation. Several investigators have reported in vitro corrosion of one or more types of porcelain caused by APF preparations. The purpose of this study was to determine the effect of four different fluoride desensitizer on porcelain restorations

Key words: Fluorides, Topical fluorides, and Fluoride desensitizers.

Introduction

Patients having ceramo-metal restorations may be treated with fluoride preparation for many reasons viz., for the treatment of hypersensitivity, decalcification, plaque accumulation and to inhibit the caries.[1,2] Various forms of fluoride have been used such as professionally applied topical fluoride, ingestion of tablets, rinsing with fluoride solutions and use of gels containing fluoride[3].

Topically applied fluorides agents cause surface changes and weight loss of materials (Veneering) including porcelain, composite resin and glass ionomer cements4. These materials have glass like elements susceptible to reaction at acidic PH2· Fluorides have a PH of 4-5. The presence of acids may cause changes in surface and weight of the material. This study was conducted to evaluate the effect of fluoride desensitizing agents on the surface roughness of porcelain and to evaluate the surface chemistry and SEM changes after application of fluorides for 5 minutes and 24 hours.

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Materials and Methods

Specimen preparation

Porcelain powder was mixed with modeling liquid and the mixed was filled into a brass ring measuring 8mm diameter and thickness 2mm. The condensed porcelain was separated from the brass ring and transferred on to the firing tray and fired in the dentin bake programme.After firing the porcelain pellets was examined for any surface irregularities/defects. Using the same method 64 good porcelain pellets was prepared.

Four commercially available fluoride desensitizing agents used in the study were.

a. Biflourid

b. Flouridin

c. FlouridiN5

d. APF 1.23%

Specimen treatment

The specimens were divided into two groups. Group I & Group II. In group I the specimens were immersed in each of the fluoride desensitizing agents for five minutes and then rinsed with distilled water and blotted dry. In group II the specimen were immersed in fluoride desensitizing agents for twenty four hours and then rinsed with distilled water and blotted dry. All the specimens were stored until they were examined using the scanning electron microscope.8 specimens were treated with each type of fluoride desensitizers. Each group

contains four sub groups. Group IA, Group IB, Group IC , Group ID. Group IIA, Group IIB, Group IIC, Group IID.

"Scanning electron microscopy", All specimens were coated with gold and subjected to SEM and surface chemistry analysis EDS.

Results

Energy dispersive spectroscopy (EDS) was carried out to check the surface roughness of the porcelain samples. Table I shows the elemental changes as seen in EDS for both Group II and I. The basic elements in which the changes observed were silica, potassium and calcium. Results of ANOVA test are listed in Table ll.

Silica content for 5 minutes and 24 hours in group IA & group IIA shows P value> 0.05 which is statistically not significant. Potassium content for 5 minutes and 24 hours in group IA & group IIA shows P value> 0.05 which is statistically not significant. Calcium content for 5 minutes and 24 hours shows mean value - 1.3900 & 1.3275 with P values >.05 which is statistically not significant.

Silica content for 5 minutes and 24 group IB & group IIB hours shows mean value of 80.9750 & 83.4800 respectively with P value < 0.10 which is statistically significant. Potassium content for 5 minutes and 24 hours shows mean value of 16.6875 & 14.1875 respectively with P value < 0.05 which is statistically significant. Calcium content for 5 minutes and 24 hours group IB & group IIB shows mean value of 1.4575 & 1.1075 respectively with P value> 0.05 which is statistically not significant.

Silica content for 5 minutes and 24 hours group IC & group IIC shows mean value of 79.4880 & 80.9880 respectively with P value < 0.05 which is statistically significant. Potassium content for 5 minutes and 24 hours shows mean value of 23.0400 & 25.7325 respectively with P value < 0.05 which is statistically significant. Calcium content for 5 minutes and 24 hours group IC & group IIC shows mean value of 1.2825 & 1.2650 respectively with P value> 0.05 which is statistically not significant.

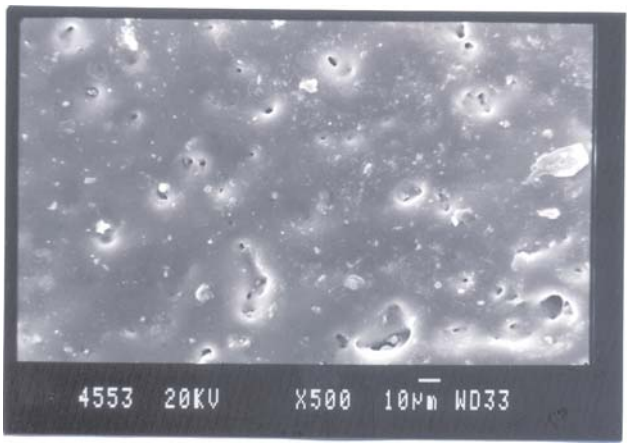
Silica content for 5 minutes and 24 hours group ID & group IID shows mean value of 73.9825 & 69.9825 respectively with P value> 0.05 which is statistically not significant. Potassium content for 5 minutes and 24 hours shows mean value of 25.5175 & 27.4725 respectively with P value> 0.05 which is statistically not significant. Calcium content for 5 minutes and 24 hours shows mean value of 1.5500 & 1.3575 respectively with P value> 0.05 which is statistically not significant.

SEM analysis of the test porcelain samples were done prior to the fluoride treatment.

Fig.1 - Photograph showing the SEM image of test specimen prior to fluoride treatment

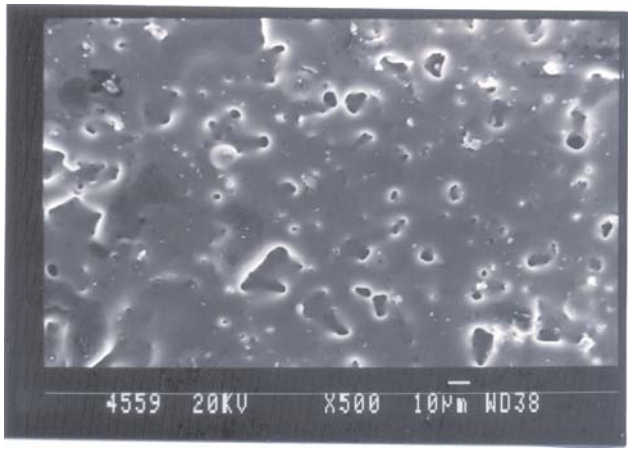
It shows smooth textured surface of the porcelain samples. SEM photographs showed surface roughness after 5 minutes of fluoride application.

Fig.2 - Photograph showing the SEM image of porcelain samples after 5 minutes



Similarly surface roughness was observed after 24 hours of fluoride application

Fig.3 - Photograph showing the SEM image of porcelain samples after 24 hours of fluoride treatment



24 hours fluoride application showed more roughness compared to 5 minutes.

Discussion

Topically applied fluoride preparations are shown to etch the venerating materials[5]. Dental ceramics contain a large amount of glass components that can be easily etched and pitted by the action of fluoride ions on the silicon oxygen network. When these fluoride ions come in contact with glass in an acidic environment forms water-soluble fluorosilicate.

Various formulations of APF containing phosphoric acid and hydrofluoric acid have been used. The hydrofluoric acid dissolves the fillers particles resulting in pitted surface. This surface roughness may cause surface staining and increased plaque accumulation. Plain APF, Bifluorid, Fluoridin and Fluoridin N5 were used in this study to check the effect on ceramics. Except the plain APF other three preparations contain sodium fluoride. Studies have shown that sodium fluoride cause less surface changes compared to APF.[1, 2, 6, 7] Hydrofluoric acid is more destructive than phosphoric acid because it etches glass at temperature found in the oral cavity. Whereas phosphoric acid degrades glass at higher temperature.[5]

EDS analysis showed, Crystalline precipitates on the surface and these were the reaction products of sodium, potassium, calcium, aluminum which were not soluble in water. Therefore, clinical analyses suggest that when topical fluorides are applied to the porcelain surfaces, there is precipitation reaction occurring on the surface and less soluble products precipitates on the surface thereby increasing the sample weight. This study suggests that there are changes between 5 minutes and 24 hours fluoride application but statistically not significant.

SEM photographs showed surface roughness when the fluoride desensitizing agents were used on the porcelain surface. This suggests that there is alteration on the surface of the porcelain sample when fluorides are applied topically. Bifluorid, Fluoridin and Fluoridin N5 showed less surface roughness compared to APF. It appears that as the pH of the fluoride gel decreases, the ability to etch dental porcelain surface increases. Also the duration of exposure to the fluoride solution, difference in the fluoride concentration2 influences the etching. In this study both the 5 minutes and 24 hours has been advocated, though 24 hours may not be clinically relevant since 5 minutes is usually amount of time the patient is subjected to fluoride treatment. But it also gives an idea of the effect of fluoride on porcelain when the long-term topical fluorides are administered. All fluoride preparations showed etching and pitting of the administered surface. The degree of etching could be related to the concentration of the product, viscosity and duration of the immersion of porcelain samples.

Conclusion

Within the limitations of this study it can be concluded that exposure to four commercially available fluoride desensitizers used to prevent sensitivity can affect the porcelain restorations. SEM photographs of the porcelain samples exposed to the topical fluoride agents showed that different agents and time duration had different effects on the morphology of the porcelain surface. Fluordin N5 and Fluoridin showed surface roughness less when compared to APF. The dentist must weigh the risk against the benefits of fluoride preparation for patients having ceramo-metal restorations.

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Element		Period	Mean	SD	diff mean	Diff SD	Paired t	p-value	Signi.
Si	Group- IA	5 minutes	73.9875	4.1436	0.4875	6.7726	0.1440	>0.05	NS
	Group - IIA	24 hours	73.5000	4.0541					
	Group- IB	5 minutes	80.9750	4.2373	-2.5050	2.0041	-2.4999	<0.10	S
	Group- IIB	24 hours	83.4800	2.3528					
	Group- IC	5 minutes	79.4850	1.2734	-1.5000	0.9336	-3.2134	<0.05	S
	Group- IIC	24 hours	80.9850	0.7799					
	Group- ID	5 minutes	73.9825	5.0014	4.0000	4.9019	1.6320	>0.05	NS
	Group- IID	24 hours	69.9825	0.2839					
K	Group- IA	5 minutes	19.5800	1.1490	0.0000	4.6527	0.0000	>0.05	NS
	Group - IIA	24 hours	19.5800	5.7399					
	Group- IB	5 minutes	16.6875	3.9717	2.5000	1.5264	3.2757	<0.05	S
	Group- IIB	24 hours	14.1875	2.4463					
	Group- IC	5 minutes	23.0400	4.4183	-2.6925	1.7788	-3.0274	<0.05	S
	Group- IIC	24 hours	25.7325	2.7051					
	Group- ID	5 minutes	25.5175	3.6196	-1.9550	4.9502	-0.7899	>0.05	NS
	Group- IID	24 hours	27.4725	1.3384					
Ca	Group- IA	5 minutes	1 .3900	0.3080	0.0625	0.5698	0.2194	>0.05	NS
	Group - IIA	24 hours	1.3275	0.3495					
	Group- IB	5 minutes	1.4575	0.3955	0.3500	0.3513	1.9927	>0.05	NS
	Group- IIB	24 hours	1.1075	0.0936					
	Group- IC	5 minutes	1 .2825	0.1825	0.0175	0.2464	0.1421	>0.05	NS
	Group- IIC	24 hours	1.2650	0.2246					
	Group- ID	5 minutes	1.5500	0.2380	0.1925	0.2786	1.3818	>0.05	NS
	Group- IID	24 hours	1.3575	0.2016					

Table I - Elemental Changes for Group I and Group ll, showing Mean, Standard Deviation, Difference of Mean, Difference of SD, Paired t-test and I

Variable	SS Effect	df Effect	MS Effect	SS Error	df Error	MS Error	F	p	Signi
Si	98.8179	3	32.9393	224.3524	12	18.6960	1.7618	>0.05	NS
K	64.6746	3	21.5582	154.9388	12	12.9116	1.6697	>0.05	NS
Ca	0.2676	3	0.0892	1.7590	12	0.1466	0.6084	>0.05	NS

Table II- Analysis of Variance between two groups

References:

1. Copps DP, Lacy AM, Curtis T. Carman JE. "Effects of topical fluorides on five low-fusing dental porcelains". J.Prosthet Dent, 1984; 52: 340-343.
2. Kula K, Kula TJ. "The effect of topical APF foam and other fluorides on veneer porcelain surfaces". Pediatric Dentistry, 1995; 17: 356-361.
3. Yafeem A, Zalkind M, "The effect of topical application of fluoride on composite resin restorations". J. Prosthet.Dent, 1984; 45: 59-62.
4. Kula KS, Thompson V, Kula T, Nelson S, Selvaggi R, Liao R "In vitro effect of topical fluorides on sealant materials". J Esthet Dent. 1992; 4: 121.
5. Kula K., Nelson S, Kula T, Thompson V, "In vitro effect of acidulated phosphate fluoride gel on the surface of composites with different filler particles" 1. Prosthet. Dent, 1986; 56: 161-169.
6. Wunderlich RC and Yaman P, "In vitro effect of topical fluoride on dental porcelain". J.Prosthet.Dent, 1986; 55: 385-388.
7. Council on Dental Therapeutics: Accepted Dental Therapeutics, EdAO, Chicago: American Dental Association, 1984.