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Alteration of composite resin after the application of fluoride varnish: an in vitro study

Abstract

Introduction: The characteristics of the surface in the restorative material are fundamental for its longevity, but some chemical solutions may be able to damage them, such as fluoride varnish, generating biofilm accumulation and discoloration of the material.

Aim: To compare the surface roughness and microhardness of the composite resin after application of the fluoride varnish.

Materials and methods: The total sample was 144 specimens. The roughness and microhardness test were measured four times. The ANOVA statistical test was performed for repeated samples according to the results of the Kolmogorov-Smirnov normality test. The present study presented a confidence level of 95% and $p<0.05$.

Results: The group fluoride of sodium with tri-calcium phosphate had an increase of microhardness after the applications; likewise it showed higher roughness in comparison to the varnishes studied.

Conclusion: The varnish with sodium fluoride with tri-calcium phosphate increases the surface microhardness of the restorative material, however it increases the roughness of the surface; on the other hand, varnishes with sodium fluoride and sodium fluoride with CPP-ACP reduce both the microhardness and the roughness of the resin.

Keywords: topical fluorides, dental restoration, hardness test, restorative materials, discoloration

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Introduction

Restorative dental materials are used in daily clinical practice due to the aesthetics it provides and biocompatibility with the dental surface, thus allowing their preservation.[1]

The characteristics of the surface have a fundamental role in the longevity of restorations, because of the biodegradation caused by chemical solutions or even preventive means, such as oral hygiene products and fluoride varnish can be able to damage the surface of restorative materials, causing accumulation of biofilm, wear and discoloration.[2–4]

In spite of the measures taken, with the disruption of enamel and dentin it is necessary to use a restorative material to attend the progression of the caries disease. The decision of the material varies according to the type of lesion, cavity size, working protocol, among others. However, the difference is the use of fluoride varnish during treatment, which due to its properties it would be understood that it could lengthen the lifetime of the restoration, as well as maintaining its remineralizing effect on the remaining structure.[5,6]

Objective: Compare the alteration of the microhardness and surface roughness in the composite resin after the application of three different fluoride varnishes after four weeks.

Material and methods

The sample consisted of 144 specimens of composite resin. For the preparation of the blocks, cylindrical plastic molds of 5mm diameter by 2mm in height (3M-ESPE, USA) were used, a celluloid strip and a glass slide were used in the base, then the FILTEK Z350 XT color A2 (3M-ESPE, USA) composite resin was filled with a single increase handled according to the manufacturer's instructions. For the polymerization, the Elipar DeepCure-L was used for 20 seconds according to the manufacturer. The resin specimens were stored in distilled water and placed in an incubator at 37+/-1ºC for 24 hours. The dry polishing process was done 48 hours later, on both sides for two minutes with the 3M Shofu system. Later, the blocks were stored in artificial saliva after polishing for 24 hours prior to the application of fluoride varnishes.

Fluoride varnishes application

It was applied with a microbrush for 1 minute per specimen. Group 1: Duraphat (Colgate-Palmolive), group 2: Clinpro white varnish and group (3M-ESPE, USA) 3: MI varnish (GC), the indications for use according to manufacturer was followed. After the application, the blocks were kept in a glass container with artificial saliva for 7 days, for four consecutive weeks, which was changed daily in order to simulate the oral conditions. The measure on the Vickers

microhardness test was taken 24 hours after each application. The diagonal measurements of the identations were under a load of 100g for 15 seconds. The surface roughness test was the same way as the microhardness; in this case a Mitutoyo rugosimeter was used, and in each reading the instrument traveled a distance of 2.0mm (put cut-off) with a speed of 0.5mm /s in one direction, detecting irregularities of the measured surface.

Statistical analysis

The database was introduced to the statistical program (SPSS version 24). From the data collected, the tables were prepared to evaluate the association between the variables: surface microhardness with fluoride varnish and surface roughness with fluoride varnish. The ANOVA statistical test for repeated samples and Bonferroni was used according to the results of the Kolmogrov-Smirnov normality test.

Results

The results for the surface microhardness test in the control group were an average of 82.68 kg/mm^2. Compared to the varnishes studied, the sodium fluoride group with CPP-ACP showed lower microhardness in the four weeks application, however the lowest value obtained was in the fourth week with 63.25 kg/mm^2. The fluoride varnish with tri-calcium phosphate achieved greater microhardness compared to the two varnishes used. There was no statistically significant difference (p= 1,000) (Table 1).

The surface roughness test results for the control group was 0.32um, although the sodium fluoride group show a roughness of a 0.30um indicating a decrease in the third week, it can be observed in the other results that after each application the values increased in the three different compositions, being the group of sodium fluoride with tri-calcium phosphate the varnish generates greater roughness in the restorative material, showing statistically significant difference in week 1, 2, 3 (Table 2).

Table 1 Comparison of Surface micro hardness of composite resin after the application of three different fluoride varnishes from week 1 to 4

			p value				p value				p value
	Week 1	Control	0,316		Week 1	Control	1,000			Control	0,571
		Week 2	0,434			Week 2	0,979			Week 2	1,000
		Week 3	0,104			Week 3	0,718		Week 1	Week 3	1,000
		Week 4	1,000			Week 4	1,000			Week 4	1,000
	Week 2	Control	0,316		Week 2	Control	1,000			Control	0,571
		Week 1	0,434			Week 1	0,979			Week 1	1,000
		Week 3	1,000	**Sodium fluoride with tri-calcium phosphate**		Week 3	0,718	**Sodium fluoride with amorphous calcium phosphate plus casein phosphopeptide**	Week 2	Week 3	1,000
Sodium Fluoride		Week 4	1,000			Week 4	1,000			Week 4	0,560
	Week 3	Control	0,316		Week 3	Control	1,000			Control	0,571
		Week 1	0,104			Week 1	0,718			Week 1	1,000
		Week 2	1,000			Week 2	1,000		Week 3	Week 2	1,000
		Week 4	1,000			Week 4	0,766			Week 4	0,367
	Week 4	Control	0,316		Week 4	Control	1,000			Control	0,571
		Week 1	1,000			Week 1	1,000			Week 1	1,000
		Week 2	1,000			Week 2	1,000		Week 4	Week 2	0,560
		Week 3	1,000			Week 3	0,766			Week 3	0,367

Anova multiple comparisons
Bonferroni
*p<0.05

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Table 2 Comparison of Surface roughness of composite resin after the application of three different fluoride varnish from week 1 to 4

			Valor p				p value				p value
	Week 1	Control	1,000		Week 1	Control	1,000			Control	0,571
		Week 2	1,000			Week 2	0,979			Week 2	1,000
		Week 3	0,349			Week 3	0,718		Week 1	Week 3	1,000
		Week 4	0,456			Week 4	1,000			Week 4	1,000
	Week 2	Control	1,000		Week 2	Control	1,000			Control	0,571
		Week 1	1,000			Week 1	0,979			Week 1	1,000
		Week 3	0,160	**Sodium fluoride with tri-calcium phosphate**		Week 3	0,718	**Sodium fluoride with amorphous calcium phosphate plus casein phosphopeptide**	Week 2	Week 3	1,000
Sodium Fluoride		Week 4	0,438			Week 4	1,000			Week 4	0,560
	Week 3	Control	1,000		Week 3	Control	1,000			Control	0,571
		Week 1	0,349			Week 1	0,718			Week 1	1,000
		Week 2	0,160			Week 2	1,000		Week 3	Week 2	1,000
		Week 4	0,042*			Week 4	0,766			Week 4	0,367
	Week 4	Control	0,532		Week 4	Control	1,000			Control	0,571
		Week 1	0,456			Week 1	1,000			Week 1	1,000
		Week 2	0,438			Week 2	1,000		Week 4	Week 2	0,560
		Week 3	0,042*			Week 3	0,766			Week 3	0,367

Anova multiple comparisons
Bonferroni
*p<0.05

Discussion

The values obtained in the present study concluded that microhardness was not statistically different between the three varnishes used, even though that the results showed increased values in week 2 for the fluoride varnish with tri-calcium phosphate. In the study carried out by Doddamani & Babu,[7] they found that hardness increases generating greater resistance to demineralization level that can be submitted in the oral cavity. Molaasadolah et al.[8] corroborates the results obtained by Doddamani,[7] showing an increase in microhardness after the application of fluorinated varnish. Although the fluoride varnish brands where different in each research.

In the surface roughness studies, statistically significant differences were found with the use of fluoride varnish generating an increase of the surface of the composite, which is consistent with the research carried out by Avsar & Tuloglu,[9] they evaluated the effect of acidic and neutral topical fluoride obtaining as a result that both fluorides increase the roughness of the surface, showing higher results for the acid one.

A previous study reported that microhardness decreases after application of a fluoride but increases the surface roughness, which is consistent with the results obtained, because the pH of the varnish and gel influences the degradation of the material, which affects the mechanical properties of the surface, in addition it generates more accumulation of plaque causing a decrease in the longevity of the restoration.[10]

Conclusion

1. There is a variation in the microhardness and roughness on the composite resin after the application of three different fluoride varnishes compositions.
2. The varnishes with sodium fluoride, sodium fluoride and tri-calcium phosphate and sodium fluoride with amorphous calcium phosphate plus casein phosphopeptide decrease the surface microhardness of the composite resin.
3. The varnish with sodium fluoride and tri-calcium phosphate generates greater roughness than sodium fluoride and sodium fluoride with amorphous calcium phosphate plus casein phosphopeptide.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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