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The Effect of Fluoride Gel and Resin Infiltration Techniques on White Lesions

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Abstract

Objective: *Preventive techniques are important to maintain adequate oral health. Both Fluoride application and resin infiltration have been widely used to stop decay progression. In our study, we examined the effect of topical fluoride gel, and resin infiltration on the microroughness of non cavitated white lesions.*

Methods: *fifteen freshly extracted third molars were selected, then Immediately immersed in 0.09% saline. The crowns were sectioned then randomly divided into three groups (n=10) as follows: white spot lesions group, fluoride gel group, and resin infiltrate group. Then a surface roughness test was done for all samples using non-contact optical profilometry. Data were analyzed using one-way ANOVA followed by Tukey's post hoc test.*

Results: *Microroughness reduced for teeth treated with topical Fluoride (mean 1.35mm), and teeth treated with resin infiltrate (mean 1.34) compared to white spot lesions (mean 1.91mm).*

Discussion: *our study proves that using fluoride gel technique and resin infiltrate technique can improve surface microroughness of white lesions.*

Conclusion: *Fluoride gel and resin infiltration are effective in reducing the microroughness of enamel. Both techniques are non-invasive, and they can be used to reduce decay progression. More research is needed to investigate the effect of penetration depth of resin infiltration on white lesion microroughness.*

Keywords: Preventive, Fluoride, Resin Infiltration

Introduction

Preventing enamel demineralization is a major step to stop the progression of decay [1]. The application of topical fluoride, or low viscosity resin infiltration can allow remineralization of enamel surface [1-3].

Many studies confirmed the importance of topical fluoride increasing the acid resistances and strengthening the remineralization of incipient lesions [4, 5].

Resin infiltration is a minimally invasive technique for mild or moderate fluorosis and mild hypominerlization [6]. The use of resin infiltration has been effective in restoring the hardness, and the texture of intact enamel. This technique can preserve the surrounding hard tissues around WSL and remove minimal amount of enamel [7, 8]. Resin infiltration reduces the progress of interproximal lesions [9]. In addition, resin infiltration surrounds enamel crystallites to form enamel hybrid layer, which is more resistant to acid attack than sound enamel [10].

Infiltrative treatment with resin (Icon-DMG, Hamburg, Germany) is a minimally invasive technique based on the infiltration of high viscosity resin inside the hypomineralized enamel lesion [11].

Both Resin infiltration and fluoride varnish can improve white lesions in moderate- to high-caries-risk patients [12, 13]. The resin infiltration seals white spot enamel lesions and prevents enamel microleakage [14].

Materials and Methods

Specimen Preparation

Fifteen freshly extracted third molars, without anatomical defects, were anonymously collected for this study. The teeth were immersed in 0.09% saline after extraction.

We separated the crowns using a low-speed diamond disc. Then specimens were sectioned longitudinally in a mesiodistal direction to have **thirty working surfaces** (buccal and lingual), **ten samples/group**. Each surface was coated with an acid-resistant varnish (nail polish) except for a window of exposed enamel (3×3 mm). which was covered with acid-resistant adhesive tape. The tape was removed, and all surfaces were cleaned with damped cotton.

To create white lesions, the specimens were immersed in a demineralizing solution composed of 2.2 mM calcium chloride, 2.2 mM monopotassium phosphate and 0.05 mM acetic acid. The pH was adjusted to 4.4 using 1 M potassium hydroxide for 21 days.

Then, the specimens were randomly divided into three groups (n=10) as follows: first group, control; second group, fluoride gel alone; third group, Er-YAG laser alone. The specimens were kept in de-ionized water between processes. The surfaces of the specimens were serially polished, and surface roughness was tested using non-contact optical profilometry. Statistical Analysis was done using ANOVA test, and Tukey's test was applied for pairwise comparisons.

Study Design

The enamel specimens were randomly allocated to 3 groups (10 specimens in each group):

- **Group 1:** WSL group without fluoride application or resin infiltrate
- **Group 2:** Application of APF gel
- **Group 3:** Application of resin infiltrate

Acidulated phosphate fluoride application: An acidulated phosphate fluoride gel (Ionite fluoride gel, dharma research, USA) containing 1.23% fluoride ions, stored at room temperature, was applied on the tooth surfaces of group 2. Fluoride application was performed for four minutes using a cotton swab. Samples were then washed with deionized water for one minute.

Resin infiltration application: Icon (DMG Chemisch-Pharmazeutische Fabrik, Hamburg, Germany) was strictly used according to the manufacturer's instructions. Icon is a methacrylate-based, light curing, low-viscosity resin. The infiltration procedure is summarized in Table 1.

Table 1: Steps of application of Resin Infiltration

Step	Applied substance
Cleaning	Water
Surface Conditioning	Icon-Etch (15% HCL) for 2 min
Cleaning	Water for 30secs
Drying	Dry air
Drying	Icon Dry (99% ethanol)
First infiltration	Icon infiltrate 3 min
Hardening	Light hardening with Translux Power Blue 40 s (Heraeus Kulzer, Hanau, Germany)
Second infiltration	Icon infiltrate 1 min
Hardening	Light hardening with Translux Power Blue 40 s (Heraeus Kulzer, Hanau, Germany)
Polishing	Epitex polishing strip 1200 (CG Germany, Bad Hamburg, Germany)

Assessments

Surface Roughness Test

Non-contact optical profilometry was used to measure the surface profile in the center of the delineated area. For each enamel sample, three readings were taken, and the average was calculated.

Statistical Analysis

Numerical data was presented as mean and standard deviation values. Normality was explored by checking the data distribution and using the Shapiro-Wilk test. The data was normally distributed and was analyzed using one-way ANOVA followed by Tukey's post hoc test. The significance level was set at $p < 0.001$ within all tests. Statistical analysis was performed with R statistical analysis software version 4.1.3 for Windows (www.R-project.org/).

Results

The white lesion group showed the highest microroughness among all groups (mean 1.91), however white lesions received Fluoride treatment showed less microroughness (mean 1.35).

White lesions received Icon treatment showed the least microroughness between all groups (mean 1.34), Figure1, table 2.

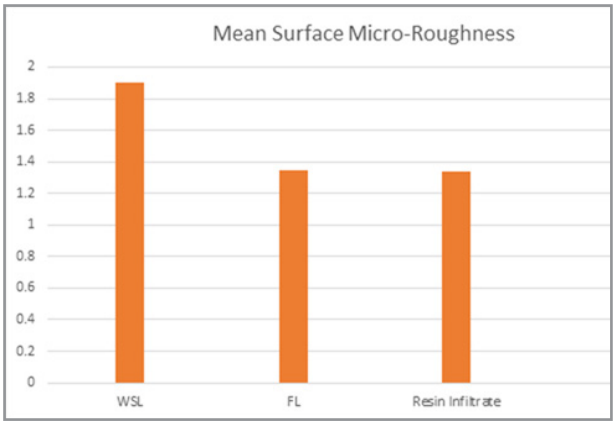

Figure 1: Shows mean of surface microroughness of white lesions, Fluoride applied lesions, and resin infiltrate applied lesions.

Table 2: shows the mean microroughness of WSL, Fluoride group and Icon group.

	WSL	FL	ICON	P-VALUE
Mean	1.91	1.35	1.34	<0.001
SD	0.20	0.18	0.20	
Samples	10.00	10.00	10.00	
Alpha	0.05	0.05	0.05	
CI	0.14307	0.12876	0.14307	

Discussion

Preventive treatments are essential to stop the progress of caries in the initial stages as it will help to remineralizer affected enamel and prevent cavitation. Fluoride is a primary noninvasive treatment of incipient lesions as it will allow for remineralization [15]. Applying topical Fluoride can be challenging as it needs more compliance patients, thus can affect remineralization of the incipient lesions [16].

Resin infiltration is a new technique that is used to manage and treat white lesions. Resin infiltration obstructs enamel diffusion pathway, thus stopping the effect of acids [16, 17]. Resin infiltration has a masking effect that can hide the white spot lesions [16, 18].

The present study found that microroughness of the white spot lesions has the highest mean value compared to Fluoride group and Icon group. Both Fluoride and Icon were able to reduce microroughness of white lesions. This study found the microroughness of Fluoride group and Icon group with closer mean value (1.35 and 1.34) respectively. Similarly, another study that investigated the effectiveness of icon infiltration on enamel, found that Icon can reduce roughness of enamel comparing to sound enamel [19].

Another study found resin infiltration able to arrest white spots lesions in permanent teeth with less microroughness than fluoride varnish group after 6 months post treatment [20]. Another research found Icon resin infiltration more effective on remineralization of white spot lesions when compared to Clinpro XT varnish [21].

Although our study showed that Icon can be effective to reduce microroughness on white spots of permanent teeth, another study explained that Icon surface roughness is like sound enamel in both primary and permanent teeth [22].

Conclusion

Remineralization of enamel lesions can be done using both fluoridated and non-fluoridated substances. Both Fluoride and resin infiltration can reduce the microroughness of white lesions, however the penetration of resin infiltration can be determined by the depth of the lesion itself. Both techniques can be effective in treating and preventing the progress of dental decay, however clinical judgment is needed for indication of each procedure.

Topical Fluoride application needs compliant individuals, while resin infiltration depends on the technique sensitivity. Although Topical Fluoride allows remineralization, it does not mask the white spots. On the other side, resin infiltration provides a more esthetically acceptable choice.

In summary, both techniques can be used, clinical judgements by the dental providers, financial consideration by the patients, and cosmetic concerns, can play an important role when choosing between different techniques.

Limitations

The present study has some limitations as we did not measure the penetration depth of resin infiltration, nor enamel microhardness after application of resin infiltration. Some researchers found that resin infiltrate can increase the microhardness of enamel after treatment. Thus, can be used to treat incipient lesions that are not cavitated yet [17].

The penetration of resin infiltration can be affected by the depth of the lesion itself [8]. Our study did not measure the depth of the white lesion; thus, we cannot guarantee that resin infiltration was able to remineralizer the white spot lesion.

Our study focused only on permanent teeth, however applying resin infiltration can still be effective treating primary teeth [22].

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