International Journal of Biomedicine 14(2) (2024) 329-334
http://dx.doi.org/10.21103/Article14(2)_O16

ORIGINAL ARTICLE

Dentistry

INTERNATIONAL JOURNAL OF BIOMEDICINE

Comparative Evaluation of Resin Infiltration and Bifluoride Varnish in White Spots in Children between the Ages of 8 and 15 Years

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Abstract

The aim of this study was to compare the efficacy of resin infiltration and bifluoride varnish in white spot lesions (WSLs) in children between the ages of 8 and 15.

Methods and Results: This study was conducted at Alma Mater Europaea Campus College "Rezonanca" (Pristina, Kosovo) and enrolled 60 participants (34 females and 26 males) between the ages of 8 and 15 years with WSLs in the vestibular surface on permanent anterior teeth. The participants were randomly assigned to the resin infiltration (Icon®) group (Group 1, n=30) and the bifluoride varnish (F&A Biflu) group (Group 2, n=30). Both materials were applied on permanent anterior teeth with WSLs in enamel. WSLs were assessed using ICDAS-II (International Caries Detection and Assessment System) criteria by visual inspection, which were coded as 1 and 2. Lesions were evaluated before the material was applied (T0), just after application (T1), and at a 6-month follow-up (T2). A total of 173 teeth from 60 participants were included in our study. Group 1 showed a significant decrease in ICDAS-II scores throughout time intervals T0-T1 (P=0.001), T0-T2 (P=0.001), and T1-T2 (P=0.041). In Group 2, there was no visible difference between T0-T1 (P=1.00) but a significant decrease between T0-T2 (P=0.001) and T1-T2 (P=0.001). Comparisons between the two groups in relation to T0, T1, and T2 were analyzed using the independent samples t-test. Significant differences have been presented in two cases at T1 (P=0.001) and T2 (P=0.003). ICDAS-II scores decreased significantly in Group 1.

Conclusion: The application of resin infiltration in WSLs was found to be more effective than the application of bifluoride varnish. While the effects of bifluoride varnish in WSLs persisted over time, the effect of resin infiltration was evident as soon as WSLs were treated. Moving forward, we recommend considering resin infiltration as a favorable option for WSL treatment. Future studies with long-term follow-ups are necessary to corroborate these results.**(International Journal of Biomedicine. 2024;14(2):329-334.)**

Keywords: white spot lesion • ICDAS-II criteria • bifluoride varnish • resin infiltration

For citation: Krasniqi B, Pavlevska M, Kurshumliu ED, Xhemajli BL, Kutllovci T. Comparative Evaluation of Resin Infiltration and Bifluoride Varnish in White Spots in Children between the Ages of 8 and 15 Years. International Journal of Biomedicine. 2024;14(2):329-334. doi:10.21103/Article14(2)_OA16

Abbreviations

BFV, bifluoride varnish; **FV**, fluoride varnish; **RI**, resin infiltration; **WSL**, white spot lesion.

Introduction

Dental caries, often known as tooth decay, is one of the most common chronic disorders afflicting people worldwide; people are susceptible to it throughout their lives.(1) The balance of pathogenic and preventative factors determines the start and progression of caries.(2) Dental disease treatment is quite expensive in all nations, and prevention is very easy and efficient.[3] First, mineral loss causes microporosities, which may be seen clinically as white, opaque, and rough areas. If the mineral loss persists, these white spot lesions (WSLs) will ultimately grow into lesions with cavitation.[4-6]

White spot lesions are described as demineralization of the enamel surface and subsurface without cavitation. Such symptoms are the early clinical signs of the development of dental caries, with a possibility of reversal. These lesions are distinguished by their white chalky, opaque appearance.[7] Active WSLs are 'chalky'/dull and uneven on probing, but inactive lesions are glossy and smooth on probing.[8] White spot lesions are common in orthodontic patients, especially beneath broken bands, around bracket bases, and in areas where brushing is difficult.[9,10]

Noninvasive or minimally invasive therapies are essential for stopping tooth decay before caries develops and for reducing treatment time and costs.[11] So far, numerous strategies for treating WSLs have been researched.[11,12] It has been demonstrated that in noninvasive treatments of WSLs, topical fluoride products, along with diet and good dental hygiene, improve lesion remineralization.[13]

Bifluoride varnish (BFV) is good for accelerating tooth remineralization and fluoridation. The unique mix of the two fluoride salts allows for both immediate high fluoride release through NaF and long-term fluoridation through CaF_2. The easily soluble sodium fluoride releases fluoride ions quickly, which are converted to calcium fluoride on the tooth surface to assist remineralization efficiently. Fluorides have been used for many years as an effective way to prevent and stop caries. Researchers have proven that fluoride achieves its preventive effects by being incorporated into the structure of teeth, making them stronger and more resistant to attack by acids released by bacteria.

Resin infiltration (RI) in treating early proximal caries lesions is a new concept in dentistry, with beneficial clinical applicability for clinicians and high patient acceptance. Such infiltration is effective in arresting smooth-surface enamel lesions in permanent teeth in children [14-16] and is an alternative approach to treating early caries lesions that are not expected to remineralize or arrest by noninvasive measures when performed with low-viscosity light-curing resins (so-called infiltrants). Resin infiltration has lately been recognized as a minimally invasive treatment. The RI therapy, which involves filling the enamel intercrystalline spaces with a low-viscosity resin with a high penetration coefficient, prevents the lesion from growing further.[17-20] The effectiveness of RI in stopping caries lesions has been studied in vitro,[21] in situ,[22] and in vivo,[14] and clinical evidence of its ability to cover up WSLs has been provided.[23,24] However, more research is required to fully understand the camouflage impact of the RI approach and the potential remineralization action of fluoride compounds within the non-cavitated active WSLs. [25]

The aim of this study was to compare the efficacy of RI and BFV in WSLs in children between the ages of 8 and 15.

Materials and Methods

This study was conducted at Alma Mater Europaea Campus College "Rezonanca" (Pristina, Kosovo) with prior approval from the Ethical Committee (AD-3408/22, 14.06.2022) of this institution and enrolled 60 participants. The parents of the children were informed about the whole procedure and signed an agreement to include their children in the study.

Participant selection

The participants were randomly assigned to the RI (Icon®) group (Group 1, n=30) and the BFV (F&A Biflu) group (Group 2, n=30). Both materials were applied on permanent anterior teeth with WSLs in enamel. Inclusion criteria were participants between the ages of 8 and 15 years with WSLs in the vestibular surface on permanent anterior teeth. Exclusion criteria were participants with active carious lesions, restoration of the surface of the teeth being treated, and deciduous teeth.

The clinical selection was done using artificial light, a dental mirror, a ball-ended probe, and air drying. WSLs were assessed using ICDAS-II (International Caries Detection and Assessment System) criteria by visual inspection, which were coded as 1 and 2. Lesions were evaluated before the material was applied (T0), just after application (T1), and at a 6-month follow-up (T2).

Treatment procedures

Resin infiltration

All participants received the same preparation protocol for teeth cleaning, with a brush and paste. A lip retractor, cotton roll, and gum shield were used to maintain a dry working environment. The RI procedure was performed according to the manufacturer's instructions. A 15% hydrochloric acid gel was applied over WSLs for two min. Next, the acid was rinsed for 30 seconds, and the treated surfaces were dried, then ethanol was applied for 30 seconds and was dried. In the last step, RI was applied to the surface of the lesion using a micro brush and left for three min. Excessive material was wiped away from the surface using a cotton roll before light curing. After light curing for 40 sec, the application of RI was repeated once for 1 minute and light cured for 40 sec. Rough surfaces were smoothed using silicone discs and polishes.

Bifluoride varnish

The surfaces to be treated with BFV were carefully cleaned and air-dried. One or two drops of medication were applied using the applicator as a thin layer to the surfaces to be treated. The varnish penetrates the tooth tissue for a few seconds before being air-dried. For the next two hours, the children were told to eat soft foods and beverages that were not sticky or firm and not to brush or floss for the rest of the day.

Follow-up examination

Lesions on permanent anterior teeth were evaluated by ICDAS-II criteria for two groups at the T0, T1, and T2 time periods. The collected information was analyzed statistically.

Statistical analysis was performed using the statistical software package SPSS version 26.0 (SPSS Inc, Armonk, NY: IBM Corp). Baseline characteristics were summarized as frequencies and percentages for categorical variables and mean ± standard deviation (SD) for continuous variables. Inter-group comparisons were performed using Student's t-test. A probability value of $P<0.05$ was considered statistically significant.

Results

A total of 173 teeth from 60 participants were included in our study. In Group 1, there were 16 females and 14 males; in Group 2, there were 18 females and 12 males. The number of teeth in Groups 1 and 2 was 85 and 88, respectively. The mean age of patients in Group 1 and Group 2 was 11.37±3.02 and 11.50±2.46 years, respectively (Table 1). Group 1 showed a significant decrease in ICDAS-II scores throughout time intervals T0-T1 (*P*=0.001), T0-T2 (*P*=0.001), and T1-T2 (*P*=0.041). In Group 2, there was no visible difference between T0-T1 (*P*=1.00) but a significant decrease between T0-T2 (*P*=0.001) and T1-T2 (*P*=0.001) (Table 2). After six months of follow-up, ICDAS-II scores decreased in two groups (Figure 1).

Table 1.
Distribution of study groups by gender.

	Group 1 n (%)	Group 2 n (%)	Total n (%)
Gender			
Female	16 (53.3)	18 (60.0)	34 (56.7)
Male	14 (46.7)	12 (40.0)	26 (43.3)
Total participants	30	30	60 (100)
Total teeth	85	88	173 (100)
Age (mean ± SD), years	11.37 ± 3.02	11.50 ± 2.46	

Table 2.
ICDAS-II scores throughout time intervals in two groups.

Groups	Time	ICDAS II scores (mean ± SD)	Comparison between different time intervals		
			Mean difference	Comparison	*P*-value
RI	T0	1.67 ± 0.488	1.133	T0-T1	0.001
	T1	0.53 ± 0.515	1.400	T0-T2	0.001
	T2	0.27 ± 0.458	0.267	T1-T2	0.041
BFV	T0	1.76 ± 0.437	0	T0-T1	1.00
	T1	1.76 ± 0.437	0.882	T0-T2	0.001
	T2	0.88 ± 0.600	0.882	T1-T2	0.001

Fig. 1. *Photos of the subjects before and 6 months after the treatment.*

a) Group 1: WSLs + RI; b) Group 2: WSLs +BFV.

Comparisons between the two groups in relation to T0, T1, and T2 were analyzed using the independent samples t-test. Significant differences have been presented in two cases at T1 (*P*=0.001) and T2 (*P*=0.003) (Table 3). Figure 2 shows the changes in ICDAS-II scores with time. ICDAS-II scores decreased significantly in Group 1 after participants were treated with RI. Figure 3 shows a comparison between RI and BFV groups in three-time intervals.

Table 3.
Comparison between the two groups in different time intervals.

Group	Time	ICDAS II scores (mean ± SD)	Comparison between different time intervals		
			Mean difference	Comparison	*P*-value
RI	T0	1.67 ± 0.488	0.098	T0 (RI) – T0 (BFV)	0.556
BFV		1.76 ± 0.437			
RI	T1	0.53 ± 0.515	1.231	T1 (RI) – T1 (BFV)	0.001
BFV		1.76 ± 0.437			
RI	T2	0.27 ± 0.458	0.616	T2 (RI) – T2 (BFV)	0.003
BFV		0.88 ± 0.600			

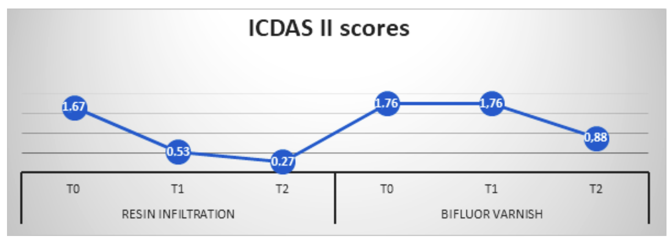

Fig. 2. *The changes in ICDAS II scores with time.*

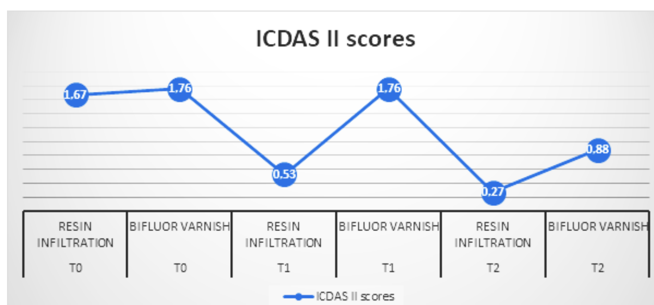

Fig. 3. *Comparison between RI and BFV groups in three-time intervals.*

Discussion

The present study was performed to determine the efficacy of the RI and BFV application on non-cavitated active WSLs in 8-15-year-old children. In this randomized controlled clinical trial, changes in lesions were evaluated before and after application, and at a 6-month application of RI and BFD on WSLs. The vestibular surface of teeth with WSLs was evaluated according to the ICDAS-II criteria.

White spot lesions are described as surface and subsurface enamel demineralization without cavitation. First, there is mineral loss, which generates microporosity. If mineral loss continues, these WSLs will progress to cavitation lesions.[4-7] White spot lesions often appear in patients with orthodontic appliances, especially around dentures and in areas where brushing is difficult.[9,10]

While some studies contend that WSLs cannot fully disappear, others assert that progress may take place over the course of 5 to 12 years. As part of preventative dentistry, it is increasingly essential to use minimally invasive procedures to preserve as many healthy tooth tissues as possible to treat WSLs on teeth and improve their appearance.

Since these techniques are well accepted by patients, they are preferable over restorative therapy. After a one-year follow-up without therapy, Enaia et al.[26] found that 57.1% of WSLs improved, 26% stayed the same, and 16.7% worsened. Given that lesions might worsen and patients may refuse to participate, it is obvious that masking the opaque look during remineralization using spontaneous and low fluoride treatments would take a long time. One noninvasive treatment option for WSLs is fluoride. Higher fluoride concentrations result in deposits of a material that resembles calcium fluoride if the varnish is applied to the tooth surface for a prolonged period. The calcium fluoride material that is formed in the pores and cariogenic sites of enamel might eventually cause fluoride to penetrate the tooth plaque or the underlying enamel. Fluoride release can help early WSLs get remineralized and prevent demineralization.[27]

Several studies have demonstrated that topical fluoride therapy is beneficial for remineralizing WSLs, and using an FV is a simple and reliable procedure. FVs offer several advantages, including a regulated release of fluoride and shorter treatment durations, compared to traditional fluoride techniques like gels.[28,29] In our study, we focused on evaluating the effects of BFV on WSLs. Our results demonstrated a significant decrease in ICDAS-II scores after a 6-month follow-up, indicating that BFV effectively reduces WSLs, consistent with findings from previous studies. However, it's worth noting that some studies, such as those by Güçlü et al.[30] and Girish Babu et al.,[31] did not find a significant difference in the remineralizing potential between varnishes containing both CPP-ACP and fluoride, compared to those containing fluoride alone. These contrasting results highlight the need for further investigation into the specific mechanisms and formulations of FVs to optimize their efficacy in managing WSLs. Furthermore, Autio-Gold and Courts [32] found that FV treatment effectively reversed and stopped active enamel lesions, thereby reducing the necessity for restorative interventions. Consistent with prior research, the present study observed a significant reduction in ICDAS-II scores of WSLs in the BFV group from T0 to T2.

In the present study, BFV was only administered at the initial therapy session to represent the typical clinical use of FV in children, and it was not repeated until the 6-month follow-up. This application differs from previous studies, which used repeated FV treatments over a short period.[33] The goal of the RI concept is to stop the progression of enamel caries lesions and block the enamel's ability to absorb dissolved minerals and acids.[34] Consistent with this concept, our results demonstrate that RI significantly reduced the ICDAS-II score immediately after application and at the 6-month follow-up, compared to baseline values of WSLs, which is supported by other studies.[35,36] The mean ICDAS-II score before, just after application, and at 6 months was 1.67, 0.53, and 0.27, respectively, in the RI group, and 1.76, 1.76, and 0.88, respectively, in the BFV group. The findings demonstrated a significantly higher decrease in mean ICDAS-II score before and just after application, before and after 6 months in the RI group, as compared to the BFV group. On the other hand, a decline in the mean ICDAS-II score before and after 6 months was recorded in the BFV group.

Comparing the efficacy of RI and BFV treatments in WSLs, we found that the RI group exhibited a statistically significant decrease in lesion reduction immediately after treatment and at the 6-month follow-up, compared to the BFV group. This finding is consistent with a study conducted by Giray et al.,[37] indicating the superiority of RI over BFV in WSL managing. Our results support previous research demonstrating the effectiveness and minimally invasive nature of RI, highlighting its advantages over alternative treatment options for WSLs.

Additionally, our findings align with an in vitro study comparing the effects of RI and BFV on enamel surface properties. By permeating into the enamel, the resin effectively blocks acid-entrance channels by forming a diffusion barrier. BFV, on the other hand, might provide a comparatively thin coating layer. These results further emphasize the superior efficacy of RI in managing WSLs and suggest its potential as a preferred treatment modality for enamel demineralization.

Conclusion

The application of resin infiltration in white spot lesions was found to be more effective than the application of bifluoride varnish. While the effects of bifluoride varnish in white spot lesions persisted over time, the effect of resin infiltration was evident as soon as white spot lesions were treated. Moving forward, we recommend considering resin infiltration as a favorable option for white spot lesion treatment. Future studies with long-term follow-ups are necessary to corroborate these results.

Competing Interests

The authors declare that they have no competing interests.

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