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Short Communication

Surface Properties and Color Stability of Resin-Infiltrated Enamel Lesions; A Review

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Resin infiltration therapy utilizes a low-viscosity resin that readily flows into an etched enamel substructure. Once it has infiltrated, the material is light-cured. The refractive index of the resin is very close to that of enamel, which virtually eliminates the appearance of the WSLs. Surface microcracks and microfissures could occur on the surface of the resin-hydroxyapatite complex after aging challenges. These changes may render the resin-infiltrated areas susceptible to discoloration. It can be concluded that resin infiltration is prone to discoloration as compared to other remineralization methods and clinicians should keep this information in mind when planning to use resin infiltration.

Keywords: Resin-infiltration, Color, Enamel, Review.

INTRODUCTION

The use of fluoride to minimize or prevent demineralization has been previously shown to be effective. Fluoride ions delivered through mouth rinses, varnishes, gels, and sealants have been reported to reduce the severity and incidence of WSLs in orthodontic patients. However, due to lack of patient compliance, enamel demineralization remains a challenge in orthodontics, and in some cases, the presence of white spots may cause significant esthetic problems. The esthetics of postorthodontic WSLs can be improved using microabrasion and resin infiltration techniques, wherein success is attributed to the removal or masking of the superficial lesions. Resin infiltration therapy utilizes a low-viscosity resin that readily flows into an etched enamel substructure. Once it has infiltrated, the material is light-cured. The refractive index of the resin is very close to that of enamel, which virtually eliminates the appearance of the WSLs.

LITERATURE REVIEW

Hallgren et al., (2016) reported that in-vitro resin infiltration treatment of WSLs significantly reduced discoloration caused by these lesions compared with controls. The infiltration treatment produced a significant improvement in color difference, significantly reverting *L**, *a**, and *b** values back toward baseline values, with a resultant color difference that falls within the perceived acceptability threshold. The color competent visual evaluators found color differences between surfaces treated with resin infiltrant and adjacent untreated control surfaces were clinically acceptable.

In another study conducted by Rey et al., (2014), they evaluated *in vitro* the staining susceptibility of an infiltration resin (Icon, DMG, Hamburg, Germany) and compared it with several marketed bonding systems. Fifty 1-mm-thick disk-shaped specimens were prepared for Icon and each bonding material. Initial specimen color was assessed by a spectrophotometer. Specimens in each group were then randomly divided into five sub-groups and stored in an incubator at 37˚C in the dark for 60 days. Groups 4 and 5 were used as negative controls by being stored dry and in tap water, respectively. Test groups were stored in (1) coffee, (2) tea, or (3) red wine. After 60 days of storage, new spectrophotometric measurements were performed and *dE* (color difference) was calculated to determine color change. Icon showed higher staining susceptibility. The clinician should be aware of the staining potential of infiltration resins over time.

Based on the results obtained by Araujo et al., (2015), it can be concluded that enamel infiltrated with Icon presents significant color alteration after staining when compared with sound enamel. Therefore, patients should avoid the consumption of colored beverages and foods to increase the longevity of the resin infiltration in esthetically important areas. However, if the discoloration of the infiltrant occurs, bleaching

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treatment can be used successfully. *In vivo* studies should be performed to assess more accurately the staining behavior of Icon.

Zhao & Ren (2016) concluded that the surface hardness of resin-infiltrated enamel lesions was high and remained stable following the thermocycling challenges. Surface roughness and color stability of resin-infiltrated enamel lesions were less than ideal and might further deteriorate after aging in the oral environment. Surface microcracks and microfissures could occur on the surface of the resin-hydroxyapatite complex after aging challenges. These changes may render the resin-infiltrated areas susceptible to discoloration.

Ceci et al., (2017) claimed that results obtained from their present study could be of clinical relevance. Clinicians are provided with information on the staining potential of esthetic restorative materials when exposed to natural staining agents. All the materials tested showed significant color alterations after exposure to staining dyes. It is speculated that while Icon can fix the initial esthetic problem associated with white spot lesions, the resin may become more discolored than other materials over time, especially when the patient habitually consumes teeth-staining food and beverages. Nevertheless, this has been investigated on pure Icon discs. Icon will not be available in the oral environment in pure form. In the clinical setting, Icon will only be a part of a stained tooth area, which will also include tooth structure. Also, polishing of the infiltrated tooth area is mandatory in the clinical situation to remove the surface layer, which stains strong over time. In conclusion, more *in vivo* studies are needed to assess the real staining potential of Icon resin infiltration technique.

Cohen-Carniero et al., (2014) conducted a study which showed a less favorable result as regards color stability of lesions infiltrated with resin when compared with the remineralized lesions. Considering that this was an *in vitro* study in artificial lesions produced in bovine enamel, which simulated contact with coloring solutions, its results cannot be extrapolated to clinical reality. The results, however, point out the need for clinical evaluation of the color stability of lesions infiltrated with resin over the course of years. Furthermore, superficial caries lesions in enamel undergo color alteration over the course of time, irrespective of the medium to which they are exposed. Treatment options for these lesions, such as remineralization and resin infiltration, allow a smaller variation in the color of enamel over time; however, resin infiltration obtained less favorable results when compared with remineralization.

Borges et al., (2014) reported that based on the methodology used and considering the limitations of this study, it can be concluded that the immersion of the specimens in staining solutions (wine and coffee) resulted in significant color alteration. The demineralized enamel treated with resin infiltration showed significantly higher staining than all other tested groups; however, repolishing of the specimens can minimize the staining effect.

CONCLUSION

It can be concluded that resin infiltration is prone to discoloration as compared to other remineralization methods and clinicians should keep this information in mind when planning to use resin infiltration.

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CONFLICT OF INTEREST

There is no conflict of interest among the authors regarding the writing and publication of this research.

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ETHICS STATEMENT

An ethical approval was obtained from the REU review board.

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