



Resin Infiltration Recent Trends in Aesthetic and Restorative Dentistry: A Systematic Review

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ABSTRACT

Objective: The Purpose of this systematic review was to evaluate the contemporary in vivo scientific evidence for resin infiltration (RI) in aesthetic and restorative dentistry. **Materials and Methods:** The PubMed database was searched for randomized controlled trials that evaluated the in vivo effect of RI as an adjuvant treatment in aesthetic and restorative dentistry and recent trends in this contest. The keywords used were 'resin infiltration, recent trends', 'resin infiltration, aesthetic dentistry', 'resin infiltration, restorative dentistry', with the 'clinical trial' filter activated. Among the 170 articles originally identified with these keywords, only 04 were included for this review. **Results:** All 4 articles reported on resin infiltration with respect to aesthetic and restorative dentistry. One of the studies had been conducted on 21 consecutive subjects with 39 quadrants in each group in which Resin infiltration improves the esthetic appearance of demineralized teeth. The results showed enough durability for over 6 months. The quality of the studies was assessed to be high with respect to simple randomization, controlled trial design. All the researches included showed color stability and improvement with respect to adjacent enamel surfaces after treatment with RI when compared with the baseline control group over a specific period. **Conclusion:** This systematic review revealed that RI appeared to be an effective method to improve an aesthetic and restorative outcome in terms of appearance and longevity of the restoration.

Keywords: Aesthetic dentistry, RECENT trends, RESIN infiltration, Restorative dentistry

INTRODUCTION

Methodologies for the administration of dental treatments have changed drastically lately from the routine, great restorative treatment way to a preventive intrusion. In perspective of a superior understanding of the caries procedure, current strategies should point towards halting dental lesions, dealing with tooth restoration and recognizing the dental disease right on time to stay away from destructive dental treatment, when needed utilize the least invasive techniques [1].

Numerous techniques are used in this regard for noninvasive treatment of initial dental lesion namely incipient caries lesions (rite from the first sight of discoloration to a frank cavitation stage) such as fluoride therapy for tooth repairs [2], casein phosphor peptide amorphous calcium phosphate [3] or cavity sealants [4]. Resorcinol-formaldehyde resin infiltration conducted by Robinson, et al., [5] to arrest carious lesions. This technique was later amended and introduced in dental practice as resin infiltration in which thin consistency resins are used to manage small cavities in teeth to restore form and aesthetics at the same time [6]. It enhances the tooth color by occlusion of pores within the incipient tooth lesion and reconstruction of tooth form by retaining minerals. Resin Infiltration is suggested to help restore and enhance tooth color in diseases consisting of tooth substance porosities like amelogenesis imperfecta, molar incisor hypomineralization, fluorosis and white spots [7].

The systematic reviews help to differentiate the findings obtained from clinical trials on subjects to analyze the efficacy of resin infiltration technique in conjunctions with aesthetic and a outcomes. Therefore, the aim of this systematic review was to evaluate the contemporary in vivo scientific evidence for resin infiltration (RI) in aesthetic and restorative dentistry.

MATERIALS AND METHODS

In this systematic review, the PubMed database was analyzed for clinical trials that study the relation of resin infiltration techniques to the fields of aesthetic and restorative dentistry. The keywords used in the search were ‘resin infiltration, recent trends’, and ‘resin infiltration, aesthetic dentistry’. Those articles which were related to the inclusion criteria of our research like (1) Relevance of title and abstract to the title (2) An *in vivo* randomized clinical trial (3) Relation of RI to the field of aesthetic and restorative dentistry.

The article that was in accordance with inclusion criteria was further one other researcher for content quality like randomization allocation, research design, the study groups, control group and rejection rate of participants based on follow up and assessment. The effects of resin infiltration RI to enhance tooth color and longevity of restoration at a 95% confidence interval in the study group compared with control groups incorporated in each relevant *in vivo* research selected.

RESULTS

The findings of the research strategy are displayed in Table 1. Of the 170 articles initially related to the hunt keywords recorded before, just 4 met all the consideration criteria and were held for this survey. The staying 166 articles were barred for the accompanying reasons: they were either not related, systematic reviews, *ex vivo* study, *in situ* study, studies related to stress relief, studies related to proximal and labial carious lesions with frank cavitation (Table 2).

Table 1 Details of studies analyzed

	Teeth			
Teeth Considered for Outcome	1:1 allocation	111 teeth	numerous	219 teeth with 231 lesions
Assessment Tool	Visual Analogue Scale	Spectrophotometer	Visual Analogue Scale	Spectrophotometer
Follow up	changes noticed immediately	6 months, 12 months	8 Weeks	1 Day, 1 Week, 4 Weeks, 3 Months, 6 Months

Table 2 Search results in terms of inclusion and exclusion criteria

	Authors	Total
Included Articles	Gugnani, et al. [8]	4
	Eckstein, et al.[9]	
	Senestraro, et al. [7]	
	Knosel, et al. [10]	
Excluded Articles Either not related, systematic review, <i>ex vivo</i> study, <i>in situ</i> study, studies related to stress relief, studies related to proximal and labial carious lesions with frank cavitation.	Alwafi [11]	166
	Auschill, et al. [12]	
	Cazzolla, et al. [13]	
	Silva, et al. [14]	
	Perdigao, et al. [15]	
	Manoharan, et al. [16]	
	Cagetti, et al. [2]	
	Hallgren, et al. [1]	
	Cohen-Carneiro, et al. [17]	
	Markowitz, et al. [18]	
	Yim, et al. [19]	
	Munoz, et al. [20]	
	Gresnigt, et al. [21]	
	Paris, et al. [22]	
	Ontiveros [23]	
	Yuan, et al. [24]	

Four studies included provided details regarding the utilization of RI for restoring and getting back adequate color of teeth after caries attack with an incipient lesion. The data evaluated concerning the inherent structure of the studies included are mentioned in Table 3. All investigations utilized a randomized allotment, a blinded result evaluation and a study group. The study group was portrayed by RI utilized in addition to dental bleaching in the research by Gugnani, et al. [8], and RI alone in other researches [11]. Most of the included studies looked at RI alone with the adjacent teeth and enamel substance of tooth itself as a control group [9].

Table 3 Inherent assessment of included studies

	Gugnani, et al. [8]	Eckstein, et al. [9]	Senestraro, et al. [7]	Knosel, et al. [10]
Randomization	Yes	Yes	Yes	Yes
Study Design	Clinical Trial	Clinical Trial	Clinical Trial	Clinical Trial
Test Group	RI, BL and RI+BL	RI	RI	RI
Control Group	Adjacent Tooth Substance	Adjacent Sound Enamel	Affected Teeth without RI	Adjacent Sound Enamel
Blinding/Masking	Yes	Yes	Yes	Yes
No. of Participants	24	20		21
Dentition	Permanent	Permanent teeth	Permanent teeth	Permanent teeth

The subtleties of research participants (number of patients, dentition, no of teeth, an assessment tool used, follow up duration) are mentioned in Table 1. The outcome of the investigation was assessed by Color and lightness of the white spot lesions and the sound adjacent enamel with a spectrophotometer at different time intervals using the system of the Commission Internationale de l'Eclairage [25]. The analysis of variance with repeated measures and pair-wise comparisons were used to analyze the effects of infiltration and time elapsed on the color differences at a (CI of 95% α level of 5% and a power 80% of study in the researches by Knosel, et al. [10], and Eckstein, et al. [9], similarly in a research by Gugnani, et al. [8], dental bleaching with 35% hydrogen peroxide, resin infiltration, resin infiltration with increased infiltration time and combination of techniques were used to restored and enhance tooth color followed by Immediate evaluation of changes in esthetics' and 'Improvement in opacities/stains' using a VAS and significantly better results for resin infiltration alone or combination with bleaching as compared to bleaching alone with a value of ($p < 0.001$) observed at 99% CL. While in research by Senestraro, et al. [7], RI technique was used alone to restore and improve tooth color later assessed on a photograph using VAS a significant change in color was observed in treated teeth with a value of ($p < 0.001$). Each of the 4 articles demonstrated significant differences in aesthetic and restorative results between study and control groups.

DISCUSSION

This research proposed that RI is a beneficial strategy to improve aesthetic and restoration in a tooth suffering from an incipient carious lesion to achieve the best clinical outcome. the summed improvement in tooth color after restoration with RI was significantly different ($p < 0.001$) in comparison to adjacent non-treated teeth despite the small sample sizes ranging from 21 to 24. The four studies included justifies CONSORT (Consolidated standards of reporting trials) criteria. the studies have a sample size calculation like color enhancement in teeth and the estimation was based on previous variables [7-10].

The clinical trial design incorporated in all four studies is frequently used in research fields to analyze various interventions due to its benefit of enabling a participant to help as both study and control, therefore, decreasing the intersubjective biasness. This design, however, has limitations also like the need for specific statistical tests and cross effects of some agents on adjacent segments like acids and fluoride gels, etc when used in specific trials could alter the outcome.

The researches included in this systematic review differs in study designs, observation periods, evaluation methods, but there is a similarity in terms of dentition treated, outcome assessment and protocol; strict to aesthetic and restorative aspects of initial carious lesions or tooth discoloration.

The major limitation of our systemic review is the small sample size due to restricted hunt of the articles published in only one medical database, PubMed. other search engines like Cochrane, Scopus, LILACS and SciElo, which incorporates publications either not enough or in other languages were not searched. The selected investigation also

not review dentist's and patient's satisfaction with resin infiltration techniques in the presence of other sophisticated methods and their comparison in terms of cost with other strategies.

CONCLUSION

This Systematic review uncovered the fact that utilization of RI enhances aesthetics and restoration of tooth form in non-carious and incipient carious lesions. This recommends RI as a promising noninvasive methodology and may be considered as an extra alternative to invasive and noninvasive treatment strategies. Nonetheless, high-caliber, long-duration clinical studies are required to affirm the viability of RI for non-cavitated caries sores in teeth. Specifically, to decide long term benefits, correlations need to be made among RI and other restorative techniques.

DECLARATIONS

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

- [1] Hallgren, Kevin, et al. "Color properties of demineralized enamel surfaces treated with a resin infiltration system." *Journal of Esthetic and Restorative Dentistry*, Vol. 28, No. 5, 2016, pp. 339-46.
- [2] Cagetti, Maria Grazia, et al. "Amelogenesis imperfecta: A non-invasive approach to improve esthetics in young patients. Report of two cases." *Journal of Clinical Pediatric Dentistry*, Vol. 41, No. 5, 2017, pp. 332-35.
- [3] Cochrane, N. J., et al. "Remineralisation by chewing sugar-free gums in a randomised, controlled in situ trial including dietary intake and gauze to promote plaque formation." *Caries Research*, Vol. 46, No. 2, 2012, pp. 147-55.
- [4] Griffin, Susan O., et al. "The effectiveness of sealants in managing caries lesions." *Journal of Dental Research*, Vol. 87, No. 2, 2008, pp. 169-74.
- [5] Robinson, C., et al. "Arrest and control of carious lesions: A study based on preliminary experiments with resorcinol-formaldehyde resin." *Journal of Dental Research*, Vol. 55, No. 5, 1976, pp. 812-18.
- [6] Paris, S., et al. "Progression of sealed initial bovine enamel lesions under demineralizing conditions *in vitro*." *Caries Research*, Vol. 40, No. 2, 2006, pp. 124-29.
- [7] Senestraro, Seth V., et al. "Minimally invasive resin infiltration of arrested white-spot lesions: A randomized clinical trial." *The Journal of the American Dental Association*, Vol. 144, No. 9, 2013, pp. 997-1005.
- [8] Gugnani, Neeraj, et al. "Comparative evaluation of esthetic changes in nonpitted fluorosis stains when treated with resin infiltration, in-office bleaching, and combination therapies." *Journal of Esthetic and Restorative Dentistry*, Vol. 29, No. 5, 2017, pp. 317-24.
- [9] Eckstein, Amely, Hans-Joachim Helms, and Michael Knosel. "Camouflage effects following resin infiltration of postorthodontic white-spot lesions *in vivo*: One-year follow-up." *The Angle Orthodontist*, Vol. 85, No. 3, 2015, pp. 374-80.
- [10] Knosel, Michael, Amely Eckstein, and Hans-Joachim Helms. "Durability of esthetic improvement following Icon resin infiltration of multibracket-induced white spot lesions compared with no therapy over 6 months: A single-center, split-mouth, randomized clinical trial." *American Journal of Orthodontics and Dentofacial Orthopedics*, Vol. 144, No. 1, 2013, pp. 86-96.
- [11] Alwafi, Abdulraheem. "Resin infiltration may be considered as a color-masking treatment option for enamel development defects and white spot lesions." *Journal of Evidence Based Dental Practice*, Vol. 17, No. 2, 2017, pp. 113-15.
- [12] Auschill, Thorsten M., Kristina E. Schmidt, and Nicole B. Arweiler. "Resin infiltration for aesthetic improvement of mild to moderate fluorosis: A six-month follow-up case report." *Oral Health and Preventive Dentistry*, Vol. 13, No. 4, 2015, pp. 317-22.

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- [13] Cazzolla, Angela Pia, et al. "Efficacy of 4-year treatment of icon infiltration resin on postorthodontic white spot lesions." *BMJ Case Reports*, 2018.
- [14] Silva, S. N., et al. Staining potential differences between an infiltrative resin and an esthetic, flowable composite. *Journal of Esthetic and Restorative Dentistry*, Vol. 30, No. 5, 2018, pp.457-63.
- [15] Perdigão, Jorge, et al. "Masking of enamel fluorosis discolorations and tooth misalignment with a combination of at-home whitening, resin infiltration, and direct composite restorations." *Operative Dentistry*, Vol. 42, No. 4, 2017, pp. 347-56.
- [16] Manoharan, Vidya, et al. "Is resin infiltration a microinvasive approach to white lesions of calcified tooth structures? a systemic review." *International Journal of Clinical Pediatric Dentistry*, Vol. 12, No. 1, 2019, p. 53.
- [17] Cohen-Carneiro, Flávia, et al. "Color stability of carious incipient lesions located in enamel and treated with resin infiltration or remineralization." *International Journal of Paediatric Dentistry*, Vol. 24, No. 4, 2014, pp. 277-85.
- [18] Markowitz, K., and K. Carey. "Assessing the appearance and fluorescence of resin-infiltrated white spot lesions with caries detection devices." *Operative Dentistry*, Vol. 43, No. 1, 2018, pp. E10-18.
- [19] Yim, Hyun-Kyung, et al. "Modification of surface pretreatment of white spot lesions to improve the safety and efficacy of resin infiltration." *The Korean Journal of Orthodontics*, Vol. 44, No. 4, 2014, pp. 195-202.
- [20] Munoz, Miguel Angel, et al. "Alternative esthetic management of fluorosis and hypoplasia stains: Blending effect obtained with resin infiltration techniques." *Journal of Esthetic and Restorative Dentistry*, Vol. 25, No. 1, 2013, pp. 32-39.
- [21] Gresnigt, Marco, Michel Magne, and Pascal Magne. "Porcelain veneer post-bonding crack repair by resin infiltration." *The International Journal of Esthetic Dentistry*, Vol. 12, No. 2, pp.156-70.
- [22] Paris, S., et al. "Masking of white spot lesions by resin infiltration *in vitro*." *Journal of Dentistry*, Vol. 41, 2013, pp. e28-34.
- [23] Ontiveros, Joe C. "Commentary: Alternative esthetic management of fluorosis and hypoplasia stains: Blending effect obtained with resin infiltration techniques (1)." *Journal of Esthetic and Restorative Dentistry*, Vol. 25, No. 1, 2013, pp. 40-41.
- [24] Yuan, He, et al. "Esthetic comparison of white-spot lesion treatment modalities using spectrometry and fluorescence." *The Angle Orthodontist*, Vol. 84, No. 2, 201, pp. 343-49.
- [25] Stiles, W. S., and J. M. Burch. "Interim report to the Commission Internationale de l'Eclairage, Zurich, 1955, on the National Physical Laboratory's investigation of colour-matching." *Optica Acta: International Journal of Optics*, Vol. 2, No. 4, 1955, pp. 168-81.