

Systematic Review on the Efficacy of Icon Resin Infiltration on White Spot Lesions

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ABSTRACT

Background: Resin infiltration is a new therapeutic technique for WSLs (white spot lesions) that may bridge nonoperative and operative treatment options. It's a minimally invasive procedure for filling, reinforcing, and stabilizing demineralized enamel without drilling or compromising good tooth structure. It has also been found to slow the progression of caries in lesions that are too advanced to be treated with fluoride. The current investigation of this systematic review is to evaluate the efficacy of ICON® resin infiltration on WSLs. This literature review was conducted and reported according to the PRISMA (Preferred Reporting Items for Systematic Review and Metaanalysis) statement. Seven databases (PubMed, Cochrane Library, CINAHL, OVID MEDLINE, EMBASE, Grey Literature, Wiley Online Library) were used. The MeSH terms used were 'Icon resin infiltration, ' white spot lesions, and 'clinical trials. PICOS analysis of Population- Participants with white spot lesions; Intervention- Icon Resin Infiltration; Comparison- Comparing with other different therapies; Outcome- Regression or disappearance of lesions; Study design- Randomized controlled trials. Five cross-sectional studies were included in this systematic review for the quality assessment of the efficacy of Icon resin infiltration on white spot lesions. All five studies reported a statistically significant difference between the Icon resin infiltration, lesion loss ratio, and color change. This systematic review concludes that the Icon resin infiltration on white spot lesion is effective during the initial period, i.e. first three months. Over time there is a color change in its masking. However, it is effective in reducing the lesion loss ratio.

Keywords: White spot lesions, Icon resin infiltration, Remineralization, enamel opacities, remineralizing agents.

INTRODUCTION

Enamel opacities form due to dental follicle injury during the eruption, enamel development abnormalities, or cariogenic activity in the event of poor oral hygiene.^[1] Initial enamel demineralization commonly

appears clinically as a "white spot lesion," as enamel translucency is directly related to the degree of mineralization (WSL). The WSL has been defined as "subsurface enamel porosity from carious demineralization" that presents as "a milky white opacity

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when located on smooth surfaces.^[2]The treatment of the white spot lesions is topical fluoride application and minimally invasive procedures like resin infiltration, laser irradiation, erosion-infiltration, bleaching, microabrasion, remineralizing agents like casein phosphopeptides remineralization process.^[3]Resin infiltration is a new therapeutic technique for WSLs that may bridge nonoperative and operative treatment options. It's a minimally invasive procedure for filling, reinforcing, and stabilizing demineralized enamel without drilling or compromising good tooth structure.^[4]The acid etchant is 15 % hydrochloric acid—in Icon® resin infiltration eliminates the surface layer of the decalcified region due to its penetration depth of $58 \pm 37 \mu\text{m}$.^{[5][6][7][8]}Absence of tooth structure loss, allowing stability for white spot lesions, preventing caries progression, plugging of the micropore forms in the body of the lesion, delaying the need for a restoration, decreasing recurrent decay, absence of pulp inflammation and postoperative sensitivity, lowering the risk of periodontitis and gingivitis, and better aesthetic outcomes in covering demineralized enamel are just a few of the advantages of resin infiltration. ^[9]As a result, the current investigation of this systematic review is ICON® resin infiltration on white spot lesions.

MATERIALS AND METHODS

This review was conducted and reported according to the PRISMA (Preferred Reporting Items for Systematic Review and Metaanalysis) statement. The Population, intervention, comparison and outcome model defined the inclusion and exclusion criteria. Thus, the present review investigated the efficacy of Icon resin infiltration on white spot lesions.

Search Strategy

The following databases were searched to find reports of relevant studies. Seven databases (PubMed, Cochrane Library, CINAHL, OVID MEDLINE, EMBASE, Grey Literature, Wiley

Online Library) were used. The MeSH terms used were 'Icon resin infiltration, ' white spot lesions, and 'clinical trials.

The inclusion criteria are

- Articles that evaluated the effect of Icon resin infiltration on white spot lesions.
- Articles with the study design of randomized controlled trials.
- Invivo studies.

PICOS

Population: Participants with white spot lesions

Intervention: Icon Resin Infiltration

Comparison: Compared with other different therapies.

Outcome: Regression or disappearance of lesions

Study design: Randomized controlled trials

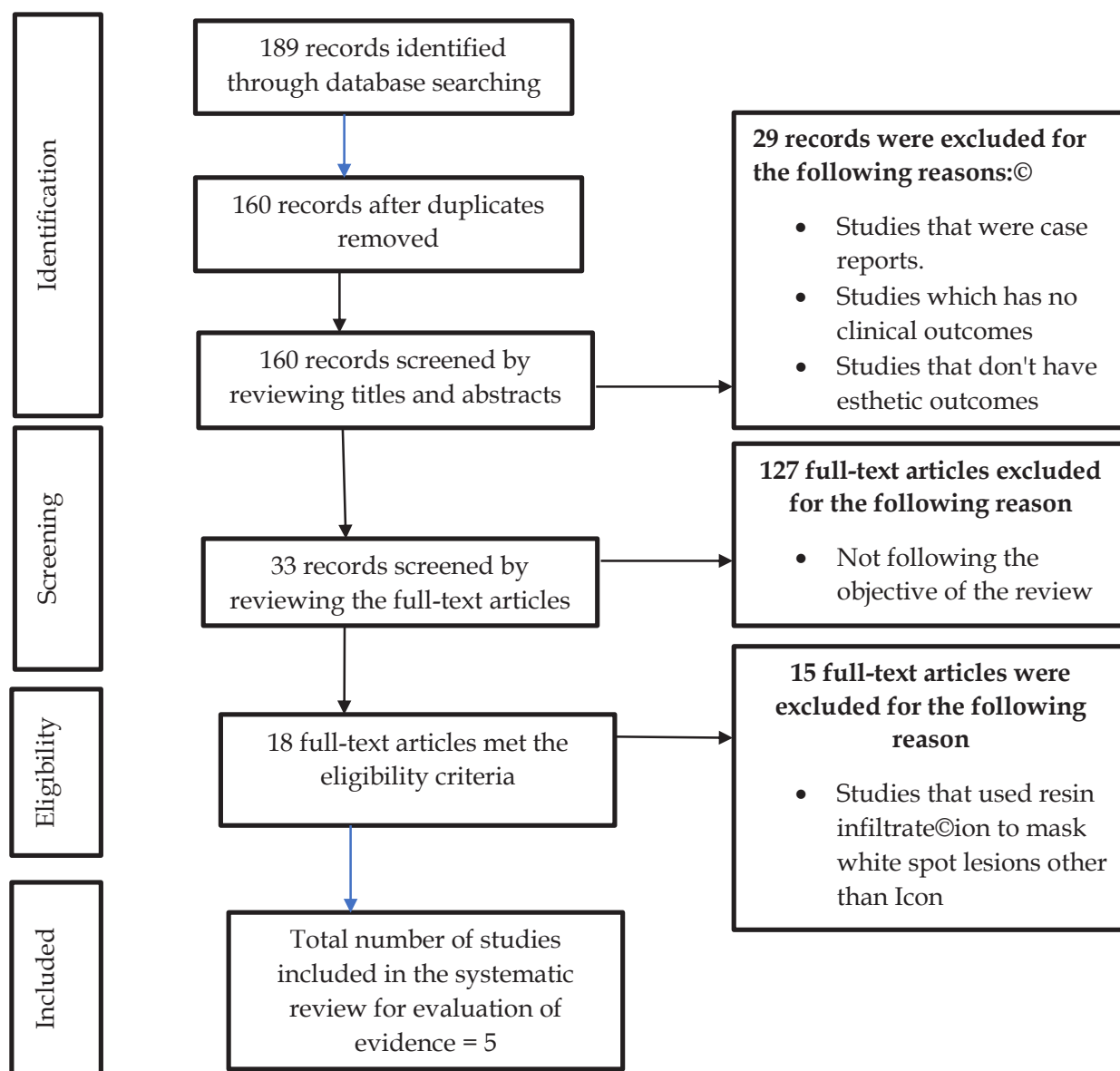
RESULT

Table 1 to 3 in next page.

DISCUSSION

Despite the fact that numerous new advanced materials and technologies have been developed to detect and cure dental caries, the problem still exists.^[15]

Michael Knoselet al.^[15]conducted a study by assessing the durability of resin infiltration in white spot lesions and sound enamel achieved over six months. Twenty-three consecutive subjects with 231 noncavitated, unrestored white spot lesions after multibracket treatment were recruited for lesion infiltration at the Department of Orthodontics, University of Gottingen (Germany). The treatment and control groups were assigned using a simple randomized, split-mouth, controlled design. After enamel conditioning with a 15% HCl gel, white spot lesion infiltration of the anterior teeth was conducted using low-viscosity light-cured resin in the treatment group. The colour and lightness of the white spot lesions and the



Flowchart 1

Table 1: Population and Interventions of the selected studies in this systematic review

S.No	Author name	Year	Patient selection	Type of study	Interventions
1	Michael Knosel et al. ^[10]	2013	23 subjects with 231 non cavitated, unrestored white spot lesions after multibracket treatment were recruited	Split mouth randomized controlled trial	Group 1: White spot lesion infiltration (Icon; DMG) low-viscosity light-cured resin after enamel conditioning with a 15% HCl gel. Group 2: Control
2	Annapurna Kannan et al. ^[11]	2019	Two hundred forty WSLs were detected in 193 teeth of 12 patients.	A randomized controlled trial	Group 1: Icon® resin infiltration. Group 2: Clinpro™ XT varnish

S.No	Author name	Year	Patient selection	Type of study	Interventions
3	Ahmed Youssef et al. ^[12]	2020	Two hundred forty WSLs were detected in 193 teeth of 12 patients.	Short term split-mouth randomized controlled trial	Group 1: Lesions were resin infiltrated with Icon (RI DMG) Group 2: ReminPro (R.P.;VOCO) Group3 (control): affected teeth were brushed with Complete Care toothpaste (CC; Himalaya).
4	Seth V. Senestraro et al. ^[13]	2013	20 patients	Randomized controlled trial	Group A: (Icon Infiltrant, DMG America, Englewood, N.J.) Group B: Placebo
5	Xi Gu et al. ^[14]	2019	Twenty patients with 128 teeth with post orthodontic WSLs were recruited.	Split mouth randomized controlled trial	Group 1: (Icon, DMG, Hamburg, Germany) Group 2: microabrasion

Table 2: Outcome of the data included in the studies

S. No	Author	Year	Outcome	Result
1	Michael Knosel et al. ^[10]	2013	Resin infiltration improves the esthetic appearance of demineralized teeth. Esthetic	The results obtained were adequate durability over six months.
2	Annapurna Kannan et al. ^[11]	2019	Immediately after the intervention, Icon® resin infiltration showed statistically significant better improvement than Clinpro™ XT varnish in restoring the colour	Except at three months, the fluorescence loss sequentially reduced more for Icon® resin infiltration (4.48 ± 1.42 at T0 to 1.48 ± 0.81 at T3) and was not statistically significant
3	Ahmed Youssef et al. ^[12]	2020	Compared to R.P. and CC, RI showed prompt and subjectively satisfactory.	Statistical analysis of the objective colour differences (ΔE^*) between the three groups revealed significant differences for R.I. vs R.P. ($P.029$), R.I. vs CC ($P.001$), and R.P. vs CC ($P.001$).
4	Seth V. Senestraro et al. ^[13]	2013	Resin infiltration significantly improved the clinical appearance of WSLs, with stable results seen eight weeks after treatment.	The mean VAS ratings for treated teeth demonstrated marked improvement relative to that for control teeth immediately after treatment (67.7 versus 5.2 , $P < .001$) and eight weeks later (65.9 versus 9.2 , $P < .001$).
5	Xi Gu et al. ^[14]	2019	Resin infiltration showed a better esthetic improvement effect when compared with microabrasion at 12 months.	In the infiltration group, the R-value and D.E. had no significant changes from T1 to T12. In the microabrasion group, the R-value and D.E. decreased significantly from T1 to T6. The R-value of resin infiltration was lower when compared with microabrasion at every recall point ($P, .001$)

Table: 3 Bias analysis for the included studies

S. No	Author and Year	Random Sequence Generation	Allocation Concealment	Selective Reporting	Incomplete Outcome Data	Blinding of Outcome Assessment	Blinding Participants and Personals
1	Michael Knosel et al. ^[10]	-	-	-	-	?	?
2	Annapurna Kannan et al. ^[11]	-	-	-	?	-	-
3	Ahmed Youssef et al. ^[12]	-	-	?	?	-	-
4	Seth V. Senestraro et al. ^[13]	?	?	-	-	-	-
5	Xi Gu et al. ^[14]	-	-	-	-	-	-

The bias is assigned as low risk (-), high risk (+), and unclear (?)

neighbouring sound enamel were measured using a spectrophotometer before infiltration and after one day, one week, four weeks, three months, and six months using the Commission Internationale de l'Eclairage system. At a level of 5% and a power of 80%, multifactorial analysis of variance with repeated measures and pair-wise comparisons was employed to investigate the effects of infiltration and time elapsed on colour differences. The results of a study including 20 patients and 39 quadrants in each group (108 teeth in the control group; 111 teeth in the treatment group) revealed that both treatment settings and time duration had a generally significant impact on the colour difference values. After infiltration, colour assimilation of white spot lesions to surrounding enamel was steady over six months, with no significant alterations; the mean colour difference of white spot lesions vs adjacent sound enamel (D.E. baseline vs six months) was 2.55. (95 percent confidence interval [CI], 1.431-3.678). The untreated control teeth showed no significant changes over six months compared with the baseline: mean (D.E.), 0.29 (95% CI, 0.335-0.928). No important adverse events or side effects were observed. Resin infiltration improves the esthetic appearance of demineralized teeth. The results showed sufficient durability over six months.

Annapurna Kannan et al.^[11] aimed to comparatively evaluate Icon® resin infiltration and Clinpro™ XT varnish in restoring aesthetics of white spot lesions (WSLs) present post-orthodontic treatment. Two hundred forty WSLs were detected in 193 teeth of 12 patients. The participants were analyzed—before intervention (T0), immediately after intervention (T1), three months later (T2), and six months later (T3), with a 1:1 allocation ratio for the application of Icon® resin infiltration and Clinpro™ XT varnish. Using a computer-generated allocation sequence, block randomization was done. A spectrophotometer was used to assess the colour of WSLs and the adjacent enamel, while a DIAGNOdent® was used to assess the fluorescence loss. Immediately after the intervention, Icon® resin infiltration showed statistically significant better improvement than Clinpro™ XT varnish in restoring the colour ($p = 0.000$); however, at 3 ($p = 0.001$) and 6 months ($p = 0.000$), this was reversed. Except at three months, the fluorescence loss sequentially reduced more for Icon® resin infiltration (4.48 ± 1.42 at T0 to 1.48 ± 0.81 at T3) and was not statistically significant. Clinpro™ XT varnish showed significantly better improvement than Icon® resin infiltration in restoring the colour and lightness of the WSLs at 3 and 6 months. The fluorescence loss

significantly recovered with both intervention methods between immediate application and six months. However, Clinpro™ XT varnish-treated WSLs showed a statistically significant difference compared to the adjacent sound enamel at six months.

Seth V. Senestraro et al.^[13] conducted a randomized, single-masked clinical trial involving patients who had completed orthodontic treatment to assess changes in the appearance of white spot lesions (WSLs) treated with resin infiltration. The authors divided affected teeth into control and treatment groups. The treatment group restored teeth with WSLs by using resin infiltration. They evaluated changes in WSLs photographically by using a visual analogue scale (VAS) (0 = no change, 100 = complete disappearance) and area measurements (in square millimetres). The authors analyzed the data by using a two-way analysis of variance. Results. The mean VAS ratings for treated teeth demonstrated marked improvement relative to that for control teeth immediately after treatment (67.7 versus 5.2, $P < .001$) and eight weeks later (65.9 versus 9.2, $P < .001$). The results for treated teeth showed a mean reduction in the WSL area of 61.8 per cent immediately after treatment and 60.9 per cent eight weeks later, compared with a -3.3 per cent change for control teeth immediately after treatment and a 1.0 per cent reduction eight weeks later. The study concluded that the resin infiltration significantly improved the clinical appearance of WSLs, with stable results seen eight weeks after treatment. Practical Implications. Resin infiltration, a minimally invasive treatment, was effective for WSLs that formed during orthodontic treatment.

Xi Gu et al.^[14] compared the esthetic improvement between post orthodontic white-spot lesions (WSLs) treated by resin infiltration and microabrasion for 12 months. Twenty patients with 128 teeth with post orthodontic WSLs were recruited. A simple randomized, split-mouth, positive controlled design allocated patients to resin infiltration or microabrasion groups. The lesion area ratio (R-value) was calculated between a WSL and

the labial surface of the corresponding tooth based on standardized clinical photographs. Each tooth's colour change (D.E.) was measured with a Crystaleye spectrophotometer (Olympus, Tokyo, Japan). Every measurement was taken before treatment (T0) and at different time points after treatment: 1 week (T1), six months (T6), and 12 months (T12). A total of 16 patients with 108 trial teeth were available at T12. Each group had 54 trial teeth. In both groups, there was a significant decrease in R-value and D.E. between T1 and T0 ($P, .0001$). In the infiltration group, the R-value and D.E. had no significant changes from T1 to T12. In the microabrasion group, the R-value and D.E. decreased significantly from T1 to T6. The R-value of resin infiltration was lower when compared with microabrasion at every recall point ($P, .001$). The DE had no significant differences between the two groups at any time point. Resin infiltration and microabrasion improved the esthetic appearance of WSLs and showed sufficient durability for 12 months. Resin infiltration showed a better esthetic improvement effect when compared with microabrasion at 12 months. The limitation is that the comparison group with the Icon resin infiltration is different, so the efficacy of Icon resin infiltration may vary. In addition to the lesion loss and esthetic appearance of WSLs, Icon resin infiltration had shown highest microhardness value of the demineralized enamel immediately, but after 8 weeks due to the water softening of TEGDMA polymer matrix and partial solubility of the remaining mineral in the lesion body, Icon shows decreased microhardness.^[16] Icon resin infiltration incorporated with nanoparticles of amorphous calcium phosphate shows promising effect of inhibiting enamel White spot lesions, shield the enamel and increase its hardness.^[17]

CONCLUSION

This systematic review concludes that the Icon resin infiltration on white spot lesion is effective during the initial period, i.e. first three months. Over time there is a colour change in its masking. However, it is effective in reducing the lesion loss ratio.

CONFLICTS OF INTEREST: None.

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