

Noninvasive Proximal Adhesive Restoration in the Treatment of Non-cavitated Interproximal Incipient Carious Lesions: A Case Report

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Waseem W. Radwan ¹

1. Restorative Dentistry and Endodontics, Riyadh Elm University, Riyadh, SAU

Corresponding author: Waseem W. Radwan, drradwanwaseem@gmail.com

Abstract

The noninvasive proximal adhesive restoration (NIPAR) technique is a noninvasive approach that utilizes a one-component universal adhesive for infiltration and a filled flowable resin for impermeable sealing. This technique offers several benefits. The noninvasive treatment approach is particularly significant in restorative dentistry, as it entails identifying and managing caries in their initial phases. The efficacy of the noninvasive proximal adhesive restoration technique is limited to non-cavitated lesions. In this case report, a 24-year-old male patient with no relevant medical conditions with a history of dental extractions and restorations visited the University of Geneva Dental School for a complete dental check-up. Orthopantomogram (OPG) and bitewing radiographs revealed multiple initial proximal caries in teeth # 37 (mesial), # 36 (mesial & distal), and # 35 (distal). In addition, DIAGNOcam (KaVo) was used as a diagnostic tool to establish proximal caries' progression. After discussing treatment options with the patient, a decision was made to treat the lesions at the enamel level using NIPAR.

Categories: Preventive Medicine, Public Health, Dentistry

Keywords: molar teeth., proximal caries, case-report, nipar, non-invasive proximal adhesive restoration

Introduction

Dental caries continues to be a highly prevalent disease among individuals of all ages, as evidenced by its impact on the elderly and the young [1]. Initial caries lesions are the earliest observable sign of enamel caries and are also referred to as white spot lesions. These lesions can manifest within two weeks following the accumulation of plaque [2]. There are both invasive and noninvasive treatment modalities for addressing early-stage carious lesions. Porcelain laminate veneers are a viable option for managing esthetic lesions that fail to respond satisfactorily to noninvasive interventions. This invasive treatment approach has been documented in the literature [3-4].

Nevertheless, these techniques are commonly linked with an overabundance of tissue loss. Conservative treatment options that aim to remineralize the initial caries lesions are considered noninvasive [5]. Several clinical studies have indicated that the remineralization processes do not result in any cosmetic enhancements, as assessed by the criteria of the International Caries Detection and Assessment System [6]. In addition to the techniques above, the resin infiltration method has demonstrated efficacy in various clinical and laboratory investigations and is categorized as a micro-invasive modality [7,8]. Resin infiltration is a concept that involves the utilization of resins with low viscosity to occupy the porous configuration of the primary enamel carious lesions that possess an unimpaired surface layer [9,10] in situations where the lesion's depth intensifies and results in cavity formation, the utilization of resin infiltration alone is inadequate. Composite resins must be employed to restore the cavity [11]. However, the noninvasive proximal adhesive restoration (NIPAR) technique, which combines infiltration and sealing, presents a viable treatment alternative for non-cavitated proximal lesions. This approach offers the benefits of infiltration and sealing without requiring invasive procedures [12]. Utilizing a variety of therapeutic approaches would be prudent for this specific scenario. The report demonstrates the benefits of integrating two distinct preventive approaches as a noninvasive proximal adhesive restoration. Hence this case report aims to demonstrate the application of a new noninvasive proximal adhesive restoration technique (NIPAR) in treating non-cavitated interproximal incipient caries lesions.

Case Presentation

A 24-year-old male patient visited the University of Geneva Dental School for a complete dental check-up. The medical history of the patient revealed no significant abnormalities. Patient habits revealed that he smokes one pack of cigarettes daily, brushes his teeth once daily, and never uses dental floss, despite having good oral hygiene. However, past dental history indicated the previous visit to a dentist for extraction and restoration. The oral examination showed extraction of wisdom teeth and restoration in #26. The plaque accumulation was minimal, with no gingival inflammation and periodontal pockets. Oral mucosa and tongue were within normal limits.

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Orthopantomogram (OPG) and bitewing radiographs of the teeth were taken for the patient. The radiographs revealed multiple initial proximal caries, mainly in posterior teeth. In addition, DIAGNOcam (KaVo) was used as a diagnostic tool to establish proximal caries' progression. The bitewing radiographs showed initial proximal caries in teeth # 37 (mesial), # 36 (mesial & distal), and # 35 (distal) (Figures 1, 2

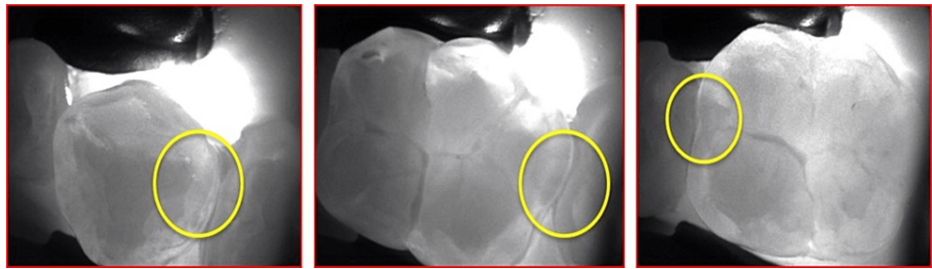


FIGURE 1: DIAGNOcam KaVo showing initial proximal caries in third quadrant



FIGURE 2: Bitewing radiograph showing initial proximal caries in teeth # 37 (MS) # 36 (MS and DS) and 35 (DS)

#: tooth number, 37: Permanent left mandibular second molar, 36: permanent left mandibular first molar, 35: permanent left mandibular second premolar, DS: distal surface, MS: mesial surface

After reviewing treatment options with the patient, a decision was made to treat the lesions at the enamel level using NIPAR. Before beginning therapy, written informed consent was acquired. Oral prophylaxis was performed to remove food debris and dental plaque (Figure 3). In addition, oral hygiene instructions were given to the patient.



FIGURE 3: Mouth after oral prophylaxis

Procedure

A rubber dam (Nic Tone, Expert Tech Solution) was applied to isolate the teeth. A diamond-coated metal finishing strip was used to prepare the proximal enamel surface. The proximal enamel surface was etched by applying 35% Orthophosphoric acid (H_3PO_4) for 20 seconds. In order to ensure complete penetration of the acid, dental floss DF 834 (CURAPROX) was utilized, followed by a water rinse for 20 seconds (Figure 4).

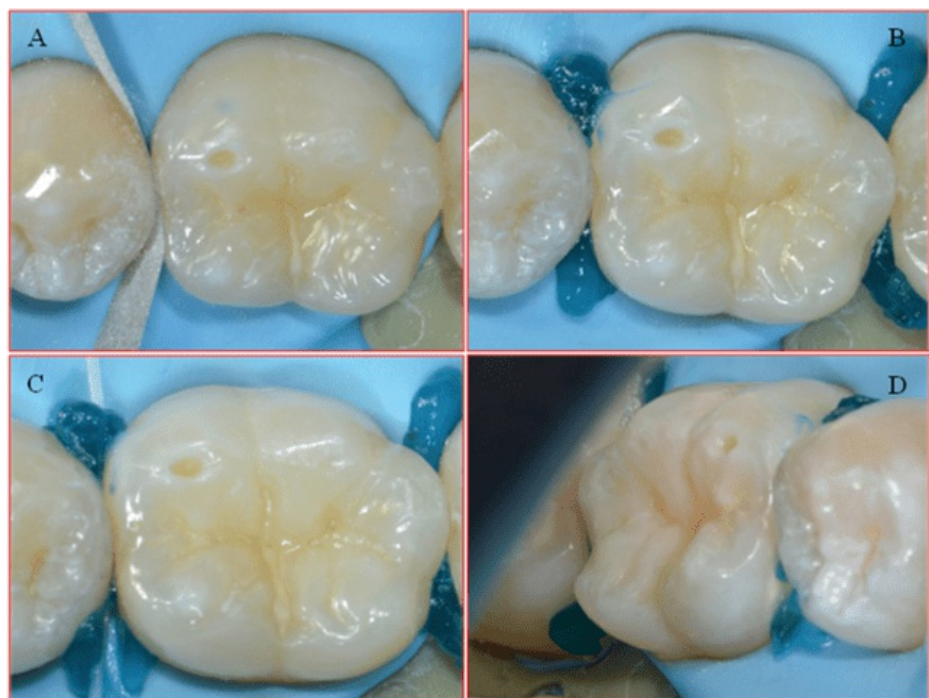


FIGURE 4: A. Diamond-coated metal finishing strip to prepare the proximal enamel surface. B. Application of 35% H_3PO_4 for 20 seconds. C. Complete penetration of H_3PO_4 using dental floss. D. Water Rinse for 20 seconds

H_3PO_4 : Phosphoric acid

A small cotton pellet soaked in ethanol was placed for complete water evaporation. A white chalky appearance was seen as a result of the acid etch reaction. The bonding agent (3M™ Scotchbond™ Universal Adhesive) is applied to the acid-etched enamel surface. Dental floss was used to adapt the bonding agent completely (Figure 5).

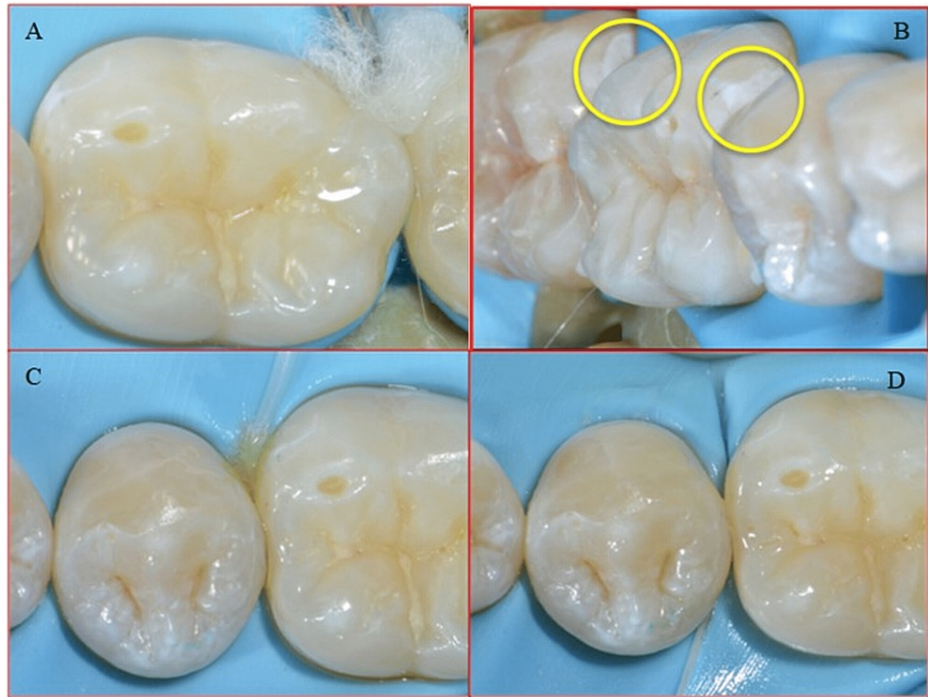


FIGURE 5: A. Ethanol for complete evaporation of water. B. White chalky appearance after acid etching. C. Application of bonding agent. D. Use of dental floss for complete adaptation of the bonding agent.

The air was sprayed to spread the bonding agent uniformly, which was then light-cured for 30 seconds. The flowable resin (Tetric EvoFlow®, Ivoclar) was then applied as a restorative material on the enamel surface. In order to enhance the complete penetration of the resin into the proximal surface, dental floss was used, as shown in (Figure 6).

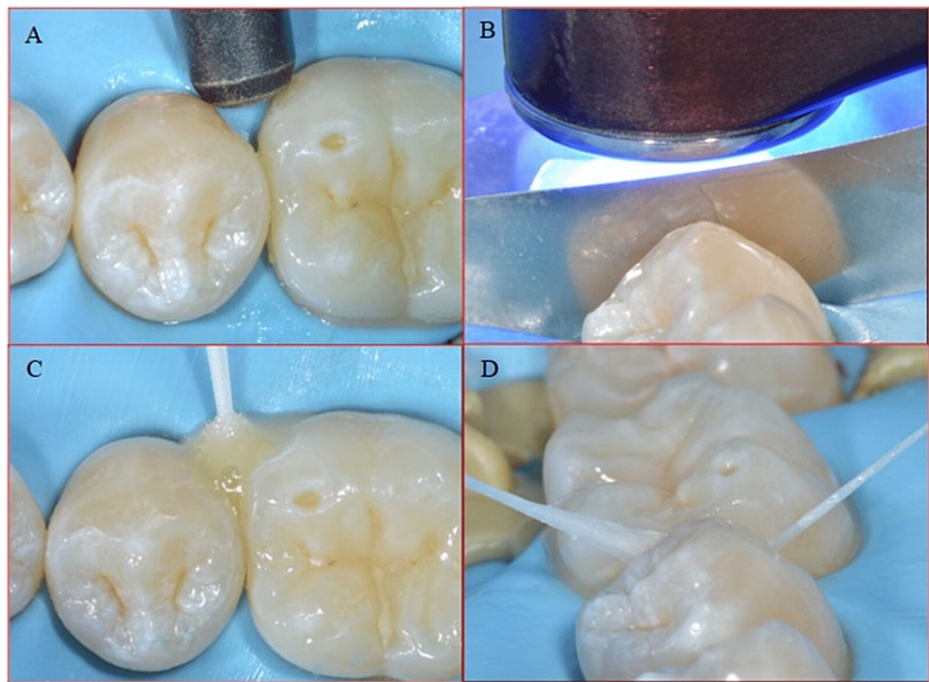


FIGURE 6: A. Air spray used to spread bonding agent in tight contacts. B. Metal matrix prevents adhesion of the proximal surface during polymerization. C. Flowable composite is applied as a restorative material. D. To enhance perfect penetration of the resin into proximal surface, dental floss is used.

Before initiating the polymerization reaction using light curing, a metal matrix (Polydentia, Switzerland) is used to prevent adhesion of the proximal surface during polymerization. The glycerine gel was applied to inhibit oxidation. The curing for 20 seconds was then carried out through the glycerine gel to avoid the oxygen inhibition layer. Excess glycerine was removed with water and dental floss (Figure 7).

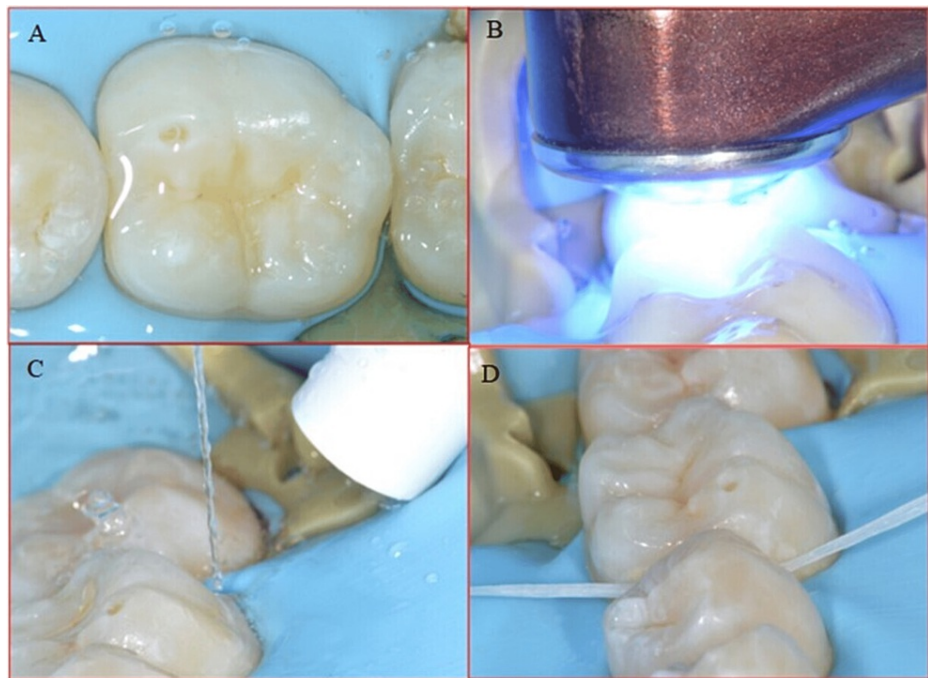


FIGURE 7: A. Glycerin gel is applied to inhibit oxidization. B. Polymerization for 20 seconds through the glycerin gel to avoid the oxygen inhibition layer. C. Washing excess glycerin. D. Use dental floss to remove excess resin.

After six months, the patient was recalled for evaluation. The clinical examination revealed intact proximal restoration without any discoloration. While bitewing radiographs revealed the absence of progression of caries into surrounding tissues. The pre-treatment and six-month post-treatment radiographs of proximal incipient lesions are shown in Figure 8. Moreover, no complications were observed during or following the treatment procedure.



FIGURE 8: Bitewing radiographs showing before and after six months follow-up of treated incipient lesions

Discussion

In this case report, the patient undergoing routine bitewing radiographic examination disclosed proximal non-cavitated carious lesions in teeth # 37 (mesial) # 36 (mesial & distal), and # 35 (distal), which were confirmed by DIAGNO cam. A non-invasive fluid resin treatment was initiated to restore these proximal lesions.

Using resin infiltration in combination with non-invasive interventions has been demonstrated to be a successful therapeutic strategy for managing non-cavitated proximal caries lesions in primary and

permanent dentition. The accumulated evidence [13-15] was deemed to be solid and trustworthy with the incorporation of more recent assessments. Based on the reports, the treatment's long-term effectiveness was validated by monitoring lesion progression for most trials that evaluated lesions in permanent teeth over 36 months [16]. Additionally, one follow-up study conducted for seven years reported the effectiveness of fluid resin in treating non-cavitated proximal caries [13].

The noninvasive fluid resin infiltration procedure is a one-visit process that offers mechanical stabilization of demineralized enamel and exhibits enhanced resin penetration. The utilization of this approach aids in the prevention of lesion progression and reduces the likelihood of secondary caries. No instances of postoperative sensitivity or pulpal irritation, nor any cases of gingivitis or periodontitis, have been reported. The intervention mentioned above has been well-received by patients [15]. One of the reasons for this long success may be that the resin infiltration protects the initial lesions against acid attacks. According to various research studies, it has been suggested that resin-infiltrated enamel exhibits greater resistance toward acid attacks, consequently reducing the likelihood of caries lesion formation [17,18].

Using an abrasive strip on proximal surfaces, in conjunction with orthophosphoric acid etching, has been observed to improve the elimination of the hyper-mineralized layer. This technique also facilitates superior infiltration of adhesives into enamel lesions [12]. The utilization of unwaxed floss in the application of orthophosphoric acid in the proposed non-invasive proximal adhesive restoration protocol is recommended to facilitate optimal contact between the gel and the lesion surface. This approach effectively mitigates the formation of air pockets or bubbles on the lesion surface, which may impede the action of the gel [12]. The 35% phosphoric acid was chosen in this technique due to its high effectiveness in the removal of the hyper-mineralized layer after the use of an abrasive strip and thereby enabling better infiltration of adhesives into enamel lesions compared to the use of 15% Hydrochloric acid (HCl) for two minutes.

In the present case, Scotchbond Universal was applied, a single-component adhesive that the manufacturer reports to exhibit hydrophilic properties before polymerization, thereby facilitating optimal wetting of the tooth structure. After drying and curing, Scotchbond Universal demonstrates an exceptional conversion level and acquires a comparatively hydrophobic nature. According to the literature, a superficial filled resin coating offers superior protective properties compared to unfilled sealants. Utilizing a flowable resin to safeguard the infiltrated area is believed to augment further the level of protection against chemical and mechanical challenges that the lesion may face [18].

Based on prior observations [19,20], it has been noted that around 30-40% of lesions that penetrate the first third of dentin exhibit 43-45 micro cavitations. The non-invasive proximal adhesive restoration protocol can potentially mitigate the progression rate of dental caries by utilizing flowable composite material to fill these micro-cavities effectively.

The advantage of utilizing NIPAR is its ability to effectively demonstrate a greater extent of infiltration, which can be attributed to mechanical abrasion and the application of phosphoric acid. Additionally, NIPAR facilitates the achievement of an optimal surface seal through the utilization of flowable composite materials. Furthermore, NIPAR is a compelling therapeutic approach for managing non-cavitated or minimally cavitated lesions. However, a disadvantage of NIPAR is that it is technique sensitive and requires the use of a DIAGNOcam for proximal carious lesion identification. Moreover, the patient's good oral hygiene compliance is very much essential success of the treatment.

Conclusions

The early intervention of the non-cavitated proximal caries is crucial to prevent the advancement of the lesion. The non-invasive proximal adhesive restoration (NIPAR) protocol demonstrated in this case report has the potential to offer a compelling therapeutic alternative for non-cavitated or even micro-cavitated proximal carious lesions. This case report outlines the steps involved in non-invasive proximal adhesive restorations of the proximal carious lesion.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

References

1. Bernabe E, Marcenes W, Hernandez CR, et al.: Global, regional, and national levels and trends in burden of

- oral conditions from 1990 to 2017: a systematic analysis for the global burden of disease 2017 study. *J Dent Res.* 2020, 99:362-73. [10.1177/0022034520908533](https://doi.org/10.1177/0022034520908533)
2. Holmen L, Thylstrup A, Ogaard B, Kragh F: A polarized light microscopic study of progressive stages of enamel caries in vivo. *Caries Res.* 1985, 19:348-54. [10.1159/000260866](https://doi.org/10.1159/000260866)
 3. Sá TC, de Carvalho MF, de Sá JC, Magalhães CS, Moreira AN, Yamauti M: Esthetic rehabilitation of anterior teeth with different thicknesses of porcelain laminate veneers: an 8-year follow-up clinical evaluation. *Eur J Dent.* 2018, 12:590-3. [10.4103/ejd.ejd_241_17](https://doi.org/10.4103/ejd.ejd_241_17)
 4. Rotoli BT, Lima DA, Pini NP, Aguiar FH, Pereira GD, Paulillo LA: Porcelain veneers as an alternative for esthetic treatment: clinical report. *Oper Dent.* 2013, 38:459-66. [10.2341/12-382-T](https://doi.org/10.2341/12-382-T)
 5. Theodory TG, Kolker JL, Vargas MA, Maia RR, Dawson DV: Masking and penetration ability of various sealants and ICON in artificial initial caries lesions in vitro. *J Adhes Dent.* 2019, 21:265-72. [10.3290/j.jad.a42520](https://doi.org/10.3290/j.jad.a42520)
 6. Yuan H, Li J, Chen L, Cheng L, Cannon RD, Mei L: Esthetic comparison of white-spot lesion treatment modalities using spectrometry and fluorescence. *Angle Orthod.* 2014, 84:343-9. [10.2319/032113-232.1](https://doi.org/10.2319/032113-232.1)
 7. Bourouni S, Dritsas K, Kloukos D, Wierichs RJ: Efficacy of resin infiltration to mask post-orthodontic or non-post-orthodontic white spot lesions or fluorosis - a systematic review and meta-analysis. *Clin Oral Investig.* 2021, 25:4711-9. [10.1007/s00784-021-03931-7](https://doi.org/10.1007/s00784-021-03931-7)
 8. Wierichs RJ, Langer F, Kobbe C, et al.: Aesthetic caries infiltration - long-term masking efficacy after 6 years. *J Dent.* 2023, 132:104474. [10.1016/j.jdent.2023.104474](https://doi.org/10.1016/j.jdent.2023.104474)
 9. Kielbassa AM, Muller J, Gernhardt CR: Closing the gap between oral hygiene and minimally invasive dentistry: a review on the resin infiltration technique of incipient (proximal) enamel lesions. *Quintessence Int.* 2009, 40:663-81.
 10. Sadikoglu IS: White spot lesions: recent detection and treatment methods. *Cyprus J Med Sci.* 2020, 5:260-7.
 11. Sadıkođlu IS: Using resin infiltration technique and direct composite restorations for the treatment of carious lesions with different depths. *Case Rep Dent.* 2023, 2023:5908006. [10.1155/2023/5908006](https://doi.org/10.1155/2023/5908006)
 12. Abdelaziz M, Lodi-Rizzini A, Bortolotto T, Garcia-Godoy F, Feilzer AJ, Krejci I: Non-invasive proximal adhesive restoration (NIPAR) compared to resin infiltration for treating initial proximal carious lesions. *Am J Dent.* 2018, 31:255-60.
 13. Paris S, Bitter K, Krois J, Meyer-Lueckel H: Seven-year-efficacy of proximal caries infiltration - randomized clinical trial. *J Dent.* 2020, 93:103277. [10.1016/j.jdent.2020.103277](https://doi.org/10.1016/j.jdent.2020.103277)
 14. Cebula M, Gstemeyer G, Krois J, Pitchika V, Paris S, Schwendicke F, Effenberger S: Resin infiltration of non-cavitated proximal caries lesions in primary and permanent teeth: a systematic review and scenario analysis of randomized controlled trials. *J Clin Med.* 2023, 12:10.3390/jcm12020727
 15. Manoharan V, Arun Kumar S, Arumugam SB, Anand V, Krishnamoorthy S, Methippara JJ: Is resin infiltration a microinvasive approach to white lesions of calcified tooth structures?: a systemic review. *Int J Clin Pediatr Dent.* 2019, 12:53-8. [10.5005/jp-journals-10005-1579](https://doi.org/10.5005/jp-journals-10005-1579)
 16. Meyer-Lueckel H, Bitter K, Paris S: Randomized controlled clinical trial on proximal caries infiltration: three-year follow-up. *Caries Res.* 2012, 46:544-8. [10.1159/000341807](https://doi.org/10.1159/000341807)
 17. Neres Y, Moda MD, Chiba EK, Briso A, Pessan JP, Fagundes TC: Microhardness and roughness of infiltrated white spot lesions submitted to different challenges. *Oper Dent.* 2017, 42:428-35. [10.2341/16-144-L](https://doi.org/10.2341/16-144-L)
 18. Enan ET, Aref NS, Hammad SM: Resistance of resin-infiltrated enamel to surface changes in response to acidic challenge. *J Esthet Restor Dent.* 2019, 31:353-8. [10.1111/jerd.12471](https://doi.org/10.1111/jerd.12471)
 19. Askar H, Lausch J, Drfer CE, Meyer-Lueckel H, Paris S: Penetration of micro-filled infiltrant resins into artificial caries lesions. *J Dent.* 2015, 43:832-8. [10.1016/j.jdent.2015.03.002](https://doi.org/10.1016/j.jdent.2015.03.002)
 20. Lausch J, Askar H, Paris S, Meyer-Lueckel H: Micro-filled resin infiltration of fissure caries lesions in vitro. *J Dent.* 2017, 57:73-6. [10.1016/j.jdent.2016.12.010](https://doi.org/10.1016/j.jdent.2016.12.010)