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Resin Infiltration for Management of Enamel Hypoplasia: A Case Report with 1Year Follow-up

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Abstract

Introduction: Enamel hypoplasia is a developmental defect characterized by reduced enamel thickness, often presenting as unaesthetic white or discoloured lesions. Conventional management approaches are frequently invasive and may compromise sound tooth structure.

Case Report: A 22-year-old female patient presented with white spot lesions on anterior teeth, affecting her smile aesthetics. A minimally invasive resin infiltration technique was performed using a commercially available system.

Results: Immediate improvement in lesion appearance was observed, with stable esthetic outcomes at 1-year follow-up.

Conclusion: Resin infiltration appears to be an effective micro-invasive approach for managing mild to moderate enamel hypoplasia, offering satisfactory esthetic results while preserving tooth structure.

Keywords: Enamel hypoplasia, resin infiltration, white spot lesions, minimally invasive dentistry, esthetics

Introduction

Enamel hypoplasia is a defect of the teeth in which the enamel is deficient in the amount of mineral, caused by incomplete or defective enamel matrix formation. Prevalence of enamel hypoplasia is 15.1 %. Enamel hypoplasia is characterized by defects in the enamel that may manifest as opaque white areas, yellowish to brown discoloration, surface depressions, grooves, or regions of enamel thinning, chipping, or loss. The condition arises from disturbances during enamel formation and can result from a wide range of etiological factors. These include genetic and hereditary developmental disorders, nutritional deficiencies such as inadequate vitamin intake, maternal illnesses during pregnancy, exposure to medications taken by the mother prenatally or by the child during the early stages of tooth development, preterm delivery, low birth weight, dental trauma, infections, malnutrition, and various systemic health conditions.

Other treatment options for enamel hypoplasia are Micro/ Macro abrasion, but these are not reliable because there is a chance of recurrence. Composite resin restoration, indirect composite veneer, indirect ceramic veneer, full crown are alternative treatment options for enamel hypoplasia. But these are all invasive treatments.

The Resin Infiltration Concept:

Resin infiltration is a micro invasive technique that has been commercially available since 2010. The technique involves conditioning the tooth surface with 15% hydrochloric acid, followed by dehydration using an ethanol-based solution and subsequent application of a resin infiltrant containing triethylene glycol dimethacrylate (TEGDMA). Originally, this material (ICON, DMG) was designed for the management of early interproximal carious lesions and white spot lesions affecting anterior teeth. Clinical experience has also shown that this technique can effectively mask enamel discolorations that are not caused by caries. From a histological perspective, enamel possesses microscopic pores and enlarged intercrystalline spaces that serve as channels for the movement of acids and dissolved minerals. These structural characteristics allow early enamel lesions to be penetrated by liquids, including low-viscosity resin materials, making resin infiltration a feasible treatment approach. Resin infiltration increases the resistance of healthy enamel to further demineralization as well.

Resin Infiltration Kit:

The resin infiltration system (ICON, DMG, Germany) comprises three syringes containing the essential components of the procedure**:**

1. An etching agent consisting of 15% hydrochloric acid (ICON Etch)
2. An ethanol-based drying solution (ICON Dry)
3. A resin infiltrant composed primarily of triethylene glycol dimethacrylate (TEGDMA) along with photo initiators (ICON Infiltrant)

Steps:

First step - A 15% hydrochloric acid gel (ICON Etch) is applied to the tooth surface for 2 minutes, followed by thorough rinsing with a water spray for 30 seconds to remove the etching agent.

Second step - An ethanol-based drying agent (ICON Dry) is subsequently applied to dehydrate the lesion and eliminate water trapped within the micro porosities of the enamel. The tooth surface is then air-dried, enhancing the visibility of the porous white lesion and providing a clearer assessment of its extent.

Last step - A low-viscosity resin infiltrant (ICON Infiltrant) is then applied and allowed to remain undisturbed for 3 minutes to facilitate deep penetration into the lesion body. Following the infiltration period, any excess resin is carefully removed from the tooth surface using cotton rolls and dental floss. The infiltrant is subsequently polymerized by light curing for 40 seconds.

Case Report:

Chief complaint: A 22-year-old female patient presented to our department with concerns regarding the esthetic appearance of her smile. Her chief complaint was the presence of white spot lesions affecting the maxillary and mandibular anterior teeth.

Intraoral examination:

At the initial clinical examination, white spots in the right maxillary central incisor and left mandibular central incisor were observed. [Fig.1]

Periodontal evaluation demonstrated healthy supporting tissues, and radiographic assessment showed no evidence of abnormalities involving the periodontal structures.

The lesions presented as pronounced white opacities without any evidence of surface breakdown. Based on the clinical findings, a diagnosis of enamel hypoplasia was established. Considering the intact enamel surface, treatment with low-viscosity resin infiltration was deemed an appropriate and predictable management approach for this case.

Volume 9, Issue 5; September-October 2026; Page No 213-218
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Fig.1–Pre-operative image showing enamel hypoplasia with respect to 11 and 31



Procedure:

- The operative field was isolated with a lip retractor, a rubber dam, and eye protection for the patient during the procedure.
- The enamel surface was conditioned by applying a 15% hydrochloric acid gel (ICON Etch, DMG, Germany) for a duration of 120 seconds to facilitate subsequent resin infiltration. [Fig.2]
- Following the etching procedure, the acid gel was completely removed by rinsing with a water spray for 30 seconds, after which the tooth surface was thoroughly dried.
- Subsequently, the enamel surfaces were desiccated with 99% ethanol (ICON-Dry, DMG) for 30 seconds, followed by air drying. [Fig.3]
- Subsequently, a low-viscosity resin infiltrant (ICON Infiltrant, DMG) was applied to the enamel surfaces and left in place for 3 minutes to ensure adequate penetration into the lesion. [Fig.3]
- Any excess infiltrant remaining on the tooth surface was carefully removed using a cotton roll prior to polymerization and from the interdental area using dental floss before light curing. Then, light-cured for 40 seconds with an intensity of 1400 mW/cm2.
- A second application of the resin infiltrant was performed on the same tooth and allowed to penetrate for 1 minute. This was subsequently followed by light-curing for 40 seconds to achieve complete polymerization.

Volume 9, Issue 5; September-October 2026; Page No 213-218
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Fig.2–(a),(b) Rubber dam isolation; (c),(d)Etching with 15% hydrochloric acid gel (ICON-Etch, DMG, Germany) with respect to 11; (e),(f) Etching with 15% hydrochloric acid gel (ICON-Etch, DMG, Germany) with respect to 31

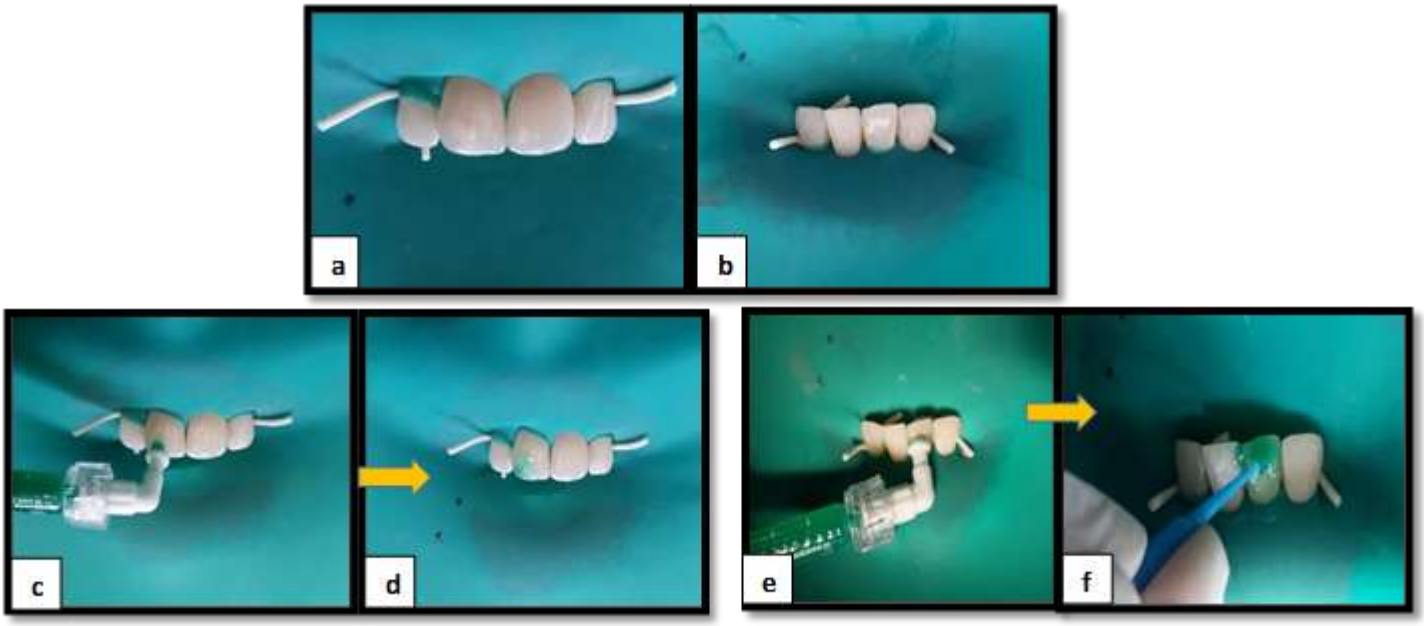
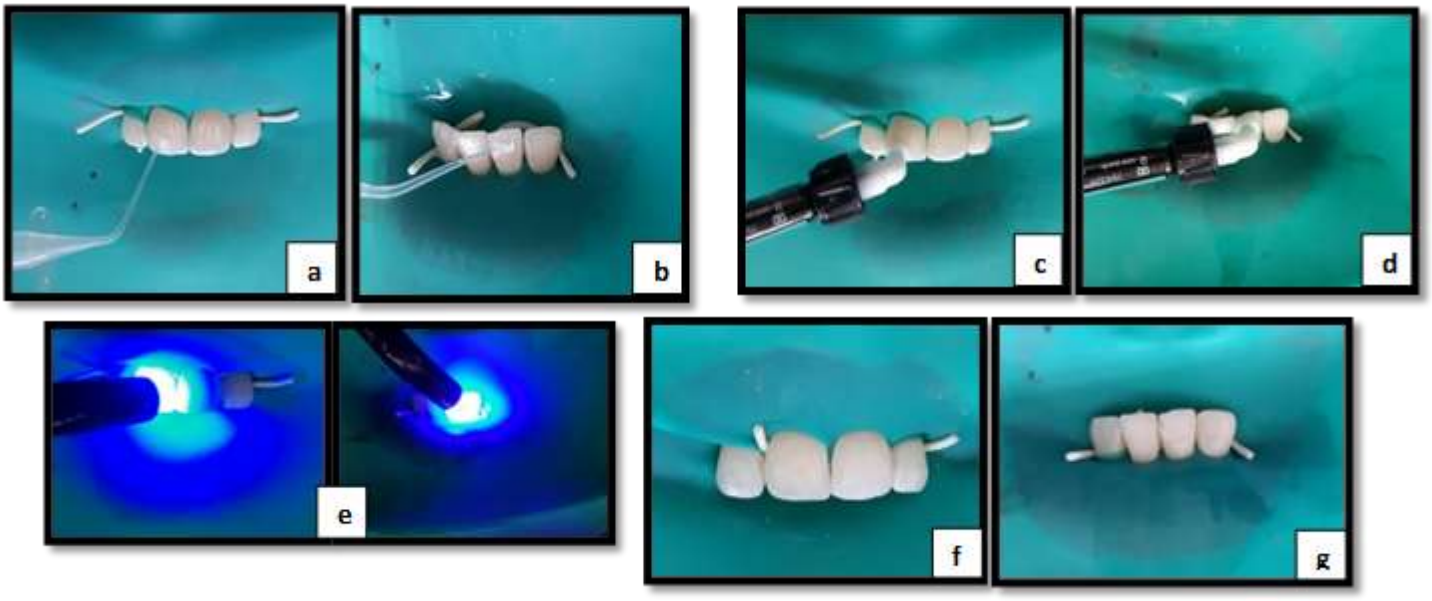
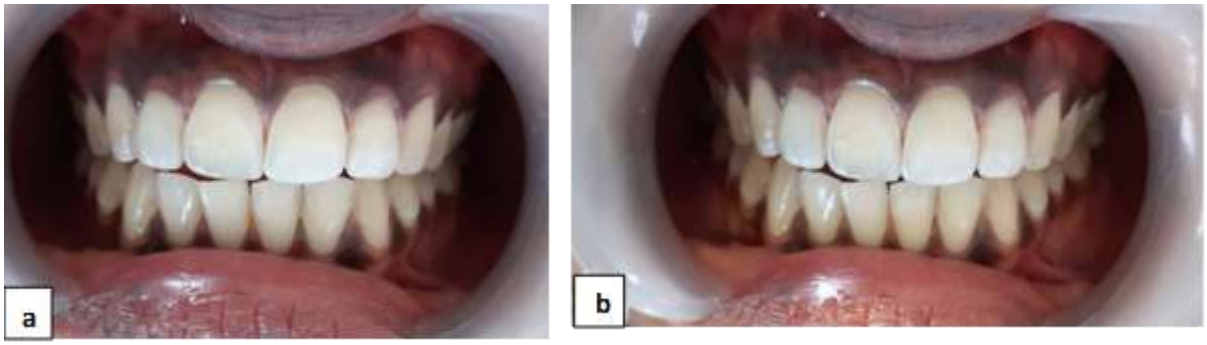


Fig.3–(a),(b) Desiccation of enamel surface using ethanol(99%; ICON-Dry, DMG) with respect to 11 and 31; (c),(d) Application of low-viscosity resin (ICON-Infiltrant, DMG) to the surface of enamel of the teeth with respect to 11 and 31; (e) Light curing with respect to 11 and 31; (f),(g) Immediate post-operative image with respect to 11 and 31



Volume 9, Issue 5; September-October 2026; Page No 213-218
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Fig.4–(a) Post-operative image; (b) 1 year follow up image



Discussion:

The present case showed esthetic improvement immediately and after 1 year of follow-up, masking the white spots caused by enamel hypoplasia.[Fig.4] Minimally invasive and non-invasive treatment approaches are increasingly preferred due to their conservative nature and preservation of tooth structure. In the present case, this treatment modality was selected because the patient was young and exhibited sound teeth without cavitation, along with healthy periodontal tissues and no associated abnormalities.

Alternative treatment options were not considered because of their higher cost and the increased risk of substantial loss or wear of healthy tooth structure associated with these procedures.

Manoharan V et al stated that it has an improved masking property with excellent patient acceptance.[1] Gu X et al. also reported superior esthetic outcomes with resin infiltration when evaluated over a 12-month follow-up period, compared with micro abrasion treatment.[2] In a systematic review, Shahroom et al. concluded that the ICON resin infiltration technique represents one of the most effective management strategies, particularly when a longer infiltration time is employed, demonstrating superior outcomes compared with other available treatment modalities.[3]

White spot lesions become more apparent when the teeth are dry due to differences in the refractive indices of enamel, water, and air, which enhance the optical contrast between the lesion and the surrounding healthy enamel. Refractive index of Enamel: 1.62. In porous enamel, the micro porosities are typically occupied by water, which has a refractive index of 1.33, resulting in a reduction in the overall optical properties of the tissue. Upon drying, the water within these pores is replaced by air, which has a refractive index of 1.00. This greater difference in refractive indices increases light scattering, making the white spot lesion appear more pronounced and readily visible. Refractive index of TEGDMA: 1.52. It basically contains Tri Ethylene Glycol Dimethacrylate (TEGDMA). It has hydrophilic characteristics, low viscosity, and a high penetration coefficient. A 99% ethanol solution is utilized to displace and remove water from the enamel micro porosities, thereby enhancing the penetration and diffusion of the resin infiltrant into the lesion.

The resin infiltrant is applied in two successive applications because the initial application undergoes polymerization shrinkage as monomers are converted into polymers. This contraction may create microscopic voids within the infiltrated area, which can be compensated for by the second application, ensuring more complete lesion penetration and sealing.

In the present case, an improvement over the course of time, i.e., immediately and 1 year follow-up, was noted. This phenomenon may occur as a result of water uptake by the resin infiltrant, particularly when residual moisture remains within the enamel micro porosities despite alcohol dehydration. The absorbed water can reduce the number of optical interfaces along the light pathway, thereby influencing the optical characteristics and appearance of the treated lesion.

Reasons that may affect the result of this treatment:

Several factors may compromise the effectiveness of resin infiltration, including inadequate isolation during the procedure, increased lesion depth, the presence of

Volume 9, Issue 5; September-October 2026; Page No 213-218
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cavitation, incomplete polymerization of the resin, and challenges in controlling the quantity of infiltrant that penetrates the lesion. In an in vitro study, Meyer-Lueckel et al. demonstrated that lesions with incomplete resin infiltration exhibit a greater susceptibility to further demineralization and lesion progression.[4]

As lesion depth increases, the likelihood of achieving complete resin infiltration decreases, making thorough penetration of the infiltrant more challenging in deeper enamel lesions. Extensive lesions may undergo greater polymerization shrinkage, which can lead to the development of internal voids and micro cracks within the infiltrated area. Resin infiltration of cavitated lesions generally yields less favourable outcomes, as the disrupted enamel surface and reduced capillary action limit the ability of the low-viscosity resin to penetrate and adequately infiltrate the lesion.

Limitations Of Resin Infiltration Technique:

Potential limitations of this technique include the need for meticulous moisture control to maintain a dry operative field throughout the procedure. Additionally, the optimal depth of resin penetration within the lesion remains uncertain, which may influence the predictability and long-term success of the treatment [1] and ICON resin infiltration exhibits a masking effect on enamel discolorations and opacities, with favourable esthetic outcomes reported in cases of mild-to-moderate dental fluorosis and enamel hypoplasia.[5]. ICON resin infiltration not only aids in arresting the progression of early carious lesions but also improves esthetics by producing a camouflage effect that reduces the visibility of white spot lesions and enamel defects. [6] The effectiveness of the camouflage effect is influenced by the depth and extent of the lesion, with shallower lesions generally demonstrating more favourable esthetic outcomes. However, further long-term studies are required to evaluate the durability of these results, particularly with regard to discoloration, staining susceptibility, and the aging characteristics of the ICON resin infiltrant.

Conclusion:

The present case report highlights resin infiltration as a conservative and effective treatment modality for improving the esthetic appearance of white spot lesions associated with mild-to-moderate enamel hypoplasia. The technique successfully masked the lesions within a short treatment period and demonstrated satisfactory esthetic stability throughout a 1-year follow-up. As a minimally invasive procedure that can be completed in a single clinical visit, resin infiltration offers significant advantages for patients, particularly children and young adults. Nevertheless, the long-term success of this approach depends on the individual's caries risk status and adherence to appropriate follow-up and preventive care protocols.

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Volume 9, Issue 5; September-October 2026; Page No 213-218
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