RMOS

Publié le 19/3/2026

Article original / Original article

Revue Méditerranéenne d'Odonto - Stomatologie

Management of post-orthodontic white spot lesions using resin infiltration Icon®: a clinical case report

AUTHOR : BOUATAY MARWENNE[1,2], TOUNSI RYM[1,2], JLASSI OUSSAMA[1,2], SAIDA SAHTOUT[1,2] .

1- Department of Conservative Dentistry and endodontics, Faculty of Dental Medicine, University of Monastir, Tunisia
2- Laboratory of Dento-Facial Clinical and Biological Approach (ABCDF) LR12ES10, Faculty of Dental Medicine, University of Monastir, Tunisia

Corresponding Author:

Email address : marwenbouattay@gmail.com

Phone number : +21624385561

Abstract

Introduction: White spot lesions (WSLs) are a common iatrogenic complication of multibracket orthodontic treatment, resulting from plaque retention and enamel demineralization. These lesions compromise aesthetics, enamel integrity, and can affect patients' social confidence. Minimally invasive approaches are increasingly recommended to manage post-orthodontic WSLs effectively.

Observation: A 23-year-old female patient presented with maxillary anterior WSLs after three years of fixed orthodontic therapy. After proper isolation, Icon® resin infiltration was performed using repeated acid etching and infiltration cycles adapted to the depth and severity of each lesion. Immediate aesthetic improvement of approximately 80% was observed, with full enamel rehydration and complete visual integration with surrounding sound enamel at the one-month follow-up. The patient was advised on oral hygiene and dietary precautions to maintain results.

Discussion: Resin infiltration acts by matching the refractive index of enamel, reducing light scattering, and reinforcing demineralized enamel mechanically. It also decreases surface roughness, limits plaque retention, and inhibits lesion progression. Compared to remineralization, bleaching, or microabrasion, Icon® infiltration preserves enamel structure while achieving both immediate and long-term aesthetic improvement. Its potential cariostatic and mechanical benefits make it a reliable, conservative, and microinvasive solution for post-orthodontic WSLs management.

Keywords: White spot lesion, Resin infiltration, Post-orthodontic, Enamel demineralization, Icon®

Introduction

Multibracket appliance (MBA) has been established as a standard orthodontic treatment. One side effect of this treatment is that iatrogenic plaque retention sites are created, leading to increased accumulation of pathogenic biofilms in the area adjacent to the appliances. In addition to plaque-induced gingivitis, this can lead to carious white spot lesions (WSL). The prevention of WSL during orthodontic treatment with MBA is of paramount importance to orthodontists, as up to 40% of orthodontic patients, or even twice as many (79.3%) as recently reported in an academic setting, may develop WSL during the first six months of treatment [1].

With the maintenance of these conditions, the formation of WSLs is attributed to the loss of minerals caused by organic acids produced by pathogenic bacteria, which dissolve calcium and phosphate ions from the enamel. This process may or may not be reversible through remineralization. [2] [4].

If the demineralization process is not stopped, the intact enamel surface eventually collapses and cavitates. These lesions are characterized by a white, chalky, opaque appearance and are commonly located in pits, fissures, and smooth surfaces of teeth. However, after the placement of fixed orthodontic appliances, there is an increasing number of plaque retention sites due to the presence of brackets, bands, wires and other applications, which make oral hygiene more difficult and limit naturally occurring self-cleansing mechanisms. [2].

WSL exhibit a decrease in mineral density and mechanical properties of the affected enamel, along with changes in molecular composition and surface microstructure. Compared to healthy enamel, the whiter appearance results from strong light scattering within the lesion. This is essentially because the mineral particles in the lesion are surrounded by water instead of mineral-rich enamel. The higher water content in lesions creates significant differences, resulting in shorter photon paths, reduced absorption, and lower transparency. This increased light absorption is mainly due to the increased variation in refractive index between the lesion substance and its surroundings. [1].

When teeth are dried, saliva is replaced with air (RI = 1.0) within the WSL porosities. The difference in RI between air and hydroxyapatite is wider than that between saliva and hydroxyapatite, making the WSL more evident in dehydrated teeth. [5].

Current minimally invasive concepts in Operative Dentistry are focused on the control of the etiological factors using noninvasive and microinvasive strategies. While noninvasive strategies aim at arresting or reverting non-cavitated enamel caries lesions, microinvasive strategies include barriers that prevent further dissolution of enamel by the acidic challenge from cariogenic bacteria. [5].

The treatment of the WSLs depends on its severity. The mild forms of WSLs can be left to natural remineralization which occurs over a period of 1 year and through other means such as CPP-ACP and fluoride var nishes. The moderate and severe forms can be treated using bleaching, microabrasion, resin infiltration and restorations. [3].

The ability of replacing air in the demineralized enamel of WSLs with a material with an RI similar to that of hydroxyapatite, such as a methacrylate resin, has been shown to mask the WSL by preventing light from scattering inside the WSL. In addition, filling the porosities with an adhesive resin reinforces the unsupported enamel crystallites in the body of the WSL. This reinforced enamel becomes mechanically stronger and more resistant to acid dissolution. [5].

With Icon® resin infiltration (DMG America, Engle wood, NJ, USA), its acid etchant—15% hydrochloric acid—removes the surface layer of the decalcified area due to its penetration depth of 58 ±37µm. This opens up access to the body of the lesion which allows the resin to occlude the pores. The body of the lesion is rendered watertight by means of the resin which has a refractive index (RI Icon® = 1.44) close to that of healthy enamel (RI=1.63) and also helps in stopping the diffusion of acids by creating a barrier within the lesion and not on the surface. [3].

Clinical Observation

A 23-year-old female patient, in good general health, presented to the Department of Conservative Dentistry and Endodontics at the Dental Clinic of Monastir (Tunisia) for the management of white spot lesions located on the anterior maxillary teeth. These lesions were a source of aesthetic concern and negatively affected her social confidence.

The patient reported having undergone orthodontic treatment with fixed appliances for three years. Despite maintaining regular toothbrushing during this period, she developed white spot lesions on the enamel surfaces of her anterior teeth.

Clinical examination revealed white spot lesions on the vestibular surfaces of the central incisors, the incisal edges of the lateral incisors, as well as on the cuspal tips of the canines and premolars.

A transillumination test performed using a cordless LED light-curing unit (B-WOODPECKER) showed mixed lesion boundaries on the central incisors, indicating both superficial and deep enamel involvement, whereas the other lesions displayed well-defined margins, characteristic of superficial demineralization.

Before initiating the treatment, a rubber dam was placed to ensure optimal isolation of the operative field. In addition, a light-cured gingival barrier (OpalDam, Ultradent) was applied to protect the gingival tissues and prevent possible injury from the etching gel.

The treatment was carried out using the resin infiltration technique (Icon Vestibular, DMG) following this protocol:

Application of ICON Etch for 2 minutes, followed by rinsing and drying for 30 seconds, then application of ICON Dry for 30 seconds.

This sequence was repeated eight times for the central incisors due to their mixed lesion type, requiring deeper demineralization, and five times for the other teeth with superficial lesions.

Application of ICON Infiltrant for 3 minutes, dispersion for 40 seconds, and flossing to remove excess material, followed by light curing for 40 seconds.

A second application of ICON Infiltrant was then performed for 1 minute, followed by light curing for 40 seconds, in order to compensate for the slight polymerization shrinkage of the resin during the first application and ensure optimal penetration of the infiltrant.

Finally, surface polishing was carried out to restore smoothness and gloss.

Immediately after the first session, the aesthetic outcome showed an approximately 80% reduction in the white spot lesions. This partial improvement was attributed to the temporary dehydration of the enamel, which may initially exaggerate the opacity of the treated surfaces.

During a one-month follow-up period, the patient was advised to maintain proper oral hygiene and adhere to dietary recommendations, specifically avoiding foods and beverages containing strong pigments or colorants. The patient was also instructed to use a fluoridated mouthwash (Orthokare®, Stoderma) containing 1450 ppm fluoride on a daily basis.

At the one-month control appointment, complete rehydration of the enamel was observed, resulting in a 100% aesthetic improvement and full blending of the treated areas with the surrounding sound enamel

Fig1. Clinical preoperative view – Post-orthodontic white spots on the upper anterior region and premolar areas

Fig2. Clinical preoperative view – Post-orthodontic white spots on the right premolar region

Fig3. Clinical preoperative view – Post-orthodontic white spots on the left premolar region

Fig4. Transillumination used to detect lesion depth

Fig5. Placement of the rubber dam and a light-cured gingival barrier

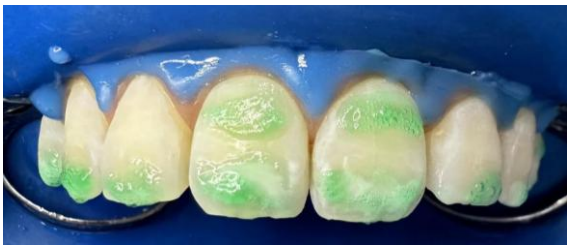

Fig6. Etching: Application of ICON-Etch for 2 minutes

Fig7. Application of Icon-Dry for 30 seconds to visualize the lesion aspect after treatment

Fig 8 et 9. Repetition of the operative protocol: 8 cycles for central incisors and 5 cycles for lateral, canine, and premolar teeth + control of substance loss

Fig10. First application of Icon-Infiltrant: Application time 3 minutes followed by light-curing for 40 seconds

Fig11. Second application of Icon-Infiltrant: Application time 1 minute followed by light-curing for 40 seconds

Fig12. Result after finishing and polishing

Fig13. One-month follow-up

Discussion

1. Mechanism and optical properties of resin infiltration

The resin infiltration technique represents one of the most important advances in minimally invasive dentistry for managing post-orthodontic white spot lesions (WSLs). The aesthetic improvement achieved after Icon® application is immediate and remarkable. The infiltrant, which consists mainly of low-viscosity tetraethylene glycol dimethacrylate (TEGDMA), penetrates the porous lesion body after surface conditioning with 15% hydrochloric acid. This etching process removes the superficial hypermineralized layer and opens access to the subsurface body of the lesion, allowing the resin to fill the porosities and create a barrier against acid diffusion [3,5]. This optical blending effect, often referred to as the “chameleon effect,” restores the visual uniformity of the enamel surface without altering the surrounding structure [7].

2. Immediate and long-term aesthetic outcomes

Several studies have confirmed that Icon® infiltration provides immediate and durable aesthetic improvements. In mild cases of WSLs, the treated enamel achieves a color and translucency similar to adjacent sound enamel, maintaining stability up to 24 months post-treatment [3]. In moderate lesions, the improvement continues progressively over time, reflecting a gradual homogenization of the optical properties between the lesion and healthy enamel [3]. In vitro fluorescence studies further support these findings, showing that resin infiltration restores fluorescence intensity to near-baseline levels and maintains it over several weeks [3]. Collectively, these outcomes establish Icon® resin infiltration as a gold standard in the minimally invasive aesthetic restoration of WSLs.

3. Mechanical reinforcement and structural recovery

The microinvasive principle behind Icon® also reinforces enamel structurally. By penetrating and filling demineralized zones, the resin provides mechanical support to the weakened enamel crystallites, enhancing resistance to further acid dissolution and improving the overall hardness of the treated surface [5]. Although microhardness values after infiltration do not fully reach those of sound enamel, the significant improvement indicates partial recovery of enamel mechanical integrity [6]. The slight discrepancy may result from incomplete infiltration of deeper regions or polymerization shrinkage, which can leave microvoids in certain areas [6]. Furthermore, the TEGDMA monomer's relatively low mechanical strength, due to the absence of aromatic rings and weaker intermolecular bonding, contributes to this difference [6]. Nevertheless, the infiltration process still confers substantial reinforcement compared to untreated lesions.

4. Impact of resin infiltration on enamel roughness and plaque retention

Surface roughness is another critical parameter influencing both aesthetics and plaque retention. Studies have reported that Icon® infiltration significantly reduces surface roughness of demineralized enamel, leading to a smoother surface that more closely resembles sound enamel [6,7]. However, in some cases, surface roughness values do not completely return to baseline. This may be due to microscopic irregularities caused by uneven resin distribution or localized over-etching of enamel [6]. Polishing the infiltrated surface after polymerization, as demonstrated in some protocols, can further minimize roughness discrepancies and enhance the final gloss [7]. The smoother, resin-sealed surface also reduces bacterial adhesion, thereby limiting new demineralization and contributing to long-term lesion stability.

5. Interaction between bleaching and resin infiltration

The effect of bleaching in conjunction with resin infiltration has also been explored, with varying conclusions. Bleaching is a non-invasive cosmetic approach widely used to harmonize tooth color and reduce contrast between WSLs and surrounding enamel [8].

(2023), However, bleaching alone is not recommended on demineralized carious lesions because hydrogen peroxide can increase surface porosity and alter enamel microstructure [7].

When bleaching is applied after resin infiltration, the outcomes depend on the interaction between the bleaching agent and the polymerized infiltrant. Some studies indicate that bleaching can slightly suppress the smoothness achieved by infiltration, increasing surface roughness due to oxidative effects on the resin matrix [7]. Nonetheless, the color uniformity between WSLs and adjacent enamel remains unaffected, demonstrating that bleaching does not compromise the aesthetic masking achieved by Icon® [7]. These results suggest that bleaching may serve as a complementary rather than competing procedure, though its timing and sequence relative to infiltration should be carefully optimized.

6. Cariostatic potential and antimicrobial enhancement

In addition to its aesthetic and mechanical benefits, the Icon® infiltration technique has potential cariostatic properties. By occluding the diffusion pathways within the lesion, the resin limits the penetration of acids and bacteria, effectively halting lesion progression [5]. Recent research has also explored the incorporation of antimicrobial agents into resin infiltrants to further enhance this effect. Among these agents, catechins—particularly epigallocatechin-3-gallate (EGCG) from green tea—have shown promising antibacterial and anti-biofilm properties [8]. EGCG inhibits enzymes such as glucosyltransferase and alpha-amylase, reducing polysaccharide synthesis and bacterial adhesion on enamel surfaces [8]. Integrating such bioactive compounds into infiltrants could provide a dual action—cosmetic restoration and biological protection—representing a significant step forward in the management of WSLs.

7. Comparison with other minimally invasive treatments

When comparing resin infiltration with other minimally invasive techniques such as microabrasion, bleaching, or remineralization with fluoride and calcium phosphate pastes, Icon® offers a unique combination of advantages. While remineralization therapies primarily aim to restore mineral content, they often fail to fully eliminate the white opaque appearance, as they do not modify the refractive index of the lesion [4,6]. Microabrasion can improve superficial defects but involves irreversible enamel loss and is less effective for deeper lesions [6]. In contrast, Icon® infiltration preserves enamel structure while achieving both aesthetic and functional recovery [3,5].

Conclusion

In summary, resin infiltration with Icon® effectively bridges the gap between purely preventive and restorative treatments. It combines the advantages of minimal invasiveness, optical masking, structural reinforcement, and caries prevention. Despite minor limitations—such as partial recovery of microhardness or variability in surface roughness—current evidence supports its clinical efficacy and durability. Future developments, such as the incorporation of antimicrobial or bioactive agents, could further enhance its protective capacity and make Icon® not only an aesthetic solution but also a preventive tool in caries management

References

1 **Kashash Y, Hein S, Göstemeyer G, Aslanalp P, Weyland MI, Bartzela T.** Resin infiltration versus fluoride varnish for visual improvement of white spot lesions during multibracket treatment: A randomized-controlled clinical trial. *PubMed.* 2024 May 11;28(6):308.

2 **Paula ABP, Fernandes AR, Coelho AS, Marto CM, Ferreira MM, Caramelo F, do Vale F, Carrilho E.** Therapies for white spot lesions: A systematic review. *PubMed.* 2017 Mar;17(1):23–38.

3 **Kannan A, Padmanabhan S.** Comparative evaluation of Icon® resin infiltration and Clinpro™ XT varnish on colour and fluorescence changes of white spot lesions: A randomized controlled trial. *PubMed.* 2019 Jul 26;20(1):31.

4 **Mohamed YS, Shamel M, El Banna S.** Laser-assisted Icon and Clinpro for restoring white spot lesions: An in vitro comparative study. *Odontology.* 2024 Nov 7.

5 **Perdigão J.** Resin infiltration of enamel white spot lesions: An ultramorphological analysis. *PubMed.* 2020 Apr;32(3):317–324.

6 **Chabuk MG, Al-Shamma AMW.** Surface roughness and microhardness of enamel white spot lesions treated with different treatment methods. *ScienceDirect.* July 7, 2023.

7 **Pereira TP, Landmayer K, Iatarola BO, Vertuan M, Magalhães AC, Francisconi-Dos-Rios LF.** Bleaching as a complement to fluoride-enhanced remineralization or resin infiltration in masking white spot lesions. *PubMed.* 2024 Sep 20;32:e20240097.

8 **Jacob SE, Varghese JO, Singh S, Natarajan S, Thomas MS.** Effect of bleaching on color and surface topography of teeth with enamel caries treated with resin infiltration (ICON®) and remineralization (casein phosphopeptide–amorphous calcium phosphate). *PubMed.* 2023 Jul 28;26(4):377–382.