

Minimalistic Intervention of White Spot Lesions and Dental Fluorosis with Resin Infiltration Technique- A Report of Two Cases

RAJI VIOLA SOLOMON¹, SHANTI PRIYA², MOHAMMED ABDUL WAHED³,
PRIYANKA GOPISHETTY⁴, MALLARAPU SATHYANVESH⁵



ABSTRACT

The advances in scientific developments in dentistry have led to the emergence of innovative technologies for early diagnosis, prevention, interception and therapeutic strategies for the preservation of tooth structure loss due to carious destruction or tooth decay arresting the carious lesions in order to preserve the tooth structure loss. Minimal intervention techniques to replace, repair, and remove as little tissue as possible is gaining significant importance over traditional techniques, as the emphasis is given on the preservation of the original tooth structure. White spot lesions are a form of enamel demineralisation which usually occurs due to dental fluorosis or postorthodontic treatment, compromising the aesthetics and self-esteem of the patient. The resin infiltration technique is a reliable treatment option advocated for the treatment of white spot lesions and non cavitated carious lesions. It is a microinvasive intervention performed without drilling or sacrificing the healthy tooth structure aiming at reinforcing the demineralised enamel by filling with visible light curing resin. The rationale for the use of resin infiltration is to allow the light-activated resin to permeate into the enamel porosities by virtue of capillary action, into the treated surface of the tooth. The infiltrated resin occludes the enamel microporosities and prevents the lesion progression further as it blocks the various pathways of ingress created by the acid penetration and dissolved materials in the enamel matrix. The first case presentation highlights the successful management of white spots visible in the maxillary anterior region of a 25-year-old female patient. The second case represents the use of the resin infiltration technique to treat and eliminate yellow-brownish stains in the maxillary anterior teeth of a 23-year-old female patient. Both the patients expressed concerns about the non uniform colour and appearance of their teeth and wanted solutions to rectify the same, without any drilling or removal of the tooth surface. This article highlights the concept of resin infiltration as a minimally invasive treatment option for the management of white spot lesions as a viable solution to suit patient specific needs.

Keywords: Aesthetics, Minimal invasive dentistry, Remineralisation

CASE REPORT

Case 1

A 25-year-old female presented to the Outpatient Department of Conservative and Endodontic Dentistry, with a primary complaint of opaque dull white spots on the front surfaces of her upper teeth giving an unpleasant appearance due to its non uniform colour and shade. The patient noticed white spots on teeth 7-8 years after completion of orthodontic treatment. On oral examination, white spot lesions extending from the upper right canine to the upper left canine on the incisal edge of labial surfaces of the teeth were noted as seen in [Table/Fig-1a]. The diagnosis was confirmed by visual examination on drying the tooth surface. The patient gave a previous history of orthodontic treatment which may have contributed to the diagnosis. Various microinvasive treatment options such as vital bleaching, macroabrasion, microabrasion, resin infiltration and remineralisation strategies were outlined to the patient along with the merits and demerits of each technique. The patient opted for the resin infiltration technique due to the advantages of the technique. Written consent was obtained from the patient before the initiation of the clinical procedure.

The treatment plan and sequence of the resin infiltration for 13 to 23 are described as follows [Table/Fig-1a-i]: Isolation of the teeth were achieved by placement of a rubber dam (HYGENIC® Dental Dam Coltene Whaledent Private Limited Maharashtra, India) to displace the soft tissues and ensure a safe dry operating field. A non fluoridated prophylaxis paste (Mira-Clin P, Prophy Paste, Hager and Werken, Germany) was used to polish the surfaces of the teeth prior to the application of the etchant. The labial surface of the teeth were treated with Icon etch gel (DMG Chemisch-Pharmazeutische

Fabrik GmbH, Hamburg | Germany) which constitutes 15% of hydrochloric acid. The gel was subsequently agitated gently for two minutes using a microbrush to achieve a homogenous etching pattern. The gel was completely rinsed away with water spray for 30 second and the etched surface was examined. The superficial stains and discolourations were eliminated by the etching process. In addition, the procedure of etching helps in the superficial removal of the highly mineralised enamel surface which may allow a better diffusion of the resin infiltrant. Residual water retained within the body of the lesion was dehydrated by application of the Icon-Dry (DMG Chemisch-Pharmazeutische Fabrik GmbH, Hamburg | Germany) which constitutes 100% ethanol for 30 seconds followed by air drying [1]. After air drying, the opacity of enamel lesions were more pronounced. The freshly etched tooth surface is now ready for treatment with the resin infiltrant which composes of tetraethylene glycol dimethacrylate as its primary constituent. With the aid of a microbrush, the Icon resin was placed on the surfaces of the etched and dried teeth for five minutes in order to facilitate penetration of the infiltrant into the porous tooth substrate. Excess resin was gently removed using a small bud of cotton and the resin was light activated for a duration of 40 seconds. A dental floss was diligently used to eliminate the excess resin that seeped into the interproximal spaces. To ensure proper blockage of the porosities of the enamel the resin infiltrant can be reapplied and cured. Finally, polishing disks and rubber cups (Shofu polishing kit, SHOFUDENTALGmbh, Germany) were used to eliminate surface irregularities and roughness to impart a smooth texture which would prevent the adherence of food stains and avoid discolourations of the treated teeth. After the procedure, the patient was asked to avoid eating any stainable food items for 24 hours as part of post-treatment instructions. An improvement in

the aesthetic appearance was achieved by homogenous masking of the white spot lesions. Patient was recalled after one month to assess the treatment outcome. On clinical examination, it was observed that the resin infiltrated surfaces of the teeth showed uniform shade of colour and harmonisation with the surrounding enamel. The optical properties as well as the aesthetic camouflage effects were not altered significantly. In addition, no progression of the early carious lesion was evident, plaque accumulation or surface roughness was noted. Follow-up was carried out for 24 months [Table/Fig-1]. On recall after two years, the patient presented with a clinically favourable outcome.



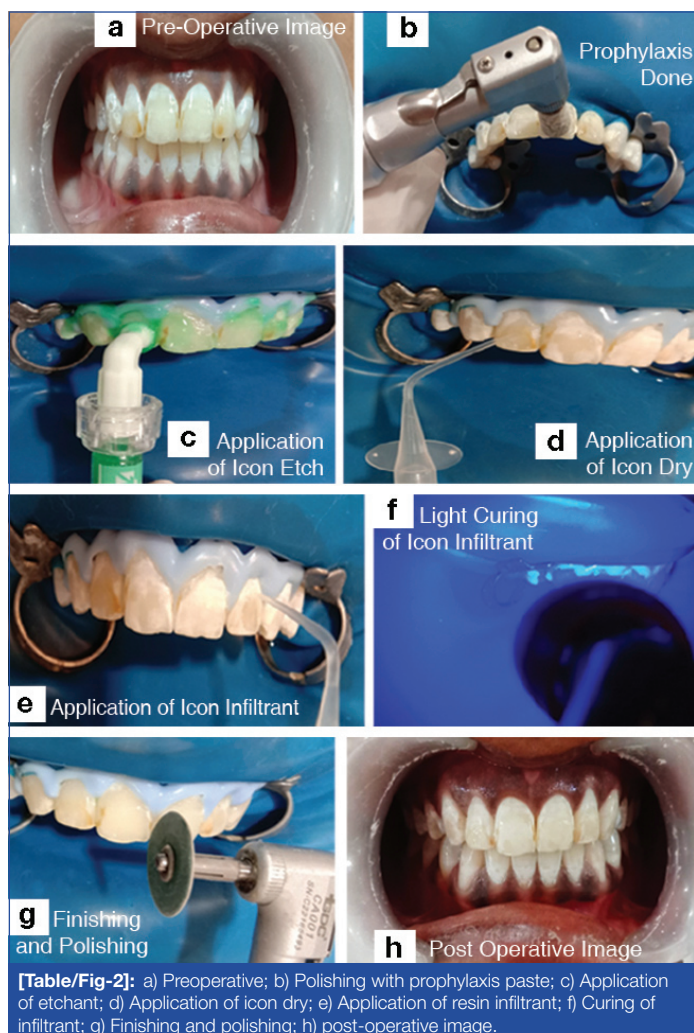
[Table/Fig-1]: a) Preoperative, white spot lesion extending from 13 to 23 on the incisal edges of the labial surfaces of the teeth; b) Polishing with prophylaxis paste; c) Application of etchant; d) Application of icon dry; e) Application of resin infiltrant; f) Curing of infiltrant; g) Finishing and polishing; h) Immediate postoperative image; i) Follow-up.

Case 2

A 23-year-old female intern at the institution, was anxious about her appearance due to the presence of yellow-brownish stains in the maxillary front teeth region, since 14 years of age. The patient gave no relevant medical history. No other contributing history of sensitivity was noted. On oral examination, mild to moderate enamel fluorosis extending from 12 to 22 as seen in the [Table/Fig-2a] [2]. On obtaining the patients' acceptance and consent

the treatment plan was finalised to incorporate resin infiltration therapy for the management of the discoloured teeth. Similar to case 1, clinical procedures i.e., etching, bonding and application of infiltrant, finishing and polishing were carried out [Table/Fig-2b-g]. Post-treatment instructions were given. The patient was recalled after one month. Clinical examination showed no discolourations suggestive of colour stability, no plaque accumulation, and no surface roughness on the surfaces of the treated teeth.

The case follow-up was performed for 24 months [Table/Fig-2h]. The two-year recall visit showed no adverse events suggesting a favourable clinical outcome.



[Table/Fig-2]: a) Preoperative; b) Polishing with prophylaxis paste; c) Application of etchant; d) Application of icon dry; e) Application of resin infiltrant; f) Curing of infiltrant; g) Finishing and polishing; h) post-operative image.

DISCUSSION

Various evidence-based literature reviews have shown the occurrence of white spot lesion from 23-95% which depends upon the method of analysis of data used [3-6]. Various authors have shown in their investigations that the frequency of occurrence of white spot lesion ranges from 72.3-84% and the extent of colour variations from mild to moderate to opaque increased by 0.125-0.200 during and after the orthodontic intervention [5,7-9]. Certain authors suggest a greater increase in the severity of enamel opacities in male patients over the females, however researchers have identified other risk factors such as poor oral hygiene, exceeded duration of orthodontic time, pre-existing developmental enamel defects contributing to an increase in the prevalence of white spot lesion [4,8,9]. The ultimate goal in managing a discoloured tooth is to achieve an aesthetically pleasing outcome as minimally invasive as feasible [10]. Common methods for enhancing the colour and aesthetic stability of white opaque lesions are remineralisation regimens, microabrasion and tooth bleaching [11]. Remineralisation can be considered the first treatment approach to correct a white spot lesion. Remineralisation can be considered as the first treatment approach to correct a white spot lesion. An early caries lesion can partially heal as a result of the incorporation of various

remineralising agents, which will arrest the further progression of the lesion [12]. Willmote D, concluded the use of fluoridated intraoral agents after the orthodontic treatment helped in reducing the size of white spot lesion to nearly 50% of its original lesion size. They also observed a gradual reduction in the lesion size to one-third after a duration of three months and a further reduction to half after 26 weeks. They concluded that lesion remineralisation occurs gradually over a period of time and the mineralisation of the subsurface defects is slowly achieved [12].

Microabrasion was considered to be the other viable conservative and effective treatment approach [13]. But it results in loss of enamel surface as reported by Tong LS et al., that about 360 µm of enamel was eroded with enamel microabrasion [14].

The alternative approach to treat such cases was Resin Infiltration (RI) technique which is a microinvasive method. This ultraconservative restorative approach improves the appearance of the teeth without much loss of healthy tissue. There is also no need to drill into the enamel surface or alter its morphology with a cutting bur. With this technique, due to the use of a chemical agent, only 30-40 µm enamel was eroded as reported by Meyer-Lueckel H et al., [15]. The RI technique is a minimal invasive aesthetic treatment used to mask the unesthetic spots in which microporosities in the lesion body were occluded by low viscosity light curing resin.

Meyer-Lueckel H et al., have reported that composite matrix material strengthened with increased content of Triethylene Glycol Dimethacrylate (TEGDMA) shows superior arrest of the development of the white spot defect when compared to Bisphenol A-Glycidyl Methacrylate (Bis-GMA) incorporated resin matrix material [15]. This is because of the better penetrating capabilities of TEGDMA after the application of ethanol. They have also reported that 15% hydrochloric acid gel has a better erosion of surface when compared to 37% phosphoric acid gel [16].

The two main objectives of this technique include- first is to arrest the progression of the lesion by occluding the porosities which serve as dispersion routes for different acids and minerals and this also prevents any further entry of bacterial invasion [16,17]. Second, it aids in concealing the lesion. The principle involved in masking the lesion depends on the difference in the reflection properties of the light when scattered inside the lesion, enamel has a refractive index of 1.62 but in presence of lesions, the pores are filled with air or water which have a refractive index of 1.0 and 1.33 respectively. The lesions that have been treated with resin have microporosities that have a refractive index of 1.46. As a result, there is a negligible variation between the refractive indices of enamel and resin infiltrated white spots making them less opaque in appearance. Therefore, variation in the refractive index of the surrounding enamel to that of the resin infiltrated lesion is negligible and this helps in masking the lesion [18-20]. Moreover, this technique blocks the lesion porosities mainly within its core with minimal effect on its superficial surface [20]. According to Robinson C and Hallsworth AS, the RI had occupied around 60±10% of the lesion's size and volume [21]. Kielbassa AM and Gernhardt CR, claim that the Icon infiltrates more than 100 µm deep producing resin infiltrated areas within the lesion [22].

Experimental in vitro research showed that RI increased lesion surface microhardness and resistance to further demineralisation [23]. Arslan S and Kaplan MH, conducted a study to analyse the impact of RI on the proximal smooth surface defects and concluded that using the RI technique for these defects is effective in reducing lesion progression [24].

Lee J et al., conducted a study on evaluation of stain penetration by beverages in demineralised enamel treated with RI and concluded that the stain penetration depth into artificially-induced carious

lesions infiltrated with Icon were lower than in demineralised yet untreated lesions [25].

In a study undertaken by Auschill TM et al., the aesthetic improvement of mild to moderate fluorosis using RI technique with a six months follow-up period was analysed. They concluded that RI is a more compliant treatment option compared to destructive, traditional methods. To ascertain the efficacy of this method further clinical studies with a long duration of follow-up are required [26]. Cazzolla AP et al., have evaluated the effectiveness of icon infiltration resin in treating postorthodontic white WSLs and concluded that the effects were aesthetically satisfactory over a time frame of three months, six months, one year and upto four years [27].

Results of the case reports discussed here showed favourable clinical follow-up periods of two years. Both the patients treated with RI technique, presented with aesthetically positive results, satisfactory clinical outcomes and they are still under periodic observation and recall.

Though, the RI technique is a minimally invasive treatment option for treating white spot lesions, it has certain drawbacks such as the depth of penetration of resin and availability of the resin in a single shade [28,29]. But as suggested by Mabrouk R et al., opaque spots resemble the intact tooth structure around them following icon penetration improving the aesthetic appearance [28]. Kugel GG et al., advocated that resin penetration has a chameleon effect when treated with resin infiltration therapy making the white spots lose their cloudy appearance and camouflage naturally with the enamel and hence may not require shade matching [29].

Clinical success is directly related to diagnosis, intervention and accurate management. Therefore, caution should be taken for proper diagnosis and case selection. RI being minimally invasive can serve as an intermediate long-term treatment modality between preventive and restorative therapy. The RI technique have many advantages like conservation and maintenance of sound hard tooth substance, inhibition of lesion progression, mechanical stabilisation of demineralised enamel, permanent seal of micropores, and deeply demineralised areas, and high patient acceptance [25].

CONCLUSION(S)

The two original case reports have a favourable follow-up period and demonstrated that the resin infiltration technique serves as an ultraconservative viable treatment modality to treat unaesthetic spots on teeth and is a great boon to aesthetic dentistry. However, further long-term clinical trials are needed to confirm the efficacy of this technique.

REFERENCES

- [1] Muñoz MA, Arana Gordillo LA, Gomes GM, Gomes OM, Bombarda NH, Reis A, et al. Alternative esthetic management of fluorosis and hypoplasia stains: Blending effect obtained with resin infiltration techniques. *J Esthet Restor Dent.* 2013;25(1):32-39.
- [2] Baskaradoss JK, Clement RB, Narayanan A. Prevalence of dental fluorosis and associated risk factors in 11-15 year old school children of Kanyakumari District, Tamilnadu, India: A cross sectional survey. *Indian J Dent Res.* 2008;19:297-03.
- [3] Tufekci E, Dixon JS, Gunsolley JC, Lindauer SJ. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod.* 2011;81:206-10.
- [4] Julien KC, Buschang PH, Campbell PM. Prevalence of white spot lesion formation during orthodontic treatment. *Angle Orthod.* 2013;83:641-47.
- [5] Khalaf K. Factors affecting the formation, severity and location of white spot lesions during orthodontic treatment with fixed appliances. *J Oral Maxillofac Res.* 2014;5(1):e4.
- [6] Richter AE, Arruda AO, Peters MC, Sohn W. Incidence of caries lesions among patients treated with comprehensive orthodontics. *Am J Orthod Dentofacial Orthop.* 2011;139:657-64.
- [7] Artun J, Brobakken BO. Prevalence of carious white spots after orthodontic treatment with multibonded appliances. *Eur J Orthod.* 1986;8:229-34.
- [8] Boersma JG, van der Veen MH, Lagerweij MD, Bokhout B, Prahland-Andersen B. Caries prevalence measured with QLF after treatment; with fixed orthodontic appliances: Influencing factors. *Caries Res.* 2005;39:41-47.
- [9] Tufekci E, Dixon JS, Gunsolley JC, Lindauer SJ. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod.* 2011;2:206-10.

- [10] Gugnani N, Pandit IK, Goyal V, Gugnani S, Sharma J, Dogra S. Esthetic improvement of white spot lesions and non-pitted fluorosis using resin infiltration technique: Series of four clinical cases. *J Indian Soc Pedod Prev Dent.* 2014;32(2):176-80.
- [11] Khoroushi M, Kachuie M. Prevention and treatment of white spot lesions in orthodontic patients. *Contemp Clin Dent.* 2017;8(1):11-19.
- [12] Willmot D. White lesions after orthodontic treatment: Does low fluoride make a difference? *J Orthod.* 2004;31(3):235-42; discussion 202.
- [13] Pini NI, Sundfeld-Neto D, Aguiar FH, Sundfeld RH, Martins LR, Locadino JR, et al. Enamel microabrasion: An overview of clinical and scientific considerations. *World J Clin Cases.* 2015;3(1):34-41.
- [14] Tong LS, Pang MK, Mok NY, King NM, Wei SH. The effects of etching, micro-abrasion, and bleaching on surface enamel. *J Dent Res.* 1993;72:67-71.
- [15] Meyer-Lueckel H, Paris S, Kielbassa AM. Surface layer erosion of natural caries lesions with phosphoric and hydrochloric acid gels. *Caries Res.* 2007;41:223-30.
- [16] Meyer-Lueckel H, Paris S. Improved resin infiltration of natural caries lesion. *J Dent Res.* 2008;87(12):1112-16.
- [17] Shivanna V, Shivakumar B. Novel treatment of white spot lesions: A report of two cases. *J Conserv Dent.* 2011;14:423-26.
- [18] Leon A, Caraiane A, Buştiuc SG, Sin CE, Raftu G. micro-invasive aesthetic treatment of non-cavitated white-spot lesions. *Romanian Journal of Oral Rehabilitation.* 2019;11(1):96-100.
- [19] Meyer-Lueckel H, Paris S. Progression of artificial enamel caries lesions after infiltration with experimental light curing resins. *Caries Res.* 2008;42:117-24.
- [20] Son JH, Hur B, Kim HC, Park JK. Management of white spots: Resin infiltration technique and microabrasion. *Journal of Korean Academy of Conservative Dentistry.* 2011;36(1):66-71.
- [21] Robinson C, Hallsworth AS. Arrest and control of carious lesions: A study based on preliminary experiments with resorcinol-formaldehyde resin. *J Dent Res.* 1976;55(5):812-18.
- [22] Kielbassa AM, 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(8):663-81.
- [23] Yazkan B, Ermis RB. Effect of resin infiltration and micro abrasion on the microhardness, surface roughness and morphology of incipient carious lesions. *Acta Odontologica Scandinavica.* 2018;76(7):473-81.
- [24] Arslan S, Kaplan MH. The effect of resin infiltration on the progression of proximal caries lesions: A randomised clinical trial. *Med Princ Pract.* 2020;29(3):238-43.
- [25] Lee J, Chen JW, Omar S, Kwan SR, Meharry M. Evaluation of stain penetration by beverages in demineralised enamel treated with resin infiltration. *Oper Dent.* 2016;41(1):93-02.
- [26] Ausschill TM, KE Schmidt, NB Arweiler. Resin Infiltration for aesthetic improvement of mild to moderate fluorosis: A six-month follow-up case report. *Oral Health Prev Dent.* 2015;13(4):317-22.
- [27] Cazzolla AP, De Franco AR, Lacaita M, Lacarbonara V. Efficacy of 4-year treatment of icon infiltration resin on postorthodontic white spot lesions. *Case Reports.* 2018;2018:bcr-2018.
- [28] Mabrouk R, Yahia S, Oueslati A, Frih N. Erosion Infiltration in the Management of Molar-Incisor Hypo mineralisation (MIH) defects. *Case Reports in Dentistry.* 2020;2020.
- [29] Kugel GG, Arsenaul P, Papas AA. Treatment modalities for caries management, including a new resin infiltration system. *Compendium.* 2009;30:01-10.

PARTICULARS OF CONTRIBUTORS:

1. Professor, Department of Conservative Dentistry and Endodontics, Panineeya Institute of Dental Sciences and Research Centre, KNR University of Health Sciences, Telang, Hyderabad, Telangana, India.
2. Reader, Department of Conservative Dentistry and Endodontics, Panineeya Institute of Dental Sciences and Research Centre, KNR University of Health Sciences, Telang, Hyderabad, Telangana, India.
3. Senior Lecturer, Department of Conservative Dentistry and Endodontics, Panineeya Institute of Dental Sciences and Research Centre, KNR University of Health Sciences, Telang, Hyderabad, Telangana, India.
4. Postgraduate Student, Department of Conservative Dentistry and Endodontics, Panineeya Institute of Dental Sciences and Research Centre, KNR University of Health Sciences, Telang, Hyderabad, Telangana, India.
5. Postgraduate Student, Department of Conservative Dentistry and Endodontics, Panineeya Institute of Dental Sciences and Research Centre, KNR University of Health Sciences, Telang, Hyderabad, Telangana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:

Raji Viola Solomon,
Professor, Department of Conservative Dentistry and Endodontics, Panineeya
Institute of Dental Sciences, Kamala Nagar, Road Number 5, VR Colony, Kothapet,
Hyderabad-500060, Telangana, India.
E-mail: dr.viola@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]

- Plagiarism X-checker: Mar 14, 2022
- Manual Googling: May 11, 2022
- iThenticate Software: Jul 20, 2022 (16%)

ETYMOLOGY: Author Origin

AUTHOR DECLARATION:

- Financial or Other Competing Interests: None
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Mar 09, 2022**

Date of Peer Review: **Mar 29, 2022**

Date of Acceptance: **May 13, 2022**

Date of Publishing: **Aug 01, 2022**