

Management of post-orthodontic White-Spot-Lesions: Clinical Handling of the Resin Infiltration Technique (Icon[®], DMG)

Manejo de Lesiones de Manchas Blancas Post-Ortodoncia: Manejo
Clínico de la Técnica de Infiltración de Resina (Icon, DMG)

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ABSTRACT: To treat initial caries lesions using the technique of resin infiltration for a restoration of natural enamel appearance. Case report of a 19 year old female who presented with moderate post-orthodontic white-spot lesions (WSLs) at the upper central and lateral incisors following two years of active treatment with a fixed orthodontic appliance, and requested an aesthetic improvement of decalcified enamel surfaces. The technique of resin infiltration (Icon[®], DMG, Hamburg, Germany) is presented as a means for not only inhibiting lesion progression, but also for an adequate rehabilitation of dentofacial esthetics. Practical tips and cues for clinical handling of the infiltration technique are provided. Resin infiltration augments the therapeutic spectrum for orthodontist as well as pediatric or general dentists in that enamel areas affected by post-orthodontic WSLs can be restored to their original appearance.

KEY WORDS: white spot lesion, resin infiltration, Icon, camouflage effect.

INTRODUCTION

The use of fixed orthodontic appliances enables orthodontists to correct malocclusions in an efficient and cost-effective way. However, a typical down-side is the formation of white spot lesions (WSL) and incipient caries. WSL accrument has been reported to occur in up to 73 % (Richter *et al.*, 2011) of subjects treated with fixed orthodontic appliances. In most cases, this is due to oral hygiene being aggravated in presence of brackets and orthodontic wires (Bishara & Ostby, 2008; Heyman & Grauer, 2013) (Fig. 1). Not inhibiting early decalcification may result in progression to carious lesions, and WSLs may present esthetic problems, especially in the esthetically relevant incisor and canine area (Bishara & Ostby; Knösel *et al.*, 2013). WSL formation may occur within a time period of only a few weeks (Ogaard *et al.*, 1988; Melrose *et al.*, 1996),

and especially the first six months in treatment are requiring the orthodontist's attention (Tufekci *et al.*, 2011). While preventive strategies such as the use of fluoride-releasing sealers, or daily rinsing with sodium fluoride mouth rinse (Benson *et al.*, 2004, 2013; Ogaard *et al.*, 2001) are helpful in reducing frequencies and severities of WSLs, decalcification in orthodontic patients still presents a problem. Restorative measures for enamel lesion therapy should be restricted to cases of cavitations, while non-cavitated lesions should receive preventive therapy aimed at arresting and remineralizing the lesion (Stahl & Zandona, 2007).

Other than being an initial stage of enamel caries that may progress to a stage of cavitation in situations of ongoing suboptimal oral hygiene, many

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patients feel their dentofacial appearance to be impaired by WSLs in anterior teeth (Bishara & Ostby; Knösel *et al.*, 2007; Heyman & Grauer). Even if the surfaces of WSLs are smoothed and hardened under the influence of unimpeded brushing and provision of local fluoridation following bracket removal, these pseudo-intact enamel surface do not improve the appearance of WSL (Shungin *et al.*, 2010) (Fig. 2). WSLs are visible as they are scattering light, instead of reflecting it, as is the case with sound enamel. The technique of WSL infiltration using low-viscosity light-curing resins (infiltrants) has been established as a new way of not only stopping or reducing progression of lesions (Tinanoff *et al.*, 2015; Doméjean *et al.*, 2015): Both long-time screening by RCTs and subsequent follow-ups, as well as case reports and in vitro research indicate a reduced visibility of infiltrated white-spot-lesions, as an additional positive side-effect, which is due to the similar refractive index of the infiltrant and sound enamel areas (Paris & Meyer-Lueckel, 2009; Neuhaus *et al.*, 2010; Rocha Gomes Torres *et al.*, 2011).

CASE REPORT

This is a report of a case of a female aged 19 years. She presented with mild to moderate post-orthodontic WSLs at the upper central and lateral incisors (Fig. 3A–C) following treatment with fixed a orthodontic appliance at the Department of Orthodontics, Universidad de La Frontera (UFRO), Temuco. As the esthetic aspect was in the scope of WSL treatment here, infiltration treatment was planned to restore the dentofacial esthetics, instead of only remineralising enamel surfaces. Infiltration treatment was performed one month following debonding. As it is known from previous reports on the subject,



Fig. 1. Fixed orthodontic appliances often impede adequate oral hygiene measures, especially in pre-adolescents and adolescents.

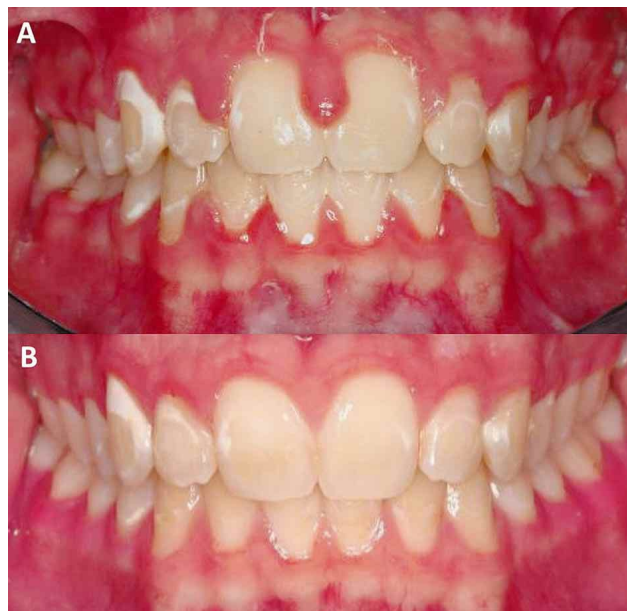


Fig. 2. Untreated WSL do hardly improve in appearance. This case depicts a situation with post-orthodontic WSLs and characteristic hyperplastic, swollen gingiva directly following de-bonding (A), as well as fifteen months later. Treatment was by tooth brushing and fluoridation, only (B).

frequencies of etching intervals needed to be adapted to the depth of the WSLs. That is, deeper seated or remineralised lesions with pseudo-intact enamel surface may require higher numbers of etching intervals (Knösel *et al.*, 2013). In this case, etching has been repeated three times (Fig. 3D). Further details on the treatment routine are provided by Figures 3A–I, with corresponding caption. Following infiltration, the enamel appearance has been re-established, and the patient was satisfied with the appearance of her teeth.

DISCUSSION

The use of fixed orthodontics requires the orthodontist to take the responsibility to inform the patient about potential side-effects of the treatment, such as WSLs. It moreover requires the necessity and capability to provide an adequate prophylaxis regime, as well as a valid strategy to treat WSLs present in spite of prophylactic measures taken.

Clinical handling of deeper seated lesions. In the present case, WSL infiltration has been performed at an almost ideal point in time, which is closely following to the appointment of de-bonding. It is known that

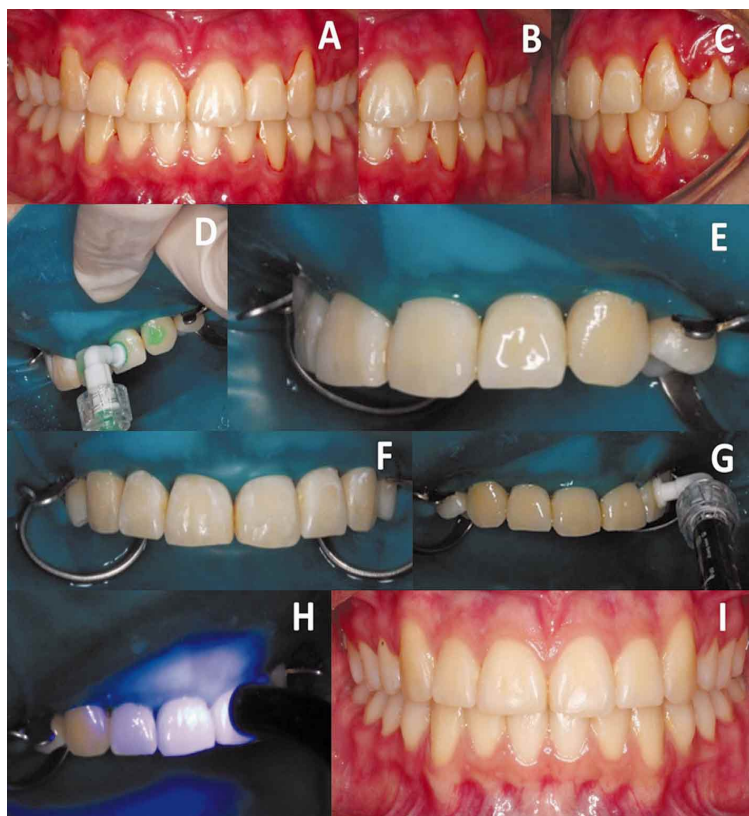


Fig. 3 A-I) Post-orthodontic situation with WSL: This case presented with mild to moderate post-orthodontic WSLs at the upper central and lateral incisors (A-C) following treatment with a fixed orthodontic appliance at the Department of Orthodontics, Universidad de La Frontera (UFRO), Temuco. Infiltration treatment was performed one month following debonding. Rubberdam was used here for gingival isolation, however, liquid dam would also be an option. Following thorough cleaning of enamel surfaces, the ICON-Etch gel (15 % HCl as supplied) was applied to the WSLs, and left on for 2 min. In this case, etching was repeated three times. In order to enable the infiltrant to deeply penetrate the WSL, ICON-Dry solution as supplied by an extra syringe was applied; it consists of 99 % ethanol and provides the additional option of giving a preview of the final esthetic outcome; if still some spots are visible at this time, an additional etching interval should be implemented. Following, the ICON-Infiltrant is applied, material in excess is removed using a cotton roll, and left on for three minutes prior to light curing. The treatment cycle ends with an additional application of the infiltrant, it is left on for one minute, light-cured again. Finally, enamel surfaces are polished and potential infiltrant residuals are being removed.

remineralisation and surface abrasion by tooth brushing after debonding hardens and smoothens porous WSL surfaces, thereby contributing to a reduction in the visibility of WSL (Backer Dirks, 1966; Fejerskov & Kidd, 2003; Holmen *et al.*, 1987). Moreover, WSLs in the present case have been moderate in expression, and both of these factors are known to be the basic conditions for highly esthetic treatment outcomes (Knösel *et al.*,

2013; Eckstein *et al.*, 2015). Infiltration of fresh and more superficial lesions have been reported to be much easier compared to older, deeper-seated lesions with thicker pseudo-intact surface layers (Knösel *et al.*, 2013; Eckstein *et al.*). The latter require several repetitions of etching intervals; the same seems to hold true for infiltration of brown spots (Knösel *et al.*, 2013; Eckstein *et al.*; Neuhaus *et al.*). In order to facilitate infiltration and improve the esthetic outcomes, the time elapse between debonding and infiltration should be as short as possible, in order to prevent remineralisation and hardening of surfaces by daily tooth brushing (Wiegand *et al.*, 2007).

Although also older lesions and brown enamel spots improve in appearance, it is highly recommended to inform patients in advance about the influence of those factors on treatment outcomes, in order to enable efficient logistics in terms of timely appointments following bracket removal, and also in order to avoid disappointment or exaggerated expectations in the case of deeper seated WSLs, or brown spots (Kim *et al.*, 2011). Basically, a removal of brackets ahead of schedule needs to be considered in some cases; however, additional costs for debonding and rebonding of brackets may incur, if treatment is to be continued following infiltration. However, technically, re-bonding of brackets to infiltrated enamel can be achieved easily, due to the adequate adhesion of composites to infiltrants (Wiegand *et al.*, 2011)

Durability of esthetic results. Several authors provided clinical data on short-term esthetic effects of WSL infiltration. Mostly, they found that a majority of WSLs were satisfactorily disguised, while some others were still noticeable (Kim *et al.*). Knösel *et al.* performed a split-mouth controlled RCT on the subject of the durability of the achieved esthetic effects of WSL infiltration. They found that there was an assimilation of WSL color to surrounding enamel following infiltration that was color stable, without significant changes over at least 12 months (Knösel *et al.*, 2013; Eckstein *et al.*).

CONCLUSIONS

The esthetic appearance of post-orthodontic WSLs is improved by resin infiltration.

Older and deeper-seated lesions require higher numbers of conditioning intervals, and so do brown enamel spots.

The best results are experienced with infiltration of mild to moderate white-spot lesions directly or closely following the appointment of debonding.

A crucial step in the treatment of post-orthodontic WSLs is to inform the patients or their parents early and during fixed orthodontic treatment, in order to enable adequate logistic steps.

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RESUMEN: El objetivo fue mostrar el tratamiento de lesiones de caries iniciales usando la técnica de infiltración de resina para una restauración de la apariencia natural del esmalte. Reporte de caso de una joven de 19 años de edad, de sexo femenino que presentó lesiones moderadas de manchas blancas (WSLs) en los incisivos centrales y laterales superiores, luego del tratamiento de ortodoncia con aparatos fijos por dos años, y solicitó una mejoría estética de las superficies descalcificadas del esmalte. La técnica de infiltración de resina (Icon®, DMG, Hamburgo, Alemania) se presenta como un medio efectivo, no sólo para inhibir la progresión de la lesión, sino también para una rehabilitación adecuada de la estética dentofacial. Se proporcionan además consejos prácticos y claves para el manejo clínico de la técnica de infiltración. La infiltración de resina aumenta el espectro terapéutico del ortodoncista, así como de odontopediatras y odontólogos generales en las áreas del esmalte afectadas con WSLs post-ortodoncia y que pueden ser restauradas a su apariencia original.

PALABRAS CLAVE: lesión de mancha blanca, infiltración de resina, Icon®, efecto camuflaje.

REFERENCES

Backer Dirks, O. The clinical testing of agents for the prevention of dental caries. *Adv. Fluorine Res.*, 4:1-2, 1966.

Benson, P. E.; Parkin, N.; Millett, D. T.; Dyer, F. E.; Vine, S. & Shah, A. Fluorides for the prevention of white spots on teeth during fixed brace treatment. *Cochrane Database Syst. Rev.*, (3):CD003809, 2004.

Benson, P. E.; Parkin, N.; Dyer, F.; Millett, D. T.; Furness, S. & Germain, P. Fluorides for the prevention of early tooth decay (demineralised white lesions) during fixed brace treatment. *Cochrane Database Syst. Rev.*, 12:CD003809, 2013.

Bishara, S. E. & Ostby, A. W. White spot lesions: Formation, prevention, and treatment. *Semin. Orthod.*, 14(3):174-82, 2008.

Doméjean, S.; Ducamp, R.; Léger, S. & Holmgren, C. Resin infiltration of non-cavitated caries lesions: a systematic review. *Med. Princ. Pract.*, 24(3):216-21, 2015.

Eckstein, A.; Helms, H. J. & Knösel, M. Camouflage effects following resin infiltration of postorthodontic white-spot lesions *in vivo*: One-year follow-up. *Angle Orthod.*, 85(3):374-80, 2015.

Fejerskov, O. & Kidd, E. A. M. *Dental Caries: The Disease and Its Clinical Management*. Oxford, Blackwell Munksgaard, 2003. pp.72-97.

Heymann, G. C. & Grauer, D. A contemporary review of white spot lesions in orthodontics. *J. Esthet. Restor. Dent.*, 25(2):85-95, 2013.

Holmen, L.; Thylstrup, A. & Artun, J. Surface changes during the arrest of active enamel carious lesions *in vivo*. A scanning electron microscope study. *Acta Odontol. Scand.*, 45(6):383-90, 1987.

Kim, S.; Kim, E. Y.; Jeong, T. S. & Kim, J. W. The evaluation of resin infiltration for masking labial enamel white spot lesions. *Int. J. Paediatr. Dent.*, 21(4):241-8, 2011.

Knösel, M.; Attin, R.; Becker, K. & Attin, T. External bleaching effect on the color and luminosity of inactive white-spot lesions after fixed orthodontic appliances. *Angle Orthod.*, 77(4):646-52, 2007.

Knösel, M.; Eckstein, A. & Helms, H. J. Durability of esthetic improvement following Icon resin infiltration of multibracket-induced white spot lesions compared with no therapy over 6 months: a single-center, split-mouth, randomized clinical trial. *Am. J. Orthod. Dentofacial Orthop.*, 144(1):86-96, 2013.

Melrose, C. A.; Appleton, J. & Lovius, B. B. A scanning electron microscopic study of early enamel caries formed *in vivo* beneath orthodontic bands. *Br. J. Orthod.*, 23(1):43-7, 1996.

Neuhaus, K. W.; Graf, M.; Lussi, A. & Katsaros, C. Late infiltration of post-orthodontic white spot lesions. *J. Orofac. Orthop.*, 71(6):442-7, 2010.

Ogaard, B.; Larsson, E.; Henriksson, T.; Birkhed, D. & Bishara, S. E. Effects of combined application of antimicrobial and fluoride varnishes in orthodontic patients. *Am. J. Orthod. Dentofacial Orthop.*, 120(1):28-35, 2001.

Ogaard, B.; Rølla, G. & Arends, J. Orthodontic appliances and enamel demineralization. Part 1. Lesion development. *Am. J. Orthod. Dentofacial Orthop.*, 94(1):68-73, 1988.

Paris, S. & Meyer-Lueckel, H. Masking of labial enamel white spot lesions by resin infiltration--a clinical report. *Quintessence Int.*, 40(9):713-8, 2009.

Richter, A. E.; Arruda, A. O.; Peters, M. C. & Sohn, W. Incidence of caries lesions among patients treated with comprehensive orthodontics. *Am. J. Orthod. Dentofacial Orthop.*, 139(5):657-64, 2011.

Rocha Gomes Torres, C.; Borges, A. B.; Torres, L. M.; Gomes, I. S. & de Oliveira, R. S. Effect of caries infiltration technique and fluoride therapy on the colour masking of white spot lesions. *J. Dent.*, 39(3):202-7, 2011.

Shungin, D.; Olsson, A. I. & Persson, M. Orthodontic treatment-related white spot lesions: a 14-year prospective quantitative follow-up, including bonding material assessment. *Am. J. Orthod. Dentofacial Orthop.*, 138(2):136.e1-8, 2010.

Stahl, J. & Zandona, A. F. Rationale and protocol for the treatment of non-cavitated smooth surface carious lesions. *Gen. Dent.*, 55(2):105-11, 2007.

Tinanoff, N.; Coll, J. A.; Dhar, V.; Maas, W. R.; Chhibber, S. & Zokaei, L. Evidence-based update of pediatric dental restorative procedures: Preventive Strategies. *J. Clin. Pediatr. Dent.*, 39(3):193-7, 2015.

Tufekci, E.; Dixon, J. S.; Gunsolley, J. C. & Lindauer, S. J. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod.*, 81(2):206-10, 2011.

Wiegand, A.; Köwing, L. & Attin, T. Impact of brushing force on abrasion of acid-softened and sound enamel. *Arch. Oral Biol.*, 52(11):1043-7, 2007.

Wiegand, A.; Stawarczyk, B.; Kolakovic, M.; Hämmerle, C. H.; Attin, T. & Schmidlin, P. R. Adhesive performance of a caries infiltrant on sound and demineralised enamel. *J. Dent.*, 39(2):117-21, 2011.

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