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Minimally invasive resin infiltration of post orthodontic lesions: A Case Report.

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Abstract: The earliest evidence of demineralization on the smooth enamel surface of a crown is a white spot lesion. It is one of the most commonly encountered esthetic problems post orthodontic treatment. The conventional treatment of these white spot lesions includes topical fluoride application, improving the oral hygiene, and use of remineralizing agents. This article uses a minimally invasive novel approach to treat white spot lesions based on infiltration of enamel caries with low-viscosity light curing resins called infiltrants. This technique is a promising treatment modality for the prevention of caries progression and improving esthetics, by diminishing the opacity.

Keyword: minimally invasive dentistry, resin infiltration, white spot lesions.

INTRODUCTION

White spot lesion has been defined as a "subsurface enamel porosity from carious demineralization" that presents itself as "a milky white opacity when located on smooth surfaces"(Summitt, 2006). The white spot lesion is the first visible evidence of cavities in the enamel, characterized by a demineralized lesion underneath an intact surface(Paris *et al.*, 2013). White spot lesions develop as a result of a dietary carbohydrate and saliva modified bacterial infection, resulting in an imbalance between demineralization and remineralization of the enamel(Chang, Walsh and Freer, 1997). The lesion is caused by the accumulation of plaque and bacteria, along with insufficient oral hygiene(Loesche, 1976). Increased oral plaque accumulation can increase the risk of white-spot lesion formulation(Gorelick, Geiger and Gwinnett, 1982).

In 1966, Backer Dirks was the first to describe the (possible) remineralization of in vivo formed natural enamel lesions, so-called white spot lesions, as a normal occurrence in the oral environment(Dirks, 1966). In the natural state, natural demineralization and remineralization continually takes place(Willmot, 2004). Saliva can remineralize white spot lesions to some degree, but this process is slow and rarely results in complete resolution of the lesions(Dirks, 1966),(Karlinsey *et al.*, 2009). When left untreated, the acids keep diffusing into the porous subsurface enamel, dissociating and producing hydrogen ions(Featherstone, no date; Featherstone and Rodgers, 1981). The hydrogen ions further free calcium and phosphate into solution, diffusing out of the tooth, which, if left to advance, eventually lead to loss of the surface integrity of the enamel which becomes cavitated(Hammad *et al.*, 2012).

Overall management of white spot lesions involves consideration of methods of preventing demineralization and also methods of encouraging remineralization of existing lesions(Sudjalim, Woods and Manton, 2006). The conventional treatment approach is based on restoration, which, in most instances, is quite invasive(Malterud, 2006; Stahl and Zandona, 2007). The aim of modern dentistry is focused on a prophylactic approach, instead of invasive restoration, of carious defects(Du *et al.*, 2012). White spot lesions can be minimized by preventive treatment with fluoride toothpaste and rinsing solutions, topical fluoride applications and oral hygiene instructions(Baeshen, Lingström and Birkhed, 2011).

Since most patients requiring treatment for white spot lesions are adolescents or young adults, minimally invasive treatments are needed to prevent excessive sacrifice of tooth material at an early age(Lee *et al.*, 2013). The common treatment modalities used for the minimally invasive treatment of white spot lesions are

remineralization products such as Fluoride products and Casein phosphopeptide amorphous calcium phosphate. Recently a promising alternative, resin infiltration technique was introduced as a type of minimally invasive treatment. The resin infiltration technique prevents further progression of the lesion using a low-viscosity resin with a high penetration coefficient, filling the enamel inter crystalline spaces(Paris *et al.*, 2007; Paris, Meyer-Lueckel and Kielbassa, 2007; Meyer-Lueckel and Paris, 2008). This technique has been reported to remove the whitish opaque color thereby changing the color and translucency of the white lesion(Rocha Gomes Torres *et al.*, 2011; Paris *et al.*, 2013). We have successfully completed numerous epidemiological and invitro studies for the betterment of our community (Prabakar, John and Srisakthi, 2016; Kannan *et al.*, 2017; Kumar, Pradeep Kumar and Preethi, 2017; Kumar, Pradeep Kumar and Vijayalakshmi, 2017; Prabakar, John, Arumugham, Kumar and Sakthi, 2018a, 2018b; Prabakar, John, Arumugham, Kumar and Srisakthi, 2018; Vishnu Prasad *et al.*, 2018; Harini and Leelavathi, 2019; Khatri *et al.*, 2019; Manchery *et al.*, 2019; Mohapatra *et al.*, 2019; Neralla *et al.*, 2019; Pavithra, Preethi Pavithra and Jayashri, 2019; Pratha, Ashwatha Pratha and Prabakar, 2019; Shenoy, Salam and Varghese, 2019; Mathew *et al.*, 2020a; Samuel, Acharya and Rao, 2020). Our team has rich experience in research and we have collaborated with numerous authors over various topics in the past decade (Deogade, Gupta and Ariga, 2018; Ezhilarasan, 2018; Ezhilarasan, Sokal and Najimi, 2018; Jeevanandan and Govindaraju, 2018; J *et al.*, 2018; Menon *et al.*, 2018; Prabakar, John, Arumugham, Kumar and Srisakthi, 2018; Rajeshkumar *et al.*, 2018, 2019; Vishnu Prasad *et al.*, 2018; Wahab *et al.*, 2018; Dua *et al.*, 2019; Duraisamy *et al.*, 2019; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Gheena and Ezhilarasan, 2019; Malli Sureshbabu *et al.*, 2019; Mehta *et al.*, 2019; Panchal, Jeevanandan and Subramanian, 2019; Rajendran *et al.*, 2019; Ramakrishnan, Dhanalakshmi and Subramanian, 2019; Sharma *et al.*, 2019; Varghese, Ramesh and Veeraiyan, 2019; Gomathi *et al.*, 2020; Samuel, Acharya and Rao, 2020)The purpose of this case report was to assess the masking effects of resin infiltration technique in post-orthodontic white spot enamel lesions and to discuss the results and limitations of this new minimally invasive therapy.

Case Report

A 24 year old patient presented in the out-patient Department of Public health dentistry, Saveetha Dental College, Chennai, with the chief complaint of a presence of white stain in the left maxillary central incisor. Patient was clinically examined on his first visit. Further, the history of the patient was recorded which showed that he had recently undergone orthodontic treatment and debonding was done a week before. Therefore, we reached a final diagnosis of the white stain being a Post-orthodontic white spot lesion. Clinical examination showed white spot lesions in relation to 21, 34, 33, 31, 41, 43, 44 and a brown stain in relation to 22 (Figure 1).

Treatment procedure

Ethical approval was sought from the Institutional Review Board, Saveetha Dental College and Hospital, Chennai, and informed written consent was obtained from the patient. For all the lesions, we planned to use the novel resin infiltration technique. The resin infiltration kit (ICON, DMG, Germany) contains 3 syringes, that is acid gel (ICON Etch), drying agent (ICON Dry), and resin infiltrant (ICON Infiltrant). The etching gel is composed of 15% HCl, water, silica and additives, the drying agent is ethanol, and the resin infiltrant is composed of tetra ethylene glycol dimethacrylate, additives, and initiators. The teeth were cleaned using prophylaxis paste, which was followed by steps of infiltration. First step included the application of 15% HCl gel (ICON Etchant) for two minutes. Subsequently, the etching gel was washed away with water spray for 30 seconds.

Second step involved the application of ethanol (ICON Dry) supplied with the kit. The ethanol desiccates the lesion body and removes the water retained in the microporosity of enamel lesion. This is followed by air drying of the tooth surface and leads to an accentuated picture of white porosity. Last step involved the application of low viscosity resin infiltrant (ICON Infiltrant), which was left for 3 minutes to allow its penetration deep into the lesion. After 3 minutes, the excess resin on the tooth surface was wiped away with cotton rolls.

This was followed by light cure polymerization for 40 seconds. Clinically, changes were remarkably evident, and immediate improvement in esthetics was observed (Figure 2). This case was followed up for a period of three and six months. The resin infiltration technique was able to provide immediate esthetic improvement in teeth affected with post-orthodontic WSL and significant improvement in esthetics was observed in the lateral incisor with a brown stain.

DISCUSSION

Caries infiltration is a micro-invasive technique that fills, reinforces, and stabilizes demineralized enamel without drilling or sacrificing healthy tooth structure. This treatment can be used to treat smooth surface and proximal caries. Conventionally, for WSLs, re-mineralization is done, but usually such lesions take a long time, and sometimes, the superficial lesion body becomes mineralized while the underlying lesion body is still porous and thus, the whitish appearance often persists(Ardu *et al.*, 2007).

Therefore this technique provides an alternative to micro/macro abrasion, tooth bleaching, composite resin bonding, prosthetic restoration or combinations of these treatment modalities.
It is reported that the masking effect seems to be related to the depth and cariogenic activity of the lesion(Kim *et al.*, 2011; Paris *et al.*, 2013). Resin infiltration involves etching of the lesion with 15% hydrochloric gel. This is done to remove the pseudo intact surface layer covering the deep lesion body in a WSL(Paris, Meyer-Lueckel and Kielbassa, 2007). Alcohol is applied to allow proper desiccation for resin to soak in the lesion body. Thus, the low viscosity resin infiltrant enters the porous enamel, and now the pores, which were early filled with water (refractive index = 1.33), are filled with infiltrant (Refractive-index of 1.46) whose refractive index matches more closely as that of enamel (1.62-1.65)(Ardu *et al.*, 2007). Hence, the improvement in the white spot lesion by the resin infiltration technique is said to be based on changes in the refractive index.
Paris and Meyer-Lueckel(Paris *et al.*, 2013; Gugnani *et al.*, 2014) reported the first successful immediate improvement of the esthetic appearance of white spot lesions that remained stable until the 10th month of follow up. Various studies since then have demonstrated the efficacy of RI technique in improvement in esthetics of WSLs(Gugnani *et al.*, 2012; Paris *et al.*, 2013), Earlier case reports(Gugnani *et al.*, 2012; Paris *et al.*, 2013) on white spot lesions treated with resin infiltration have not reported on color stability.
This case was followed up to a period of 6 months and the color stability was not only found to be consistent, but was enhanced with time. This may be attributable to the good oral hygiene maintained by the patient. In addition to this, the slow yet natural phenomenon of remineralization present in the oral cavity cannot be ignored as a factor in the esthetic enhancement of the lesions during the period of six months as described in the earliest literature possible(Dirks, 1966).

Limitations
However, resin infiltration technique has certain limitations to be discussed. A previous case report(Paris *et al.*, 2013; Gugnani *et al.*, 2014) noted that there is a need to follow the strict diagnostic criteria to distinguish between the developmental and non-developmental opacities as Resin infiltration shows limited effects in cases of developmental defects. Further, it was reported that it is a radiolucent material, which may be of concern for some dentists.Our institution is passionate about high quality evidence based research and has excelled in various fields ((Pc, Marimuthu and Devadoss, 2018; Ramesh *et al.*, 2018; Vijayashree Priyadharsini, Smiline Girija and Paramasivam, 2018; Ezhilarasan, Apoorva and Ashok Vardhan, 2019; Ramadurai *et al.*, 2019; Sridharan *et al.*, 2019; Vijayashree Priyadharsini, 2019; Chandrasekar *et al.*, 2020; Mathew *et al.*, 2020b; R *et al.*, 2020; Samuel, 2021)

CONCLUSION
Resin infiltration is a minimally invasive, painless technique to treat white spot lesions and achieve immediate results and excellent esthetics. Future research must focus on resin infiltration of long standing white spot lesions, developmental defects and moderate fluorosis.

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Fig.1: Facial view of white/brown spot lesions

Fig.2: Facial view of white/brown spot lesions immediately after treatment

Fig.3: Facial view of Resin Infiltrated lesions after 3 months

Fig.4: Facial view of resin infiltrated lesions after 6 months