Treatment of white spot lesions due to enamel hypomineralization using the resin infiltration technique

D. Spagopoulos*, M. Kotrogianni**, C. Paximada***

*Post graduate student at the department of Operative Dentistry, University of Athens
**Post graduate student at the department of Restorative and Aesthetic Dentistry, UIC
***Assistant Professor at the department of Operative Dentistry, University of Athens

KEYWORDS
Enamel hypomineralization; Resin infiltration technique.

ABSTRACT
Aim: Enamel hypomineralization is a qualitative defect of the enamel, caused by the damage of the dental semen during the enamel mineralization process. When enamel hypomineralization lesions are detected in the anterior teeth, aesthetic problems occur. In this paper, we report on the evolution of the treatment of white spot lesions due to enamel hypomineralization and a recently developed technique, the "resin infiltration technique", is presented along with the analytical description of its clinical steps and its effectiveness, through the report of two cases.

Materials and methods: The infiltration technique consists in masking the lesions with a resin which penetrates into the micropores of enamel, and restoring the normal refractive index of the tooth, as it has a refractive index similar to that of healthy enamel.

Results: Resin infiltration technique provides immediate and satisfying results, it is not time consuming, as it is performed in a single session, and it is oriented into the microinvasive concept of modern dentistry, being conservative, minimally invasive, and painless.

Conclusions: The resin infiltration technique directly improves the patient's dental esthetics. However, further studies are necessary in order to assess the long term stability of the results.

Introduction
Enamel hypomineralization is a pathological condition of the enamel due to factors occurring during the critical process of enamel mineralization, which is characterized by the deposition of inorganic salts in the organic ground substance. It is a gradual process, starting from the tops of the cusps and the cutting surfaces of the teeth, which takes place over a long time and it is very sensitive to external factors. The etiology behind hypomineralized enamel can be genetic, acquired and idiopathic. The factors resulting into acquired enamel hypomineralization are either local or general and this pathological condition may affect either the deciduous or the permanent dentition, a single tooth, a group of teeth, or even, in rare cases, the entire dentition (1). General factors include infections during the critical age of 3-4 years, especially upper respiratory infections that require treatment with antibiotics in combination with corticosteroids in order to be treated, nutritional deficiencies of vitamins A, C, D, calcium and phosphorus, poor general health and preterm birth, where enamel hypomineralization is usually combined with a series of other pathological conditions due to non-term pregnancy. Local factors include dentoalveolar infections or trauma of deciduous predecessors, surgical operations in order to correct cleft lip and palate and contaminations due to environmental factors, such as dioxins, which may be present even in breast milk, and chronic lead poisoning (still present in old buildings).

Clinically, enamel hypomineralization is characterized by opaque spots with or without a shiny surface depending on the depth of the lesion, present on the tooth surface, with increased permeability, thus increased dye adsorption capacity, and chalky texture. The color of the spots depends on the type of the dye they absorb (1). At the same time, the hypomineralized areas appear to be extremely friable, prone to fractures and caries development.

When enamel hypomineralization is detected in the anterior teeth, and in particular those in the upper jaw, aesthetic problems arise, affecting both the psychological state and social behavior of patients. In the past, different treatment strategies have been
proposed, such as microabrasion or removal of the lesion and sealing with composite resins, veneers or crowns. More recently, a technique based on the infiltration of the lesion by means of a hydrophobic low viscosity composite resin has been proposed, following the modern concept of a more conservative treatment in general. The optical improvement provided this technique occurs owing to the property of this type of resin to penetrate into the body of the lesion using capillary forces, to block the spaces between the pathological crystals of the enamel and to reflect the light in a way similar to that of the adjacent enamel (2).

The selection of the correct treatment strategy for each single case of hypomineralization depends on the depth and the extent of the lesion: the greater the depth and the extent of the lesion, the less conservative the treatment plan (3,4,5). The purpose of this paper is to describe the resin infiltration technique in the treatment of white spot lesions due to enamel hypomineralization (Figure 1, 2) and its effectiveness, through the report of two cases.

Materials and methods

The resin infiltration technique is a cosmetic procedure and as such it requires healthy periodontal tissues and tooth surfaces free of plaque, tartar and exogenous stains. Therefore, scaling and cleaning before any other intervention in the patient’s mouth is mandatory. Right after scaling, a rubber dam is placed in order to obtain a dry working field and to protect the soft tissues from possible chemical burn (Figure 3, 4). Alternatively, the protection of the soft tissues can be accomplished by applying a 2 mm layer of a low viscosity resin, as a barrier, at the cervical regions of the teeth, along with the gum line, or even by combining a layer of resin and the use of a rubber dam.

First, the etching agent (Icon Etch, DMG, Germany) is applied on the lesions in order to etch the outer layer of the enamel surface and increase its porosity, and thus to help the penetration of the resin into the lesion’s body (Figure 5a, 6a). The etching agent is a gel containing 15% hydrochloric acid (HCl), pyrogenic silicic acid and surface-active substances.
The etching agent is locally applied on the enamel surface and it is set for 2 minutes (Figure 5b, 6b), then it is suctioned off and the enamel surfaces is rinsed with water for at least 30 seconds (Figure 6c). Subsequently, the enamel surfaces are dried with oil/water-free air and abundant dehydrating agent (Icon Dry, DMG, Germany) containing 99% ethanol is applied (Figure 7, 8). This dehydrating agent is left set for 30 seconds and then the enamel surface is further dried out with oil/water-free air. The application of the dehydrating agent results in the complete removal of water from the spaces between the enamel crystals locally, thus creating the appropriate space for the resin to penetrate. At this point, the visual alteration of the lesion is the guide the clinician has in order to decide whether there is a need to repeat the etching stage or not. When wetted with Icon Dry, the whitish opaque coloration should diminish within a few seconds. If the surface layer is thick and the white spots still visible, an additional application of hydrochloric acid is suggested (6). The etching step can be repeated up to three times (6). The process is continued by applying locally on the lesions the infiltration resin (Icon Infiltrant, DMG, Germany) (Figure 9, 10a, 10b), which is a low viscosity light-curing resin consisting of tetraethyleneglycol dimethacrylate (TEGDMA) matrix, additives and initiators. Excess material is removed with dental floss and cotton rolls (Figure 10c), the resin is left setting for 3 minutes and then it is light-cured for 40 seconds (Figure 10d). Eventually, the rubber dam is removed and the tooth surfaces polished (Figure 11).

When this procedure of masking white spot lesions is successful, the aesthetics of the treated area is immediately clearly improved (Figure 12, 13, 14, 14b, 14c, 15, 16).

Follow ups are scheduled after two weeks (Figure 17, 18) and after six months in order to assess whether the aesthetic result is stable or not.

Discussion
The resin infiltration technique was initially intended to inhibit incipient carious lesions and stop their...
progress. However, several clinical trials report the aesthetic improvement of the color as well (7, 8). The translucency of the enamel is a visual effect based on the size of the spaces between the enamel crystals. The interspaces are covered with water. The structure of hypomineralized enamel crystals appears to be modified, resulting in the modification of the spaces between the crystals (4). The enamel refractive index is 1.62-1.65, while the water refractive index is 1.33 (9). The more enlarged the space between the enamel crystals, the greater the volume of the water that occupies these spaces, resulting in apparent visual change of the color of the enamel surface, due to the scattering of the light into the body of the lesion. The aesthetic improvement provided by the resin infiltration technique is based on this phenomenon. The resin infiltrant, having a refractive index of 1.46, which is similar to that of healthy enamel, penetrates into the body of the lesion covering the spaces between the hypomineralized enamel crystals, resulting in the aesthetic improvement of the lesion (10). In order to achieve even better aesthetic results, a second application of the resin is suggested, letting it set for one minute. During the second application, gaps that may have been formed due to polymerization shrinkage of the first layer are covered with resin (11). The resin infiltration technique is considered to be the most conservative technique for the management of white spot lesions, since the removal of dental tissue is minimal: 40 μm to a maximum of 77 μm in the case of multiple applications of the etching step (12). Thanks to its ability to etch such a thin layer of enamel, this technique is usually indicated for the treatment of incipient carious lesions, occurring especially after orthodontic treatment. In the case of developmental lesions, such as hypomineralization, this technique should be applied with limitations, considering the depth and the intensity of each lesion. Otherwise, the success of the final result is not guaranteed. However, the clinical improvement, compared to the previous situation, is obvious and the choice of a more invasive treatment plan is up to both the patient and the clinician.

As for any possible effects on soft tissues resulting
from the application of the infiltration technique, in case of contact of the etching agent with the oral mucosa local whitish discoloration is caused, due to chemical burn, which disappears within a few days. Regarding the stability of the aesthetic result, only a few short-term clinical studies have been conducted so far, with a maximum follow up of 12 months, where the aesthetic improvement of the lesions appears to be stable over time (13, 14, 15, 16). However, the infiltration resin has the property of adsorbing the same dyes which can cause discoloration in healthy dental surfaces, such as coffee, tea and red wine (17, 18). Therefore, patients shall be informed about this fact and they must be careful about the frequency of consumption of such substances. Possible discolorations can be removed by re-polishing the dental surfaces, which implies strict observance of the recalls at specific intervals on the part of the patient (18).

Conclusion
Hypomineralization is a qualitative disorder of the enamel. Its most common appearance is that of whitish opaque spots, with smooth surface and chalky texture. The treatment plan depends primarily on the depth and the extent of the single lesion: as long as these are limited, the infiltration of the lesion with a low viscosity resin is the most appropriate treatment strategy. The resin infiltration technique is conservative, minimally invasive, painless, not time consuming, as it is performed in a single session, and it immediately improves the patient’s dental aesthetics. Although it is the most conservative approach, the infiltration technique is far from ideal, since the lesion is masked and not eliminated and subsequent follow-ups are necessary in order to assess and maintain aesthetic stability. Further studies are therefore necessary with longer observation periods in order to acquire long-term clinical evidence about the stability of the results.

References