The etch-bleach-seal technique for managing stained enamel defects in young permanent incisors

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Abstract

Hypomineralized enamel defects frequently are manifest as a mottled-white appearance and can be associated with variable degrees of discrete yellow-brown intrinsic staining. Numerous treatment approaches have been proposed, ranging from bleaching to enamel reduction to restorative techniques. Bleaching of hypomineralized enamel lesions, using 1 to 2 applications (10 to 15 minutes each) of 5% sodium hypochlorite, has been applied clinically. Treatment using this approach has proven successful in removing yellow-brown discolorations from lesions in young permanent teeth. Young permanent incisors with yellow-brown intrinsic discolorations can often be treated by a simple and conservative bleaching protocol using sodium hypochlorite.*(Pediatr Dent 24:249-252, 2002)*

KEYWORDS: BLEACHING, STAINED ENAMEL SEALANT

Received November 15, 2001 Accepted February 5, 2002

Esthetically displeasing discolorations of permanent incisors have multiple etiologies that include both genetic and environmental factors.[1,2] Hypomineralization of the enamel is frequently associated with appearances ranging from white mottling or opaque to discrete or generalized yellow-brown discolorations. As in the case of fluorosis, these lesions are often not uniformly distributed throughout the dentition or across the area of a single-tooth crown. Unfortunately, involvement of the facial surface of the maxillary permanent incisors is not uncommon and can be of tremendous esthetic concern for young patients.[3] Hypomineralization defects of enamel are discolored due to changes in the composition and/or structure of the enamel.[4] Frequently, a decreased mineral content of the enamel is associated with an increased organic content.[5,6] Retention of enamel matrix proteins or uptake of organic material into hypomineralized enamel can cause enamel discolorations that are often yellow-brown in clinical appearance.[7]

A variety of treatment approaches have been proposed to address the esthetic concerns of discolored teeth.[8-11] The most conservative approaches involve bleaching the teeth.[12] This can be accomplished using a variety of materials that are mostly based on chemicals that generate peroxide ions. Commercially available bleaching agents can be applied in-office or using lower concentration products in repeated home treatment bleaching protocols. Vital bleaching protocols and materials are most often being applied to achieve a general whitening of the anterior teeth. The use of peroxide-based bleaching materials can cause dental sensitivity and, less frequently, gingival irritation.[12]

Microabrasion and removal of the outer enamel surface have also been advocated to manage enamel discolorations.[13] This technique can be successful for lesions that are mild and relatively superficial and do not extend to deeper enamel layers, such as might occur with moderate-to-severe fluorosis.[13,14] Microabrasion, either alone or coupled with bleaching, has the disadvantage of requiring the removal of some enamel. However, this approach is more conservative than reducing the enamel surface for the placement of facial veneers. Bleaching and microabrasion also have the benefit of being applicable for partially erupted, young permanent teeth. The placement of facial veneers is typically not considered until a patient's teeth have fully erupted and the gingival height has stabilized. Thus, definitive restorative management for enamel discolorations is typically delayed until the child is in mid to late adolescence, even though substantial concern over the appearance of discolored teeth can begin many years earlier when the teeth are partially emerged and visible.

Even very young patients can be highly concerned over discoloration of their anterior teeth. Therefore, appropriate treatments are needed for young permanent teeth that are partially erupted and have large pulp chambers and incomplete root formation. To address this problem, a conservative

Fig 1. The central incisors and incisal tips of the emerging lateral incisors have discrete yellow-brown discolorations that the patient considered esthetically displeasing

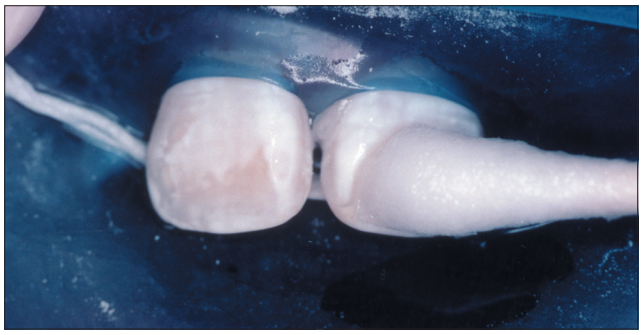

Fig 2. Bleach is continuously applied with a cotton swab to the isolated teeth

Fig 3. After a 15-minute application of sodium hypochlorite, the yellow-brown coloration has been removed and the desiccated enamel has a white-mottled appearance

Fig 4. The appearance of the previously stained areas blend in with the surrounding mottled enamel after perfusion with a clear sealant and re-hydration

treatment approach for the management of yellow-brown intrinsic staining of dental enamel is presented.

Vital bleaching protocol

Localized yellow-brown discolorations appear to respond well to bleaching with sodium hypochlorite. Sodium hypochlorite-based bleaching approaches have been suggested for removing localized and relatively discrete yellow-brown discolorations such as those seen in Fig 1. Attempts to achieve a generalized whitening of the anterior teeth that are dark or yellow are more often implemented using hydrogen peroxide-based approaches.

The teeth are cleaned with flour of pumice using a rubber cup to remove all plaque and any extrinsic surface discolorations. The teeth are then isolated with a rubber dam and each tooth is ligated to protect the soft tissues from the bleaching agent. To allow better penetration of the bleaching agent the enamel surface is etched for 60 seconds with 37% phosphoric acid.

Bleach and sealant application

Sodium hypochlorite (5%) is applied to the entire tooth surface using a cotton applicator (Fig 2). The bleach is continuously reapplied to the tooth as it evaporates. Often the discoloration can be observed to diminish over 5 to 10 minutes. If little or no change has occurred in 10 minutes, the tooth should be re-etched for 60 seconds, rinsed and bleached. The teeth may be bleached at one appointment for 15 to 20 minutes and, in some cases, benefit from additional bleaching appointments. Removal of the yellow-brown stain typically causes the previously stained enamel to take on the optical character of the adjacent enamel (Fig 3). Usually these hypomineralized and stained lesions will have a white-mottled appearance after bleaching that is much more esthetically acceptable.

To prevent organic material from re-entering the porous and hypomineralized enamel, the bleached and etched teeth can be sealed after achieving the optimal bleach result. Sealing of the hypomineralized surface is accomplished by rinsing and drying the tooth to removal all bleaching agent. Etch the tooth for 30 seconds with 37% phosphoric acid, rinse with water and treat the bleached and etched surface with a highly penetrating clear resin such as a clear sealant (Delton™, Johnson & Johnson) or composite bonding agent (Fig 4). The resin will perfuse the etched and porous enamel, creating resin tags that occlude the porosities and prevent re-staining of the hypomineralized lesion. We have observed bleached lesions for up to 5 years after initial treatment and sealing and found that little to no re-staining occurred after resin perfusion (Fig 5).

Discussion

Numerous techniques to remove intrinsic enamel discolorations have been described over the past 80 years. While the sodium hypochlorite protocol presented in this paper has been described in principle in several publications since

1991, it does not share the widespread use that hydrogen peroxide-based bleaching techniques enjoy.[11,15] The sodium hypochlorite technique has several advantages over peroxide-based protocols for the specific application of removing stains from localized hypomineralized lesions in young teeth.

First, the bleaching agent proposed is sodium hypochlorite, which has been and continues to be used extensively to remove organic material from teeth (pulp canal irrigation during endodontic therapy) and as a sterilizing agent. It is known to be highly effective at removing organic material by oxidizing it and allowing the smaller degraded molecules to be washed away. Applying sodium hypochlorite to bleach discolored, hypomineralized enamel lesions can degrade and remove the chromogenic organic material that is located in the enamel.[15] The second critical step in this bleaching approach lies in the resin perfusion of the hypomineralized lesion to prevent future chromogens from entering the porous enamel causing a re-staining of the lesion.

An in vitro assessment of hydrogen peroxide and sodium hypochlorite bleach in fluorosed teeth showed greater whitening when using sodium hypochlorite and calcium sucrose phosphate.[11] The use of calcium sucrose phosphate appeared to decrease the enamel porosity, thereby assisting the return of normal enamel optical properties and appearance. These kinds of treatments that can augment the deficient mineral content of the hypomineralized enamel lesion not only enhance the optical properties of the tooth but also help prevent re-staining and deserve further clinical study. In the absence of a proven treatment to augment these hypomineralized developmental defects, we have chosen to perfuse the defects with a highly penetrating resin.

A similar treatment approach as outlined in this paper was reported previously, differing primarily in the use of a different acid.[15] Twelve percent hydrochloric acid, as opposed to 37% phosphoric acid (as used in the current protocol), was used to etch the teeth, followed by bleaching with sodium hypochlorite. The use of 16% hydrochloric acid alone or followed by hydrogen peroxide bleaching can successfully remove intrinsic yellow-brown stains.[10] We prefer the use of phosphoric acid for two reasons. Firstly, it is readily available in most dental offices.

Second, and more important, 37% phosphoric acid removes less enamel compared with 16% hydrochloric acid. It has long been known that 37% phosphoric acid (most commonly supplied for resin boding) is highly effective at etching the enamel crystallites and increasing enamel porosity. Therefore, the etch/bleach technique presented in this paper uses materials that are readily available in the dental office and that have been shown to be clinically safe and effective.

Treatment of enamel that has a high organic content using bonding technologies can be problematic due to the organic material present within the enamel that prevents effective etching. Studies show that sodium hypochlorite can effectively remove proteins from the enamel crystallite surfaces.[16] Furthermore, it has been shown that pretreatment

Fig 5a. Yellow-brown staining of these hypomineralized, fluorotic teeth were esthetically displeasing to this young adolescent

Fig 5b. The teeth of this young adolescent responded well to sodium hypochlorite treatment and have not restained 6 months after the etch/bleach/seal approach

of the enamel with sodium hypochlorite to remove the enamel proteins can enhance the ability of acid to etch the surface, thereby improving the likelihood that resins can bond successfully to the surface.[17] In light of this, we have also applied the etch/bleach approach to treating yellow-brown hypominerlized lesions on molars where the enamel is often difficult to bond. Treatment of hypomineralized lesions in anterior and posterior teeth can enhance the enamel coloration and potentially improve the creation of enamel porosity from etching and subsequent bonding of either preventive (sealants) or esthetic resin materials.

The etch/bleach/seal technique uses readily available materials that show a high level of safety and can be used on young permanent teeth. Permanent incisor teeth that are only partially erupted can be treated, allowing older children and very young adolescents to benefit from this approach. The etch/bleach/seal technique provides a conservative alternative treatment for yellow-brown hypomineralized enamel that shows good clinical success and long-term stability. The application of conservative treatment approaches should be considered prior to applying techniques that require substantial enamel removal for the treatment of enamel discolorations.

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