Considerations about enamel microabrasion after 18 years

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ABSTRACT: Purpose: To review of the current status of enamel microabrasion method and its results 18 years after the development and application of this method. Methods: A technique performing enamel microabrasion with hydrochloric acid mixed with pumice and other techniques employing a commercially available compound of hydrochloric acid and fine-grit silicon carbide particles in a water-soluble paste have been described. Much has been learned about the application of this esthetic technique, long-term treatment results and microscopic changes to the enamel surface that has significant clinical implications. The latest treatment protocol is presented and photographic case histories document the treatment results. Clinical observations made over 18 years are discussed. Results: According to our findings, the dental enamel microabrasion technique is a highly satisfactory, safe and effective procedure. (Am J Dent 2007;20:67-72).

CLINICAL SIGNIFICANCE: The enamel microabrasion technique was developed as an method of eliminating enamel texture irregularities and discoloration defects and improving the appearance of teeth. It is a conservative procedure that has proven to be safe and clinically effective.

Introduction

In the past, teeth presenting color anomalies were restored with direct or indirect restorative materials.1 Even though satisfactory esthetics were obtained with those procedures, replacement of restorative materials was frequent, since a material with identical properties and characteristics to the dental structure was not available in the dental market.

The literature shows that some, such as Kane, in 1916 (cited by McCloskey in 19842), Bailey & Christen in 1970, Croll & Cavanaugh3 in 1986, and Croll in 1991, suggested removing spotted dental enamel with acids.

Croll & Cavanaugh,3 in 1986, proposed the application of a mixture of 18% hydrochloric acid combined with laboratory pumice in order to solve the esthetic alterations present on the enamel surface, as well as to obtain permanent results and insignificant loss of enamel. The treatment would be performed with a rubber dam in place, and the patient would wear protective glasses. The mixture was applied with the aid of a wooden stick and firm finger pressure for 5 seconds, not surpassing a total of 15 applications. Between each application, the enamel submitted to this technique should be washed and dried (Fig. 1A-D). This technique, called enamel microabrasion, allowed for a more conservative treatment, and has been commonly indicated for the removal of intrinsic enamel stains of any etiology and coloration, as well as for correction of surface irregularities on the dental enamel4-12 caused either by imperfect enamel formation or acquired after the removal of orthodontic appliances.4,13,14 Croll & Bullock,15 in 1994, reported that despite the best efforts of orthodontists and their referring dentists to educate patients in proper oral hygiene, some patients still developed dental caries or white spot decalcification of the enamel adjacent to bands or brackets. Such lesions can also occur in patients with poor oral hygiene who are not in active orthodontic treatment. Those alterations, however, should present hard texture and be located in the superficial layers of the dental enamel.

However, it is sometimes difficult to know the real depth of the intrinsic staining or of the present surface irregularity; this was a good indication for the enamel microabrasion technique as the first treatment option in cases with intrinsic stains, regardless of their etiology, dimensions, and depths.

It is difficult to accomplish the precise diagnosis of enamel stains, such as those of dental fluorosis, because the excess systemic fluoride during the years of enamel formation is not the only possible cause of discoloration of the most superficial layers of dental enamel.16-19 Chromatic alterations of brown or white coloration are frequently observed even when the patient does not report excessive contact with fluoride during the phase of enamel maturation.

Croll, in 1990,19 199120 and Killian, in 199317 used the terms "enamel dysmineralization" and "fluorosis-type stains", respectively, to describe the chromatic alterations present on the surface of the dental enamel, resulting from some disturbance in the mineralization process.

Based on the excellent esthetic results obtained in 18 years of application of the microabrasion technique, it can be reaffirmed that the etiology of intrinsic stains of enamel is not a really decisive factor for the adoption or not of the enamel microabrasion technique, but rather its texture, that is, a stain of hard texture and of any color which affects the esthetics.

The patient’s age is irrelevant when adopting this esthetic technique; however, its use can be limited by the difficulty of using the rubber dam when teeth are not totally erupted, when patients present deficient lip sealing,21 and when dental stains are located within the dentin tissue.4,5

Development of the acid/abrasive products and clinical technique

The caustic effect of 18% hydrochloric acid was a concern22 as the toxicity of the chemical product used demanded constant attention of the operator and assistant during application. Thus, in order to obtain an ideal acid/abrasive product that presented higher safety for the oral
Fig. 1. A. Post-orthodontic white enamel stain of hard texture seen in a young patient (Sundfeld et al). B. Application of 18% hydrochloric acid/pumice mixture onto tooth enamel with wooden stick. C. Three-year postoperative view. D. After removal of stains using 18% hydrochloric acid/pumice and dental bleaching with 15% carbamide peroxide Opalescence® 18 years later. (Photos reprinted with permission, Revista Brasileira de Odontologia.)

tissues and easier application on the enamel surface, Croll evaluated several acids at different concentrations with many types of abrasives in varying grits. The acids evaluated included citric acid, hydrochloric acid, nitric acid and phosphoric acid and the abrasive particles tested were dental laboratory pumice, synthetic diamond dust, aluminum oxides and silicon carbide. Since then, a number of formulas for enamel microabrasion compounds were developed that proved to be successful in removing superficial enamel discoloration.

Highly safe and efficient microabrasive products have been marketed, such as Prema Compound® and Opalustre, which contain a mild concentration of hydrochloric acid (10% and 6% respectively) for safe application in the mouth, and a fine-grit silicon carbide abrasive in a water-soluble gel for easy removal when combined with a low concentration acid. Such formulations offer a good margin of safety during application for both operator and patient, among other advantages. Besides these factors, the microabrasive systems use gear reduction rotary handpieces for precise application of the compound onto the tooth surface, which eliminates splattering of the compound and makes the procedure safer, easier, and quicker.

These microabrasive products should be applied on the spotted enamel or enamel with surface irregularities, following the manufacturers’ instructions, i.e. with a rubber dam, followed by application of a layer of solid petroleum jelly or copal vanish to the margins of the rubber dam/enamel, in order to prevent contact of the product with the gingival tissue. Application of sodium bicarbonate at the rubber dam margin or free gingival margin has also been recommended to neutralize the acid compound. It is interesting to point out the need to protect the patient’s, assistant’s, and professional’s eyes during the entire operative procedure.

With the microabrasion technique, a small amount of the

Fig. 2. Ground tooth section after enamel microabrasion. The yellowish sections are enamel, and the deeper, darker regions are dentin. The depressions in the enamel convexity of each specimen represent the area where microabrasion was performed. Analyzed by polarized light microscope. E: enamel; D: dentin; M: wear. A. Ground tooth section after enamel microabrasion, which was submitted to 15 applications of mixture of 18% hydrochloric acid/pumice. Enamel loss of 140 µm, x32 (Sundfeld et al). B. Ground tooth section after enamel microabrasion, which was submitted to 10 applications of Opalustre. Enamel loss of 200 µm, x25 (Sundfeld et al). (Photos reprinted with permission, Revista Brasileira de Odontologia; Jornal Brasileiro de Dentística e Estética.)
microabrasive compound should be firmly applied on the area corresponding to the stain or to the surface irregularities, with aid of a rotary mandrel and synthetic rubber tips and 10:1 gear reduction angle for the product Prema Compound at 30-second intervals; or with a rubber cup especially developed for that purpose, mounted on to 10:1 gear reduction angle, for the product Opalustre, to intervals of 1 minute, and with periodic washes with a water spray between each application of the compound. After the last application, the tooth should be totally washed and dried, and then polished with fluoride paste, washed and dried. Then, a 2% neutral sodium fluoride gel should be applied on the enamel for 4 minutes. After this, the rubber dam is removed and the patient is asked not to ingest solids for 30 minutes.

**Enamel microreduction: how much enamel is removed?**

In order to verify the amount of enamel removed according to the number of applications of the concentrated hydrochloric acid/pumice, Kendell observed under scanning electron microscopy some enamel loss, which varied from 12 to 46 µm, for 1 and 10 applications of the mixture for 5 seconds each, respectively. Sundfeld et al. verified, for the same mixture but using polarized light microscopy, an enamel loss varying from 25 and 140 µm, for 3 and 15 applications, respectively (Fig. 2A). Sundfeld et al. showed that in extracted teeth microabrasion with Opalustre produced enamel loss ranging from 25 to 200 µm (Fig. 2B), corresponding to 1 and 10 applications of the product for 1 minute on each tooth, respectively. Alves et al. analyzed the wear produced on dental enamel by Prema Compound noticing a loss of 22 µm after 12 applications of the microabrasive product (Fig. 2C) for 30 seconds on each tooth. Thus, the amount of enamel removed by microabrasion can be considered irrelevant.

**Appearance and use of enamel macroabrasion associated with enamel microabrasion**

The use of Prema Compound and Opalustre on intrinsic stains or on accentuated surface irregularities that reach an extensive area of the enamel surface may require a longer application time for their total removal. Thus, based on our findings and those of others, we also suggest beginning the procedure by macroreduction of the affected enamel using a fine-tapered diamond bur to lightly abrade the spotted area. This procedure reduces the time needed for microabrasion for the removal of stain as well as the amount of microabrasive material to be used. After the desired color is obtained, smoothing of the enamel surface is performed using the microabrasive product. With the previous application of the fine-tapered diamond bur, 2 or 3 applications of microabrasive products are required for achievement of the desired esthetic effect (Fig. 3 A-F).
This technique can be readily carried out at the dental office, since the treatment has a "nondestructive" nature, patient satisfaction is considerably high, and recurrence of staining or loss of vitality of treated teeth has not been verified or reported. During all these years working with this technique, we have not observed any postoperative sensitivity. However, it is possible that postoperative sensitivity may occur if too much enamel is removed. It should also be highlighted that if enough enamel is removed to allow thermal sensitivity, the stain involved must be too deep for enamel microabrasion correction alone, and a bonded restoration is indicated.

"Abrosion" effect

We have noticed clinically that teeth submitted to microabrasion present a considerably regular, smooth and lustrous enamel surface that increases over time (Fig. 4 A-D). Olin et al highlighted that this technique is believed to modify the optical properties of enamel. Donly et al coined the term "abrosion" for this phenomenon. Abrasion of enamel prism combined with acid erosion results in the development of a densely compacted prism-free layer on the enamel surface, which is capable of reflecting and refracting the light in a different way than untreated enamel and is believed to camouflage the underlying stain. This may be due to the compaction and deposition of calcium and phosphate breakdown products that result from the simultaneous erosive and abrasive action of the microabrasion compound. In vitro polarized microscopic studies have shown that the lustrous enamel glaze surface is resistant to demineralization and colonization by Streptococcus mutans.

Similarly, Leite et al observed the effect of Prema Compound on enamel by polarized light microscopy and report-
obtained, topical applications of 2% neutral sodium fluoride gel bleaching system with 10%, 15% or 16% carbamide peroxide. For those clinical conditions, a patient-administered dental gel administered within custom-formed, soft vinyl mouth trays. Topical application of dental bleaching with carbamide peroxide system 18 or, as recommended by Haywood & Heymann, 30 by hydrogen peroxide gel delivered on a polyethylene strip. Conditions, color correction can be obtained with the use of a combination of this treatment with patient-administered dental bleaching with a carbamide peroxide gel solution administered within custom-formed, soft vinyl mouth trays can be indicated without concerns, if applied on teeth without carious lesion with well-adapted restorations and without exposed dentin tissue at the cervical area, and, mainly, when well supervised by the professional. 15,17,20

According to these laboratory and clinical findings, the enamel microabrasion technique, associated or not with dental bleaching with carbamide peroxide gel, is a highly satisfactory, safe and effective procedure, which is an integral part of esthetic dentistry.

The clinical success obtained with this technique is the result of a careful clinical approach that has proven its safe clinical effectiveness throughout the years.

Combination of this treatment with patient-administered dental bleaching with a carbamide peroxide gel solution

Enamel microabrasion promotes microreduction of the enamel surface and teeth submitted to microabrasion can acquire a darker or yellowish coloration after treatment. This may be because the surface of the remaining enamel becomes thinner, revealing the dentin. In those clinical conditions, color correction can be obtained with the use of a hydrogen peroxide gel delivered on a polyethylene strip system 18 or, as recommended by Haywood & Heymann, 30 by topical application of dental bleaching with carbamide peroxide gel administered within custom-formed, soft vinyl mouth trays. For those clinical conditions, a patient-administered dental bleaching system with 10%, 15% or 16% carbamide peroxide gel solution can be used. After the desired coloration is obtained, topical applications of 2% neutral sodium fluoride gel should be applied for 4 minutes daily 9,14,20,23,30 for 1 week after treatment. We prefer to wait several weeks after completion of microabrasion, before bleaching commences, with the idea that such delay will provide ample time for complete enamel surface remineralization.

Also, the abrasion effect results in a smooth, prism-free layer of enamel and lustrous surface that increases over time, and is apparently not influenced by bleaching. The enamel surface acquires a glass-like "enamel glaze" months after treatment, just like the teeth of patients who were treated by enamel microabrasion (Fig. 6A-B). 14,20 In the same way, no alterations have been clinically observed in the hard and soft tissues of the oral cavity, as well as the sensitivity of bleached teeth during and after application of the bleaching product. This fact confirms our clinical findings that the use of patient-administered dental bleaching with a carbamide peroxide gel solution administered within custom-formed, soft vinyl mouth trays can be indicated without concerns, if applied on teeth without carious lesion with well-adapted restorations and without exposed dentin tissue at the cervical area, and, mainly, when well supervised by the professional. 15,17,20

Limitations of the enamel microabrasion technique

Throughout the evaluation years, the obtained results are long-lasting, since the dental enamel stain was removed and did not relapse on patients with adequate lip sealing, a clinical condition that excessively hinders the formation of a moisturizing pellicle on enamel, when unprotected by the upper and lower lips. 9 These patients should be referred to the orthodontist or speech therapist for achievement of correct lip positioning before the enamel microabrasion technique is initiated. Our clinical experience with several patients over many years confirms this fact (Fig. 5).

References

3. Croll TP, Cavanaugh RR. Enamel color modification by controlled hydro-


