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Enamel Microabrasion and Dental Bleaching on Teeth Presenting Severe-pitted Enamel Fluorosis: A Case Report

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Clinical Relevance

The enamel microabrasion technique associated with dental bleaching is an excellent and successful clinical procedure for reestablishing the esthetics of a severe case of enamel fluorosis, eliminating the use of adhesive restorations.

SUMMARY

The present clinical case report describes the clinical steps of enamel microabrasion associated with dental bleaching to restore severely-pitted fluorosed teeth. The process of removing the fluorotic superficial stains started by using macroabrasion with a water-cooled fine tapered 3195 FF diamond bur. Rubber dam isolation of the operative field was used to remove the remaining enamel stains and superficial irregularities with the Opalustre microabrasive compound (6.6% hydrochloric acid associated with silicon carbide particles) followed by polishing using fluoridated paste and subsequent 2% neutral fluoride gel topical application. After one month, dental bleaching was performed using 10% carbamide peroxide in custom-formed acetate trays for two hours/day for 42 days. The association of enamel microabrasion with dental bleaching was effective for reestablishing the dental esthetics of a patient with severe dental fluorosis.

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INTRODUCTION

Enamel alterations/stains are a multifactorial clinical condition that, in most cases, negatively affects the beauty and attractiveness of a smile.

Early- and post-stage caries (white spots), white spots around orthodontic brackets, scratches after orthodontic bracket removal, amelogenesis imperfecta, dental fluorosis, enamel hypoplasia, and molar incisive hypomineralization are the most frequent causes of those physical and esthetic enamel alterations.[1-8] Despite the distinct etiology, enamel microabrasion, dental bleaching, resin infiltration, and direct and/or indirect restorations are frequently adopted for reestablishing the esthetics of the affected teeth.

Dental fluorosis is an undesirable mineralization defect of dental enamel and is recognized as a side effect of the excessive and chronic ingestion of fluoride during amelogenesis, with the severity of the condition linked to "fluoride dose and the timing and duration of fluoride exposure."[9] Thus, with increased fluoride intake, the enamel defects and severity of fluorosis increases.[10,11] The most common fluoride sources are tap and well water, diet (children's cereals, chocolate-flavored milk, biscuits), bottled water and beverages (soft drinks, juices, and teas), salt, dietary supplements, and fluoride-containing dental products (dentifrices, mouth rinses, varnishes).[9,12-18] Teeth diagnosed with dental fluorosis present "white opaque areas or discolorations ranging from yellow to dark brown, in combination with porosities on the enamel surface" located on homologous teeth.[19]

Depending on the severity, dental fluorosis has a direct negative impact on the social quality of life.[15,20] Despite the possible negative consequences on the appearance of teeth, fluoridated water and other fluoride sources, such as fluoridated dentifrices, are recognized as important and effective public health strategies for preventing and reducing the incidence of caries.[9,21-24]

The esthetic treatment of enamel fluorosis is closely related to its degree of severity. Patients presenting with mild or very mild fluorosis, a clinical condition that does not always affect the quality of life,[20,25] may be submitted to enamel microabrasion and/or dental bleaching, treatments that remove and/or camouflage the white spots, respectively. On the other hand, moderate and severe enamel fluorosis have a direct impact on a patient's quality of life, and esthetic/restorative treatment (eg, ceramic restorations) is necessary.

Therefore, the aim of the present clinical case report is to demonstrate the esthetic recovery of a severe case of enamel fluorosis submitted to enamel microabrasion followed by dental bleaching.

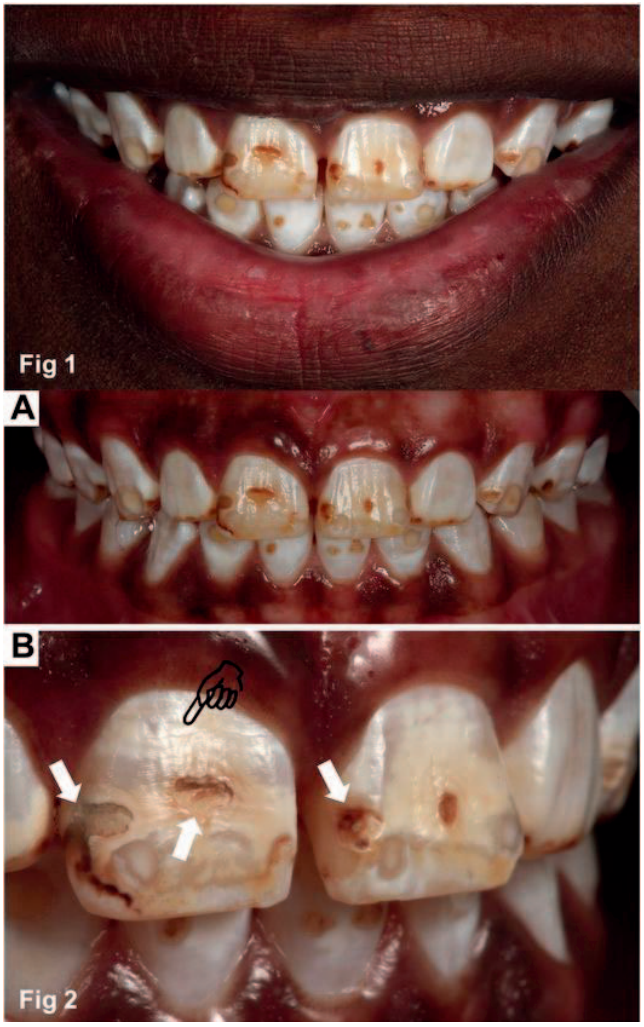

Figure 1. *A 17-year-old boy presenting with white and brown stains with a hard texture located on the facial and lingual surfaces of all teeth. Pitted areas are also found on the facial surface of anterior teeth.*

Figure 2. *Intrafacial view of the affected teeth (A). Note the pitted areas on the facial surfaces of the central maxillary incisors (arrows) and the accentuated perikymata (pointer) (B).*

CASE REPORT

A 17-year-old boy with white and brown colorations with a hard texture and pitted eroded areas (Figures 1 and 2) presented to Araçatuba Dental School/UNESP seeking esthetic treatment. After taking an accurate medical history and performing clinical analysis, a severe case of enamel fluorosis was diagnosed. Clinicians explained the treatment options to both parents and patient, and the enamel microabrasion technique was chosen to remove the stains and pitted areas on the facial surfaces of the upper and lower incisors, canines, and premolars.

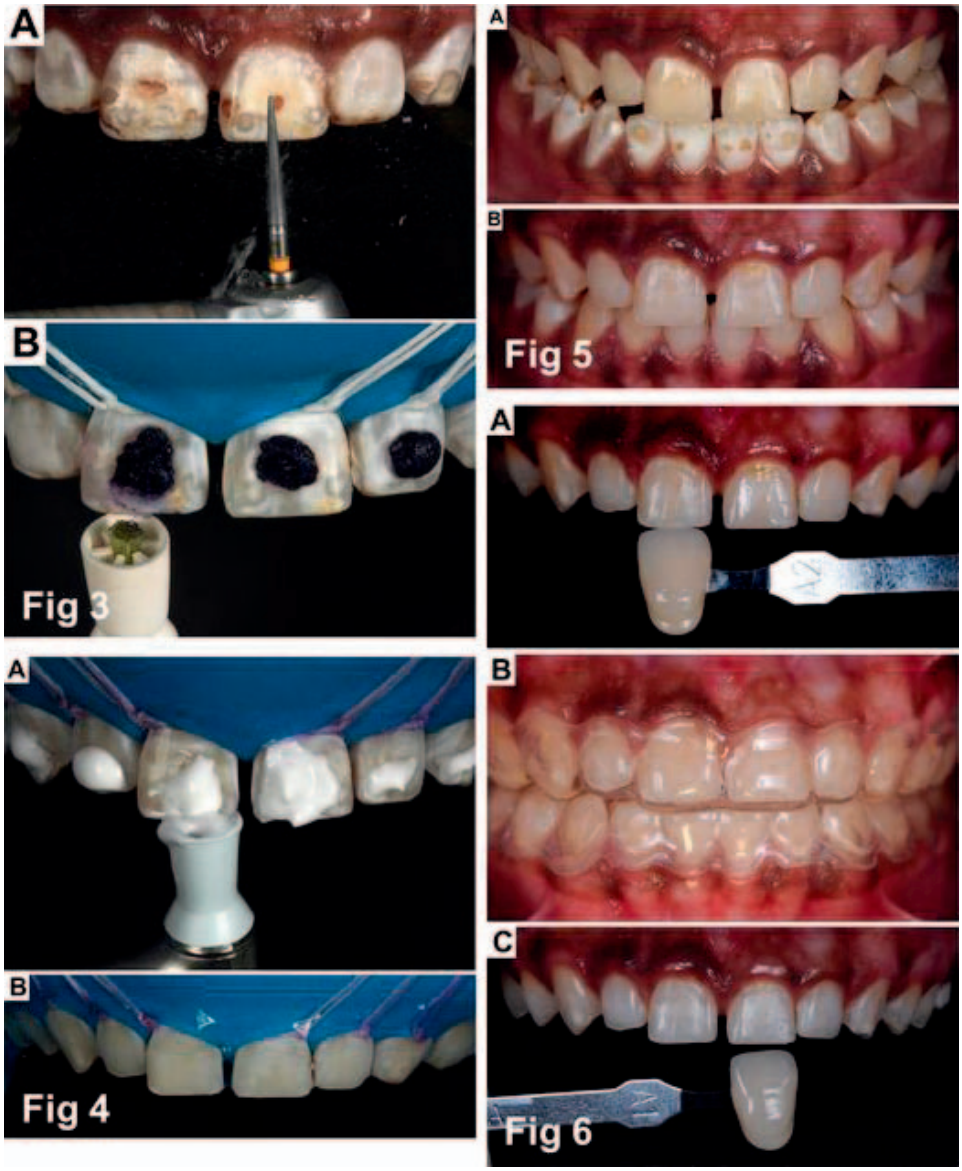

Figure 3. *Macroabrasion using a tapered fine diamond bur (No. 3195 FF, KG Sorensen) with a high-speed hand piece in the presence of water (A). Under rubber dam isolation, application of Opalustre (Ultradent; 6.6% hydrochloric acid associated with silica carbide particles) using a specific rubber cup (OpalCups, Ultradent) (B).*

Figure 4. *Polishing with fluoridated paste using a low-speed hand piece (A) followed by the application of 2% neutral-pH sodium fluoride gel for 4 minutes (B).*

Figure 5. *Frontal view right after the first macro/microabrasion session of the upper arch (A). Final view after macro/microabrasion of the lower arch (B).*

Figure 6. *Assessing tooth shade using a Vitapan Classical Shade Guide (A). Acetate custom trays positioned on the upper and lower arches for home-bleaching treatment (B). Evaluation of final color achieved after dental bleaching (C).*

After dental prophylaxis with pumice and water, the superficial layer of the stained enamel on the facial surfaces of the upper and lower incisors, canines, and premolars was removed (macroreduction) using a fine-tapered bur (3195 FF, 30 μm; KG Sorensen, Barueri, SP, Brazil) under copious water irrigation attached in a high-speed hand piece (Figure 3A).

After protecting the gingival tissues with petroleum jelly, the operative field was isolated with a rubber dam to protect the gingival tissues from the microabrasive compound. The patient, assistants,

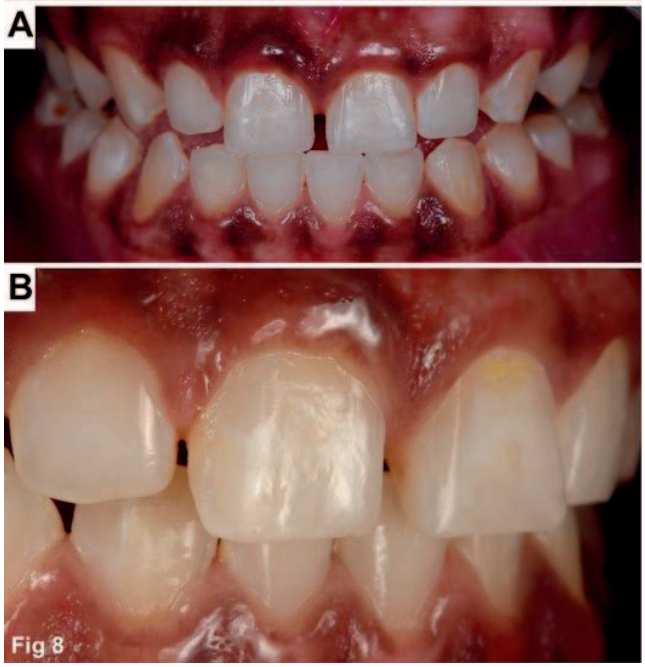

Figure 7. *Intrafacial view of upper (A) and lower (B) arches after enamel microabrasion treatment associated with dental bleaching.*

Figure 8. *Intrafacial view after accomplishing dental bleaching (A). Side view of maxillary incisors showing the complete removal of the pitted areas and the subsequent healthy, shiny and polished enamel surface acquired after enamel microabrasion (B).*

and operator wore individual protective equipment and eye protection during all the clinical procedures. The enamel microabrasive product (Opalustre, Ultradent, South Jordan, UT, USA) was used to remove the remaining stains using a specially designed rubber cup (OpalCups, Ultradent) in a low-speed hand piece under firm hand pressure (Figure 3B). The microabrasive compound was applied three times for one minute each on the facial surface of the stained teeth, with five seconds on each tooth for a total of one minute, with water rinsing between each application. After polishing the

Figure 9. *Extraoral view after enamel microabrasion treatment associated with dental bleaching. Note the more pleasant and harmonic smile.*

abraded enamel surface with fluoridated paste (Herjos, Vigodent, Rio de Janeiro, RJ, Brazil) (Figure 4A), a neutral 2% sodium fluoride gel (Apothicário Manipulation Pharmacy, Araçatuba, SP, Brazil) was applied for four minutes (Figure 4B). Figure 5 shows the enamel appearance after enamel microabrasion on the upper and lower arches.

After one month, dental bleaching was performed using 10% carbamide peroxide (Opalescence, Ultradent) (Figure 6). Alginate impressions of the upper and lower arches were made. Stone models were poured and used to fabricate the custom acetate bleaching trays. The patient was instructed to place a small drop of the bleaching gel into each tooth section of the acetate trays and advised to wear the bleaching product for two hours/day. Six tubes of the bleaching gel were used during all the bleaching treatments.

The effectiveness of dental bleaching (dental color change) was evaluated before (Figure 6A) and after (Figure 6C) the bleaching treatment in the upper and lower incisors and canines using a visual method (Vitapan Classical Shade Guide; Vita Zahnfabrik, Bad Sackingen, Germany), with the results indicating a color improvement from A2 to A1.

Assessment of dental sensitivity was performed at baseline; at days 7, 14, 21, 28, 35, and 42 of the bleaching treatment; and 14 days after completion of the bleaching treatment. No gingival irritation or sensitivity was observed and the patient was satisfied with the enamel microabrasion and bleaching treatment. Figures 7 through 9 depict the final appearance (at the four-month follow-up) after enamel microabrasion and dental bleaching.

DISCUSSION

In the past, removal of sound and affected dental tissues, followed by resin composite restorations,

was indicated as a dental treatment for fluorosis. However, the present clinical case report demonstrated that a severe case of enamel fluorosis may be successfully treated with enamel microabrasion and dental bleaching.

The scientific literature shows that an excessive ingestion of fluoride during amelogenesis affects ameloblast function and the enamel matrix, inducing changes in the developing enamel. Clinical changes in the enamel vary from chalky white opaque areas, which result from enamel subsurface hypomineralization (which increases with fluoride exposure, resulting in different levels of severity)[26] because the enamel matrix secreted during fluoride exposure fails to mineralize, to pits, grooves, and post-eruption staining in more severe cases,[10,27] making enamel more prone to fracture and wear.[28] During clinical evaluation, clinicians must be aware that the presence of white areas reveals the existence of underlying hypomineralization and that enamel fluorosis symmetrically affects groups of homologous teeth.[2]

As depicted in Figures 1 and 2, the present case report depicts a severe case of enamel fluorosis showing deep pits on the facial surface. The parents and patient reported that the pits were not found right after eruption but developed after eruption. It may be hypothesized that mechanical damage (trauma), such as drinking soft drinks in glass bottles positioned in the upper facial surface or teeth brushing, removed the surface layer that covered the hypomineralized subsurface enamel, exposing the softer enamel tissues and turning them into pits. Pitting severity is determined by the degree of enamel porosity at the time of eruption and the exposure of the tooth surfaces to masticatory forces or by other substances in the mouth,[2,29] causing secondary modifications to the enamel texture (pitting and fissures).[2]

As seen in Figure 2B, the accentuated perikymata is likely associated with chronic exposure to fluoride, which is linked to the first signs of enamel fluorosis.[10] This finding is compatible with the patient's medical/dental history, as both parents and patient reported the use of a very large amount of flavored dentifrice (1100 μg F/g; Tandy, Kolynos do Brasil, São Paulo, SP, Brazil)[30,31] on the toothbrush, which the patient used to swallow between the ages of six and eight years. Also, the parents and patient reported the use of fluoridated mouthrinses at school after lunch between the ages of three and five years, which the patient remembered occasionally swallowing. The patient also reported the daily consumption of soft drinks that contained fluoride,[13] which is associated with moderate and severe forms of fluorosis.[18]

The critical period for the increased risk of developing dental fluorosis is between three and six years of age, as fluorosis is related to periods of permanent dentition development.[32,33] Hong and colleagues[34] considered up to 48 months the critical age for fluorosis development in permanent maxillary incisors, with the first two years of life the most critical period (higher risk). The combined fluoride intake from dentifrice, mouthrinses, and soft drinks may have led to increased levels of fluoride, which was incorporated into the dental hard tissues (fluorotic teeth presents higher fluoride content than sound teeth),[35,36] directly influencing the quality of amelogenesis. The city's tap water, which the patient used during infancy, was not considered the main factor involved in the fluorotic enamel because the city's (Penápolis, SP, Brazil) fluoride levels were within the optimum risk-benefit range.[16]

The lack of supervision from the parents and school staff in regards to advising the patient to spit out toothpaste and mouthrinse likely directly contributed to the development of dental fluorosis. As the intake of fluoride from dentifrices is directly related to the amount of toothpaste used, frequency of brushing, age, and especially flavored dentifrices,[33,37-41] it is necessary for parents/caregivers to instruct and monitor the proper use of fluoridated dentifrices, while also telling the children to not swallow the dentifrice. Also, it is important for parents/caregivers to use a pea-sized amount of dentifrice during toothbrushing, which has been recommended by dentists and reduces the risk of dental fluorosis.[39,40,42] Moreover, toothbrushing should be encouraged after meals to decrease the bioavailability of fluoride.[43]

Despite the lower or nonexistent negative impact of mild and very mild enamel fluorosis,[20,44,45] the psychosocial impact of severe fluorosis on the patient's quality of life is devastating.[15,20,41] Young people can make negative value judgments about other young people based on the smile's esthetic appearance and on misconceptions that those suffering from fluorosis do not care about their teeth.[46] During the medical exam, the patient reported being unhappy with and shamed by his smile; he also reported applying liquid paper on the facial surfaces of his anterior teeth to hide the fluorotic enamel surface. De Castilho and others[47] posited that "The clinical characteristics of fluorosis lead to shy, sad, and quiet children who cover their faces with their

hands to express happiness, smile with closed lips, do not participate in school social activities, and avoid talking with their classmates and smiling due to the shame of their dental appearance." The patient reported all of those undesirable situations.

Enamel microabrasion is usually performed on mild to moderately fluorosed teeth, with a clinical success that is more predictable because the stains are more superficial. However, enamel microabrasion only slightly improves or may even be ineffective on the appearance of moderate to severely fluorosed teeth because enamel staining and opacities can penetrate to deeper enamel levels.[48] Thus, the efficacy of the enamel microabrasion technique is closely related to the severity of dental fluorosis.[48] On the other hand, the present clinical case report demonstrated the efficacy of this clinical technique on severely fluorosed teeth. At the beginning of the treatment, the authors were not sure whether the enamel microabrasion would be enough to improve esthetics. The patient and parents were aware that a conservative attempt at correcting the fluorosis would be made (enamel microabrasion) to avoid an excessive loss of tooth structure before adopting a more invasive approach (stain removal with diamond burs followed by resin composite veneer restorations).

Macroabrasion is a simple, low-cost technique that is performed using a fine-tapered diamond bur to lightly abrade and remove superficial stains and enamel irregularities (Figure 3A).[1] This procedure reduces the time needed for removing the fluorotic stains and the amount of microabrasive material to be used, especially when faced with more pronounced and deep intrinsic stains, as in the case of severe enamel fluorosis. Application of the fine-tapered bur is optional, but if it is not used will lead to a longer treatment time and more than three applications of the microabrasive product. Later, the stain removal was complemented and the enamel surface was smoothed using a microabrasive product (Opalustre, Ultradent), which is composed of 6.6% hydrochloric acid associated with abrasive silicon carbide particles, a product that presents an excellent clinical performance in smoothing the enamel irregularities/scratches left by the fine-tapered diamond bur.[5]

After enamel microabrasion, teeth can acquire a yellowish appearance due to the reduction in enamel thickness, which makes the underlying dentin more apparent.[1] Therefore, dental bleaching was adopted in this clinical case to produce a lighter tooth structure that minimized the contrast between the areas of healthy and stained enamel.[49] Previous studies reported that the association of enamel microabrasion and dental bleaching provided better and more satisfying esthetic outcomes compared with enamel microabrasion alone.[19,49] Additionally, the patient in the current case study reported no adverse side effects, such as dental sensitivity or gingival discomfort.

It is important to note that enamel microabrasion is a low-cost, easy, and conservative technique that permanently removes intrinsic stains and has proven clinical efficacy and longevity.[1,3-5,7,8] The simultaneous erosive (hydrochloric acid) and abrasive (silicon carbide particles) action of the microabrasive compound produces the "abrosion effect", a condition that densely compacts the prism-free layer on the enamel surface.[50] Clinically, the consequence is a smooth, shiny, lustrous, and healthy enamel surface (Figures 7 through 9) that maintains its esthetic quality over time.

CONCLUSIONS

Severe enamel fluorosis is a challenging and difficult case for dentists and represents a negative effect on the patient's quality of life. A conservative treatment does not always correct the esthetics of the affected teeth, and sometimes a more invasive restorative treatment is necessary. The present clinical case report described enamel microabrasion and dental bleaching as an effective and safe technique for treating a severe case of enamel fluorosis.

Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of Sao Paulo State University.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presented in this article.

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