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Clinical Technique/Case Report

Case Reports of Enamel Microabrasion Associated with At-home Dental Bleaching After Orthodontic Bracket Removal

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Clinical Relevance

Enamel microabrasion is a successful technique that can be employed for enamel surface regularization/polishing after orthodontic bracket removal.

SUMMARY

Adequate removal of residual bonded materials from the enamel surface after orthodontic bracket debonding is critical, since any remaining composite may compromise enamel surface morphology and esthetics. The following clinical case reports present the association of at-home dental bleaching using 10% carbamide peroxide and the removal of residual bonded material using a super fine, tapered diamond bur followed by the use of an enamel microabrasion product after orthodontic bracket debonding. The proposed treatment considerably improved the esthetics and

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successfully removed the grooves created during the removal of the bonding composite, resulting in a smooth enamel surface.

INTRODUCTION

Resin-based materials are typically used to bond orthodontic brackets to dental enamel surfaces, following adhesive protocols that are well-established in the dental literature.[1] However, thorough removal of adhesive materials is often necessary after orthodontic bracket debonding due to the high bond strength of resin-based materials to enamel surfaces. Several protocols for the removal of these bonding materials have been described to include the use of bracket-removing pliers, tungsten and/or titanium carbide burs, fine/super-fine/ultra-fine burs, aluminum oxide discs, diamond burs, erbium-doped yttrium aluminium garnet laser, ultrasonic tools, "Arkansas" stones, green stones, steel burs, enamel chisels, fiberglass burs, and air-abrasion with bioactive glass.[2-18] However, there is no standardized protocol regarding their effectiveness. Thus, many professionals tend to neglect the important orthodontic treatment step.

The inadequate removal of resin-based materials can result in iatrogenic enamel harm, producing enamel surface morphological alterations that may compromise esthetics and increase biofilm accumulation.[3,19] Although superficial enamel alterations appear to be inevitable during adhesive removal, the damage can be reduced to a negligible level if the proper technique is selected.[4,15-17] It is worth mentioning that the enamel surface should receive a polishing treatment after residue removal, regardless of the technique used. The inclusion of a polishing treatment improves the texture and surface smoothness of the enamel surface, approximating normal clinical conditions.[17,20]

An appropriate clinical technique for the esthetic removal of orthodontic bracket adhesive could include the use of a super-fine diamond bur, followed by the application of a microabrasive paste, and at-home vital-tooth bleaching procedures.[14,15,17,21] A survey[22] of 267 orthodontists showed a high variability in methods used for bracket removal, residue removal, and polishing protocols. Thus, it is important to discuss clinical techniques for the adequate removal of resin-based materials that would "restore" the enamel surface to its pretreatment condition, that is, a technique that reduces the iatrogenic effects to the enamel surface to an insignificant level.[2,23]

The present clinical case series aims to describe the association of at-home dental bleaching with enamel microabrasion for removing grooves created during composite removal. The use of different clinical techniques for the removal of resin-based remnants has also been discussed.

CASE REPORTS

Case Report #1 (At-home Dental Bleaching Followed by Microabrasion)

A 25-year-old female patient presented to the Restorative Dentistry Clinic at the School of Dentistry with a chief complaint of "darkened teeth" one month after orthodontic bracket debonding and the removal of residual bonded material from the buccal surfaces of maxillary incisors, canines, and premolars. The orthodontic treatment was performed for 6 months to correct an open bite in the maxillary anterior teeth region. The patient's teeth presented residual bonded material on the buccal enamel, with morphological surface alterations caused by the adhesive removal procedures, represented by the presence of superficial irregularities and grooves (Figure 1). The proposed

Figure 1. *A 25-year-old patient presenting with residual bonded material and morphological surface alterations in the buccal enamel of maxillary teeth after orthodontic bracket debonding. (A): Intraoral view of anterior teeth. (B): Extra-oral photo of the patient's smile.*

treatment plan was dental bleaching followed by enamel microabrasion. The patient was informed of the negligible and harmless removal of enamel when utilizing the microabrasion technique. The patient was informed on the quality and longevity of the achieved superficial smoothness from enamel microabrasion by a clinician with 30 years of clinical experience.

Initially, at-home dental bleaching was performed in both arches using 10% carbamide peroxide gel (Opalescence 10%; Ultradent Products Inc, South Jordan, UT, USA). The initial shade of the maxillary central incisors was recorded as A2 using a shade guide (Vitapan Classical Shade Guide; Vita Zahnfabrik, Bad Säckingen, Germany) (Figure 2). Maxillary and mandibular acetate trays were fabricated from casts made of the patient's dental arches. During the bleaching treatment, the patient was instructed to place a drop of 10% carbamide peroxide into each tooth section of the acetate trays and to use both trays at the same time for 6–8 hours each day. Three syringes (1.2 mL each) of dental bleaching product were used over 21 days of bleaching treatment. The final shade was recorded as B1 (Figure 3) upon completion of the bleaching treatment. Neither gingival irritation nor dental sensitivity were observed during treatment.

Figure 2. *Initial shade match of maxillary central incisors as A2 (Vitapan Classical Shade Guide; Vita Zahnfabrik).*

Figure 3. *Final shade match of maxillary central incisors as B1 (Vitapan Classical Shade Guide; Vita Zahnfabrik).*

One week after dental bleaching, the residual bonded material was removed from the maxillary teeth using a super-fine tapered diamond bur (15 μm, #3195 FF; KG Sorensen, Barueri, Brazil) in a high-speed handpiece (KaVo 505C Extratorque; KaVo do Brasil Ind) under water-cooling (macroabrasion) (Figure 4A). The enamel surface was verified under reflector light and with tactile assessment using a #5 dental explorer to ensure complete removal of residual resin. Enamel microbrasion was then performed under rubber dam isolation using a microabrasive product (Opalustre; Ultradent Products Inc) to finalize the enamel surface. The microabrasive product was applied using a specific rubber cup (OpalCups; Ultradent Products Inc) in a low-speed handpiece (KaVo MicroMotor; KaVo do Brasil Ind, Joinville, SC, Brazil) and at a slow rotation speed, to prevent splattering of the product (Figure 4B). Three applications of 60 seconds each were performed on each of 4 teeth, with the teeth being rinsed with water/air spray between each application. The enamel surfaces were polished using a fluoride-containing paste (Herjos; Vigodent SA Indústria e Comércio, Rio de Janeiro, Brazil) (Figure 4C), water-rinsed and air-dried, and immediately received a topical application of 2% neutral-pH sodium fluoride gel for 4 minutes

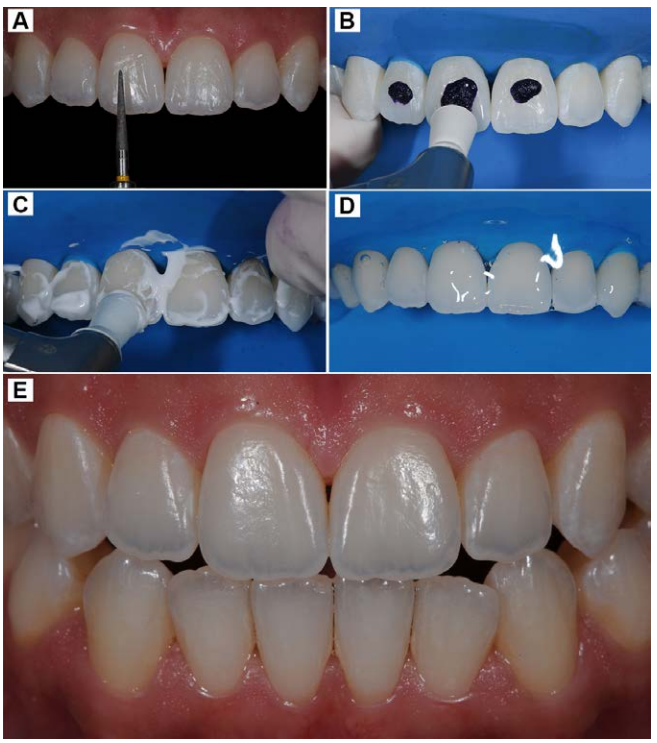

Figure 4. *(A): Removal of bonded material using a fine-tapered diamond bur. (B): Application of enamel microabrasive product. (C): Polishing of enamel surfaces with fluoride paste. (D): Topical application of 2% neutral-pH sodium fluoride gel. (E): 14-day follow-up.*

(Figure 4D). A 14-day follow-up was performed, and excellent clinical results were observed for the enamel surface (Figure 4E).

Impressions of the upper and lower central incisors were taken before and after the clinical procedures using polyvinyl siloxane impression material (Express XT Putty and Light Body; 3M Oral Care, St Paul, MN, USA) in order to fabricate epoxy resin (Epo-thin resin; Buehler, Düsseldorf, Germany) replicas to evaluate the enamel surface under a stereo-microscope (SteREO Discovery.V20; Carl Zeiss Microscopy GmbH, Jena, Germany) under 7.5x and 30x magnifications (Figures 5, 6, and 7). The middle-thirds of the buccal surfaces of all teeth demonstrated that the application of the microabrasive product, after the use of a diamond bur for the removal of residual resin material, was effective for creating a uniform and smooth enamel surface.

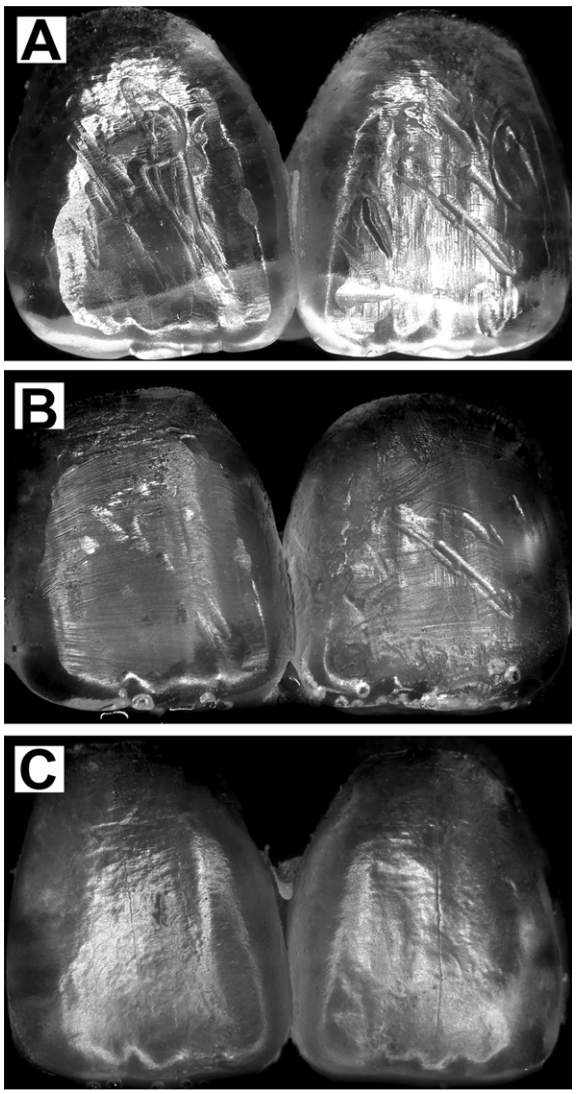

Figure 5. *Microscopic images of buccal surface of maxillary central incisors. (A): Initial. (B): After macroabrasion for removal of residual bonded material with application of a diamond fine-tapered bur. (C): After application of enamel microabrasive, at 7.5x magnification.*

Case Report #2 (Microabrasion Followed by At-home Dental Bleaching)

An 18-year-old female patient presented to the Restorative Dentistry Clinic at the School of Dentistry, with residual

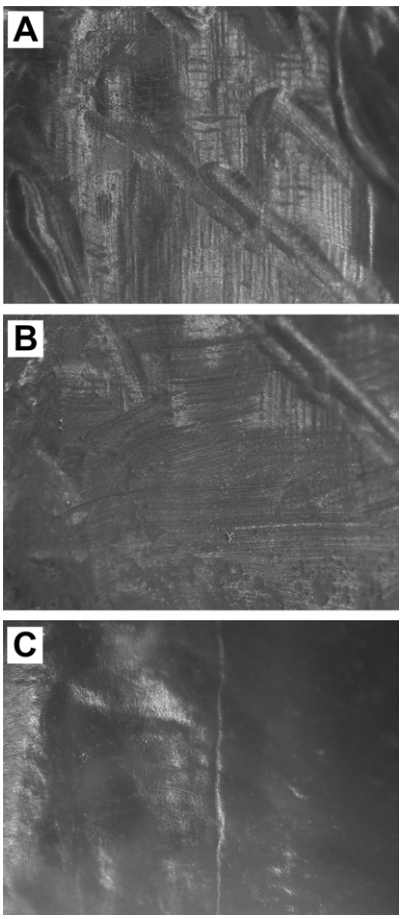

Figure 6. *Microscopic images of buccal surface of maxillary central incisors. (A): Initial. (B): After macroabrasion for removal of residual bonded material with application of a diamond fine-tapered bur. (C): After application of enamel microabrasive, at 30x magnification.*

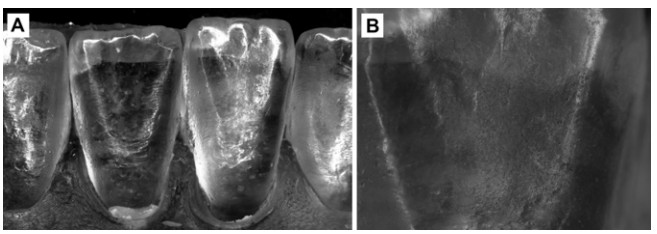

Figure 7. *Microscopic images of buccal surfaces of mandibular central incisor teeth. (A): At 7.5x magnification. (B): At 30x magnification.*

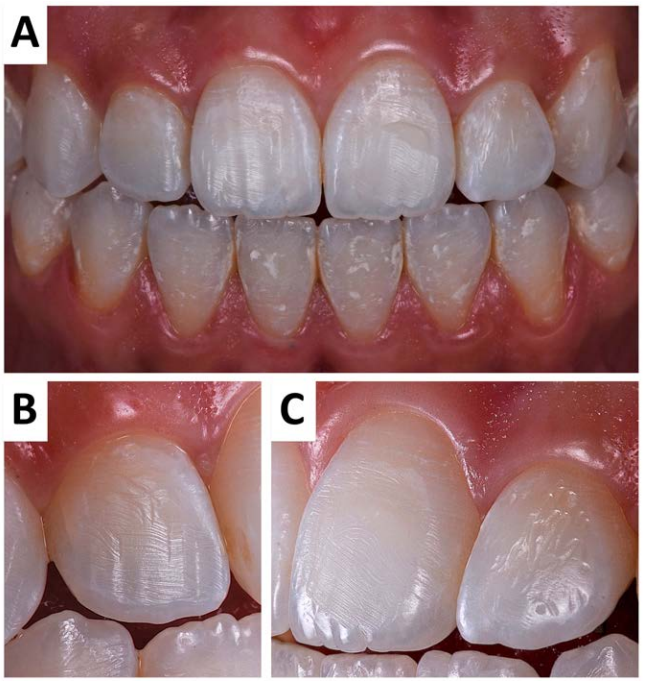

Figure 8. *Initial view after bracket debonding (A), depicting scratched enamel surfaces due to improper removal of resin cement (B and C).*

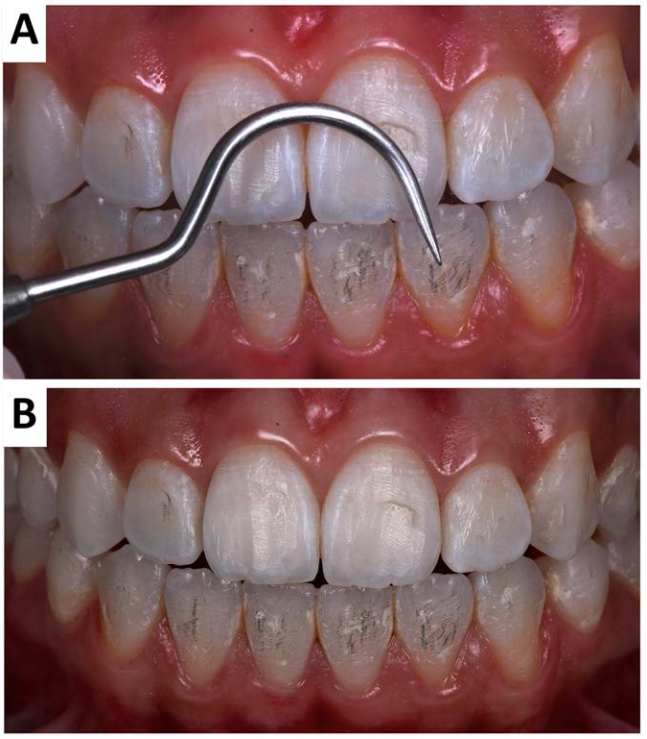

Figure 9. *Resin cement highlighted with an exploratory probe (A and B).*

bonded material and morphological alterations on the buccal surfaces of her maxillary and mandibular incisors, canines, and premolars (Figures 8 and 9). The orthodontic treatment was performed to correct an open bite in the maxillary anterior teeth region. The proposed treatment plan was dental bleaching followed by enamel microabrasion. The patient was informed of the negligible and harmless removal of enamel when utilizing the microabrasion technique. The patient was informed on the quality and longevity of the achieved superficial smoothness from enamel microabrasion by a clinician with 30 years of clinical experience.

The protocol used for removing the residual bonded material and enamel grooves/irregularities started with a super-fine diamond bur (15 μm, #3195 FF; KG Sorensen) (Figure 10), followed by microabrasion of the enamel under rubber dam isolation, with 3 applications of the microabrasive product (Opalustre; Ultradent Products Inc), using a specified rubber cup (Figure 11). The enamel surfaces were polished using a fluoride paste (Herjos; Vigodent SA Indústria e Comércio) (Figure 12A), water-rinsed and air-dried, followed by the immediate topical application of 2% neutral-pH sodium fluoride gel for 4 minutes (Figure 12B). Effective regularization and adequate smoothness of the enamel surface was obtained.

After one week, at-home dental bleaching using a 10% carbamide peroxide (Opalescense; Ultradent Products

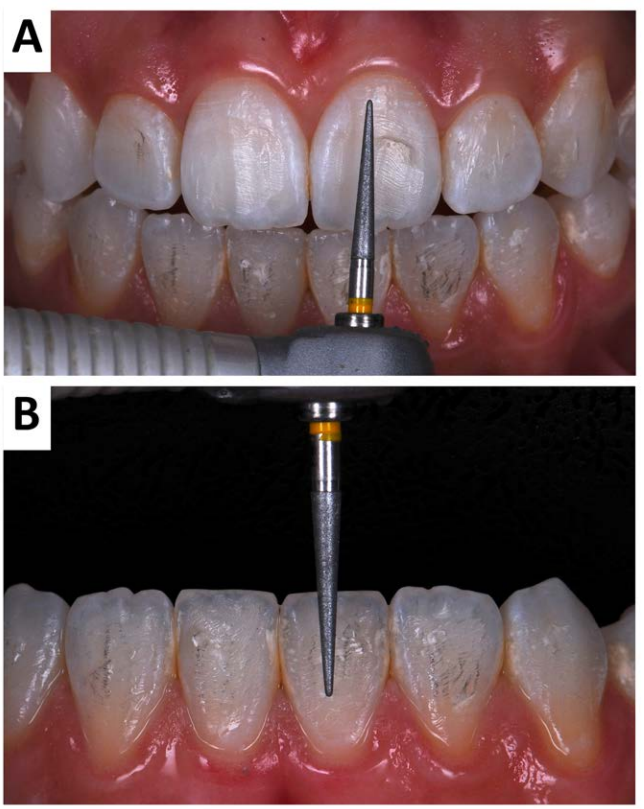

Figure 10. *Residual resin cement removal using a fine-tapered diamond bur (A and B).*

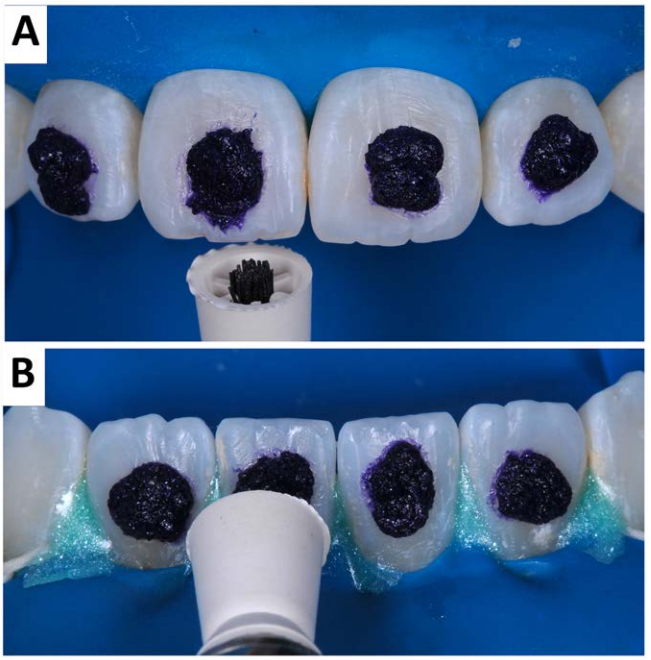

Figure 11. *Application of the microabrasive product (Opalustre; Ultradent Inc) on the facial surface using a specific rubber cup (OpalCups; Ultradent Inc) (A and B).*

Figure 12. *Application of a prophylaxis paste (A) followed by 2% neutral-pH sodium fluoride gel (B).*

Inc) for 2 weeks was prescribed. The initial and final shades of the maxillary central incisors were recorded as A1 and B1, respectively, using a shade guide (Vitapan Classical Shade Guide; Vita Zahnfabrik) (Figure 13).

DISCUSSION

Removal of bonded orthodontic brackets involves the risk of damaging the enamel surface and altering its morphology. Restoring the enamel to its original morphology, to include surface regularity and texture, is an even bigger challenge. The bonding procedures of orthodontic brackets to the tooth structure involves acid etching of the enamel surface and resin-based materials (adhesive systems, resin composites, resin cements). Upon completion of orthodontic treatment, and subsequent bracket removal/debonding, the enamel surfaces must be carefully treated so that the residual bonded material is properly removed in order to prevent surface alterations. All these steps involve the risk of damaging the enamel surface and changing its original morphology.[18] Improper residue removal can lead to discoloration and increased biofilm accumulation.[3,19] The present clinical case series describes the use of an enamel microabrasion technique after orthodontic bracket removal in order to produce a smooth enamel surface, after the use of a super-fine diamond bur for the removal of bonded resin-based materials.

Figure 13. *Final aspect after home-dental bleaching using carbamide peroxide, depicting a smooth, clean, and healthy upper (A) and lower (B) enamel surface.*

Although *in vitro* studies describe different residue removal methods after bracket debonding, there is no consensus on which technique is most suitable for addressing the damage caused to the enamel. A systematic review[5] reported that the most popular technique for residue removal was the use of tungsten carbide burs, which was deemed a faster and more effective technique when compared with the use of aluminum oxide discs, ultrasonic tools, hand instruments, rubber points, and/or diamond composite burs. However, the use of tungsten carbide burs may not be enough to completely remove the residual bonded material.[24-26] Furthermore, when these burs are used in association with high-speed handpieces, the enamel surface roughness can increase, similar to the roughness caused by an ultra-fine diamond bur.[4]

The use of diamond burs leads to the formation of grooves on the enamel surface that are proportional to the abrasives present in these burs[17] (Figure 1). Similarly, the use of aluminum oxide discs can also create grooves/scratches on the enamel surface,[6] which also require a polishing protocol to minimize damage to the enamel surface. Another study[27] reported that the association of a fine diamond bur with twelve 20-fluted carbide burs after bracket debonding yielded a rougher enamel surface than a sound enamel surface. Based on multiple reports, it is possible to conclude that proper residue removal from the enamel surface without damage to the enamel is difficult to achieve.[3]

Another protocol has been suggested[6] by using a 30-blade tungsten carbide bur at high-speed, followed by abrasive-containing rubber tips (Enhance; Dentsply Sirona, Inc, York, PA, USA) and a final polishing with aluminum oxide paste. This procedure seems to produce less harm to the enamel surface and requires less chair-side time. Polishing with a pumice paste has been shown to be inadequate for providing adequate enamel surface roughness after residue removal using 12 (fine), 16 (super-fine), and 20 (ultra-fine) blade titanium carbide burs.[7,13] A split-mouth design clinical study[20] observed that the use of either aluminum oxide discs or a microabrasive product were efficient methods for smoothing the surface of dental enamel. However, the application of the microabrasive product more consistently regularized the dental enamel surfaces independently of the number and/or magnitude of grooves, while the aluminum oxide discs were not efficient for surfaces with deeper grooves and irregularities. This fact could be observed in the images of Case Report #1, which were made with the stereo microscope under 7.5x and 30x magnification (Figures 5 and 6).

The microabrasion technique is commonly employed to remove intrinsic stains or smooth enamel, resulting in an increased glossiness.[17,28,29] In addition, an enamel surface with reduced roughness is more resistant to colonization by Streptococcus mutans.[30] This "abrasion effect" is created by the compaction of minerals from the product's abrasive acid action on the dental enamel.[31,32] The microabrasion technique removes 25 μm of dental enamel for each 1-minute application (10 applications would remove 200 μm), on average.[15] It is worth mentioning that only 3 applications of the microabrasive product were used for each of the presented case reports, suggesting minimal enamel loss when compared with the amount of remaining enamel. Therefore, enamel microabrasion can be considered a minimally invasive approach that may be safely used for this purpose. A microscopic analysis was conducted for Case Report #1 (Figures 5 and 6) in order to assess if the acid/abrasive action reached the deeper regions of the superficial enamel grooves, leaving them considerably regular and polished. This was evident by comparing the buccal surface of the maxillary central incisors to the buccal surfaces of the mandibular central incisors, which were and were not submitted to orthodontic treatment, respectively (Figure 7).

Both clinical cases in the present report resulted in desirable shade alteration without sensitivity during and/or after the treatment. The recommendation of when the bleaching procedures should be conducted (prior to or after residue removal) did not affect shade alteration. The action of the bleaching product occurs intrinsically by diffusion of their by-products through the entire dental substrate and is not affected by the presence of a small amount of resin-bonded material.[14] It should be noted that for Case Report #1 both dental arches required the same 21 days of bleaching treatment for a satisfactory result, even with the mandibular arch having no residual bonded material, since it did not receive orthodontic treatment.

The presence of residual bonding material and superficial grooves in both clinical cases were clearly visible on the buccal surfaces after bracket debonding, justifying the application of a diamond bur followed by enamel microabrasion, a technique commonly employed.[14-17] The enamel microabrasion technique allowed for adequate removal of the residual bonding material and regularization of the enamel surface through the acid/abrasive action of the microabrasive product. Removing the adhesive remnants with a super-fine diamond bur (macroabrasion) did not lead to substantial enamel loss, but it promoted complete removal of the adhesive materials, as seen in Figures 5 and 6. Enamel microabrasion achieved a highly polished/smooth enamel surface; consequently, glossy and natural-looking enamel can be verified in Figures 4E and 13.

CONCLUSIONS

The association of at-home dental bleaching with enamel microabrasion was effective for obtaining satisfactory shade alteration associated with a smooth and regular enamel surface after orthodontic bracket debonding, highly contributing to improved dental esthetics.

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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