©Operative Dentistry, 2016, **41-1,** 8-14

# Treatment of Enamel Surfaces After Bracket Debonding: Case Reports and Long-term Follow-ups

RH Sundfeld • LM Franco • LS Machado
NIP Pini • FM Salomao • RB Anchieta
D Sundfeld



### Clinical Relevance

After bracket debonding and mechanical removal of residual bonded material, the use of enamel microabrasion can be an excellent method for restoring the morphologic characteristics of the enamel surface.

*Renato Herman Sundfeld, DDS, MS, PhD, professor, Araçatuba Dental School, UNESP – São Paulo State University, Department of Restorative Dentistry, Araçatuba, SP, Brazil

Laura Molinar Franco, DDS, MS, PhD student, Araçatuba Dental School, UNESP – São Paulo State University, Department of Restorative Dentistry, Araçatuba, SP, Brazil

Lucas Silveira Machado, DDS, MS, PhD, postdoctoral fellow, Araçatuba Dental School, UNESP – São Paulo State University, Department of Restorative Dentistry, Araçatuba, SP, Brazil

Núbia Inocêncya Pavesi Pini, DDS, MS, PhD student, Department of Restorative Dentistry, Piracicaba Dental School, UNICAMP – University of Campinas, Piracicaba, SP, Brazil

Fábio Martins Salomão, DDS, MS, PhD student, Araçatuba Dental School, UNESP – São Paulo State University, Department of Restorative Dentistry, Araçatuba, SP, Brazil

Rodolfo Bruniera Anchieta, DDS, MDS, PhD, Centro Universitário do Norte Paulista - UNORP, São José do Rio Preto, SP, Brazil.

Daniel Sundfeld, DDS, MDS, PhD student, Department of Restorative Dentistry, Piracicaba Dental School, UNICAMP – University of Campinas, Piracicaba, SP, Brazil

*Corresponding author: R José Bonifácio 1193, Araçatuba, SP, 16015-050, Brazil; e-mail: sundfeld@foa.unesp.br

DOI: 10.2341/15-003-T

## SUMMARY

**After bracket debonding, residual bonded material may be observed on the enamel surface. When not properly removed, this residual material can interfere with the surface smoothness of the enamel, potentially resulting in staining at the resin/enamel interface and contributing to biofilm accumulation. Clinical case reports demonstrate clinical procedures to remove residual bonded material after bracket debonding. A water-cooled fine tapered 3195 FF diamond bur was used to remove the residual bonded material. Subsequently, the enamel surface was treated with Opalustre microabrasive compound. After one week, overnight dental bleaching was initiated using 10% carbamide peroxide in custom-formed trays for four weeks. The enamel microabrasion technique was found to be effective for polishing the enamel surface and for reestablishing the dental esthetics associated with dental bleaching. Longitudinal clinical controls of other clinical cases are presented.**

## INTRODUCTION

The aim of orthodontic treatment is to correct the malpositioning of teeth, which can affect the pa-

Figure 1. *Example of resin cement remaining after bracket debonding.*

tient's mastication, speech, and hygiene. Consequently, the functional correction can also provide better dental esthetics by providing harmony between the teeth and smile. Nevertheless, there are concerns regarding the adhesion of brackets, including the need for sufficient bond strength, ease of debonding, and the limited risk of permanent damage to the enamel surface.[1]

At the conclusion of orthodontic treatment and after bracket debonding, residual bonding material may remain on the facial enamel surface (Figure 1), which may clinically influence the esthetics of the enamel and smile.[2] When not properly removed, this retained resin bonding material interferes with surface smoothness of the enamel, potentially resulting in staining at the resin/enamel interface and contributing to biofilm accumulation.[3,4]

Several protocols have been proposed for removing the residual bonding material, such as using pliers; using diamond, carbide, or tungsten burs; and polishing with discs, cups or points or with impregnated aluminum abrasive discs.[3,5-9] Ultrasonic removal and bioactive-glass air-abrasion have also been reported in the literature.[6,10] Regardless of how carefully the residual material is removed, however, iatrogenic damage to the enamel after debonding procedures is inevitable.[3,11] No instrument can achieve complete composite removal without affecting the enamel surface.[2,12] Therefore, these techniques result in some superficial damage to the enamel surface, inducing scratches or grooves on enamel tissue, which can affect the anatomical shape and surface smoothness.[8,13,14] Additionally, improper debonding can result in cracks on the enamel surface or fracture of the enamel prisms.[3] As a consequence, tooth sensitivity, increasing risk of caries, and pulp necrosis can occur,[3] especially when dealing with ceramic brackets.[1]

Figure 2. *A 25-year-old male patient who presented with residual bonded material on the maxillary and mandibular facial surface after removal of orthodontic brackets.*

To obtain a smoother and more regular enamel surface, some studies[15-18] have proposed removing residual material by using a diamond bur in a high-speed handpiece under water cooling and subsequent enamel microabrasion. The microabrasion technique is used to remove superficial intrinsic stains and to repair superficial enamel defects. Microabrasion has shown excellent clinical results, both immediately after its completion and after long-term follow-up.[19-22]

The current study presents clinical case reports that describe the steps for removing the residual material after orthodontic bracket debonding, followed by enamel microabrasion and dental bleaching. The effectiveness and longevity of the treatment are evaluated using scanning electron microscope (SEM) images and through the long-term results of previous clinical cases.

## CASE REPORT

After bracket removal with orthodontic pliers, a 25-year-old male patient presented to a dental clinic with residual bonded material on the facial surface of teeth in the upper and lower arches (Figure 2). All of the necessary clinical procedures required to remove the material were explained to the patient, who consented to the treatment. An initial impression was made of the teeth before the clinical procedures using a silicone impression material (Express XT Putty and Light body, 3M ESPE, St Paul, MN, USA) in order to analyze the enamel surface under SEM. After professional prophylaxis with pumice and water, the remaining bonding material was scratched with an explorer probe to highlight the remaining resinous material and to guide the operator during its removal (Figure 3). Then, a fine-tapered diamond bur (3195 FF, KG

Figure 3. *Resin bonding material was highlighted with an explorer to guide the operator during its removal procedure.*

Sorensen, Barueri, Brazil) was used to remove the resin remnants (Figure 4) under water-cooling until no residual material could be identified by air-drying followed by scratching the enamel surface with an explorer. After complete removal, a new impression was made as previously described. The upper arch was then isolated with a rubber dam. The operator, dental assistant, and patient's eyes were protected during all clinical procedures.

Opalustre enamel microabrasion compound (Ultradent Products Inc, South Jordan, UT, USA) was applied to the enamel surfaces using a specific rubber cup (OpalCups, Ultradent Products Inc) with enclosed brush bristles specifically developed for this purpose (Figure 5). The cup was coupled with a low-rotation micromotor, and the compound was applied using a very slow speed to prevent splattering. Three applications were performed on each of four teeth for a period of 60 seconds. After each application, the teeth were rinsed with water/air spray. Later, the surfaces were polished with 1200-ppm fluoride paste (Herjos, Vigodent SA Indústria e Comércio, Rio de Janeiro, Brazil) and then washed and dried. The immediate aspect after the microabrasion is represented in Figure 6. A topical application of 2% neutral-pH sodium fluoride gel (FGM Products, Joinvile, Brazil) was performed on the treated enamel surfaces for four minutes. A final impression was taken. The same procedures were performed at the next session for the lower arch.

Figure 5. *Enamel microabrasion using Opalustre.*

One week after completing the procedures, overnight vital dental bleaching was performed using 10% carbamide peroxide (Opalescence, Ultradent Products Inc) in custom-formed trays for four weeks. The patient was instructed to place a small drop of the bleaching gel into each tooth section, from the second premolar to the second premolar. The final presentation is shown in Figure 7.

Epoxy resin was used to cast the impressions. Before examination, the samples were positioned on aluminum stubs and subjected to a vacuum in a sputter coater (SCD-5 sputter coater, Oerlikon Balzers, Bingen, Germany) for deposition of a thin layer of gold in order to increase the surface reflectance. Qualitative images were obtained from a SEM (JSM 5600LV, JEOL, Tokyo, Japan) operating under 15 kV (Figures 8 through 11).

Figures 12 and 13 represent follow-ups of similar clinical cases in which the patients were treated using the same technique described in the present case on patients after 14 years and 18 years, respectively.

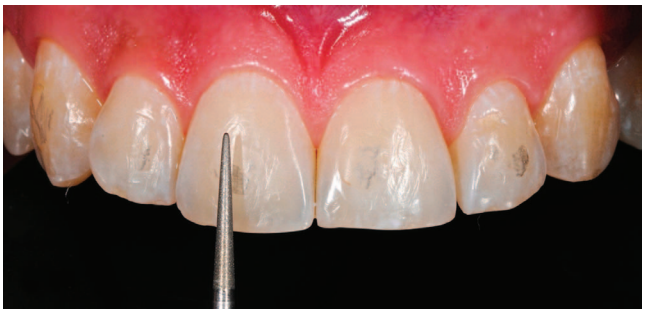

Figure 4. *Residual bonded resin removal using a fine-tapered 3195 FF diamond bur on the facial surfaces of the maxillary arch.*

Figure 6. *Appearance of the teeth immediately after enamel microabrasion.*

Figure 7. *Appearance of the teeth one month after microabrasion and dental bleaching. No residual bonding material was found.*

## DISCUSSION

The process of debonding orthodontic brackets should include creating an enamel surface that is as close as possible to its pretreatment condition.[12,23,24] Therefore, the enamel microabrasion technique was used in the current case study to promote a smoother enamel surface after removing the remaining resin with a fine-tapered diamond bur. The present study reports three clinical cases (some with long-term follow-up and SEM images) that showed the effectiveness of the enamel microabrasion technique in creating smooth enamel after removing the resin bonded material with a fine-tapered diamond bur and approximating the original state of the enamel surface.

Possible failure types after bracket debonding are adhesive between the enamel and the adhesive resin, partially adhesive and cohesive in the adhesive resin (mixed), or adhesive between the bracket base and the adhesive resin, with the latter two requiring removal of remaining resin.[11] Although some reports have suggested the use of tungsten carbide burs to remove the resin bonded material,[9,24,25] Alessandri Bonetti and others[2] reported that 20.8% of tooth surfaces still had composite remnants when using a high-speed 12-bladed tungsten carbide bur followed by finishing with graded medium, fine, and superfine Sof-Lex discs. Ulusoy[3] found adhesive remnants on the enamel surface with either 30- or 12-fluted tungsten carbide burs. Øgaard

Figure 8. *(a and c): SEM images showing enamel facial surfaces of the upper incisors after bracket removal. (b): Clinical aspect of residual bonded material on the facial surfaces of upper incisors after bracket removal.*

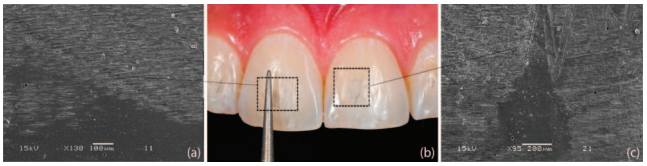

Figure 9. *(a and c): SEM images showing scratches on the facial enamel surfaces of the upper incisors after bracket removal and the application of a fine-tapered diamond. (b): Removal of residual bonded material using a fine-tapered diamond.*

and Fjeld[1] claimed that the use of tungsten carbide burs in a slow-speed handpiece or debonding pliers may result in adhesive material being left on the enamel after debonding. Ryf and others[14] also observed a large amount of composite on the enamel surface after grinding with carbide burs.

Some practitioners prefer conventional diamond burs for the removal of composite remnants; however, these burs may scratch the enamel because of their shape and sharpness, regardless of the care and experience of the practitioner.[3] The scratches that are left by conventional diamond burs are influenced by the speed and pressure of the bur on the tooth surface.[13] The fine-tapered diamond bur was chosen in these clinical reports because it is able to remove all remaining materials. However, even with the literature advocating the use of different clinical procedures to obtain a more regular and smooth surface after removal of the residual bonded material,[8,11,13,26,27] it has been observed that the enamel does not recover the characteristics of unaltered enamel.

The use of burs results in deep gouges on the enamel surface and an increase in surface roughness.[9] Thus, the finishing of enamel surfaces after removing directly bonded attachments is essential.[9] Eliades and others[8] reported that there was no consistent roughness-reducing effect of finishing with aluminum oxide discs, regardless of the resin removal protocol used. Additionally, those aluminum oxide discs have been reported to leave adhesive remnants on the enamel surface.[28] On the other hand, the use of polishing/silicone brushes is not sufficient for removing the bonded materials[3,14] or

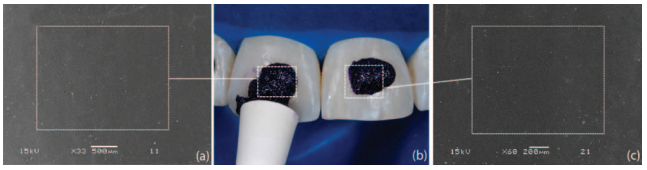

Figure 10. *(a and c): SEM images showing smooth and regular enamel of the upper incisors after the application of Opalustre. (b): Application of the enamel microabrasion compound (Opalustre).*

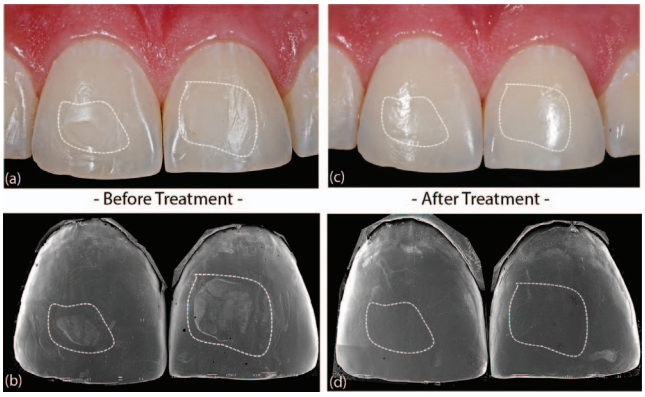


Figure 11. *(a and b): Clinical and SEM images showing the initial condition of the upper central incisors after orthodontic treatment revealing residual bonded material. (c and d): Clinical and SEM images representing the facial enamel surface and the complete removal of the residual bonded material after application of a fine-tapered diamond bur followed by enamel microabrasion. The technique was able to regain the natural aspect of enamel eliminating scratches/grooves.*

the grooves and scratches created by the burs.[3,8] Polishing systems with good composite polishing properties may leave a lustrous surface and more composite remnants because they become invisible to the naked eye,[14] a condition that hinders removal by the operator.

In the present study, the microabrasion technique was adopted as a finishing procedure. This technique is indicated for removing intrinsic enamel stains, superficial irregularities of hard surfaces, or any coloration that can compromise dental esthetics.[17,19-22,29-31] Application of the microabrasive compound promotes superficial enamel demineralization, followed by the subsequent polishing of the surface. This polishing is possible because the technique combines the erosive and abrasive effects of the microabrasive mixture, which contains low acid concentrations (hydrochloric acid 6.6%) and an abrasive agent (silica), applied mechanically using a low-rotation micromotor.[22] The procedure has been shown to be a safe and conservative treatment,[19,32,33] and the enamel wear is clinically imperceptible.[21,22] Sundfeld and others[16] observed enamel loss ranging from 25 μm to 200 μm for 1 and 10 applications, of one minute each, respectively, when using the Opalustre product. They concluded that this enamel loss may be considered clinically irrelevant compared with the remaining enamel surface because enamel thickness may exceed 1400 μm.[34]

Indeed, as observed in this clinical case report, other studies[15-18] have also verified and demonstrated the versatility of enamel microabrasion after bracket debonding; those studies have indicated that


Figure 12. *(a): Patient with residual bonded resin on the maxillary and mandibular teeth. (b and c): Fourteen years after resin removal, enamel microabrasion, and teeth bleaching. Note the polished, healthy, and shiny enamel.*

this technique is ideal for complete enamel surface finishing because the diamond bur produces grooves that correspond to the size of the abrasive diamond particles.[15] The microabrasion technique provides an enamel surface that is regular, smooth, and lustrous over time[15-17,19] because of the abrasion effect promoted by the technique.[31,35] The simultaneous abrasion and acid erosion of enamel prisms may compact mineralized tissue within the organic area, replacing the outer layer of prism-rich enamel with a densely compacted, prism-free region.[35] The resultant enamel presents a glass-like surface, changing its optical properties and resulting in a glossy surface.[22,36] Furthermore, Segura and others[37] used polarized light microscopy to demonstrate that a surface submitted to this microabrasion technique shows a higher resistance to demineralization and to colonization by *Streptococcus mutans*.

During and after dental bleaching, the teeth did not show sensitivity, corroborating the findings of Brauchli and others [5] and Sundfeld and others.[19,38] Those studies demonstrated that the use of carbamide peroxide-based bleaching agents in custom trays can be prescribed safely after microabrasion if applied on nondecayed or well-restored teeth that do not have exposed dentin at the cervical or incisal regions and under the supervision of a dental professional.

One may claim that the association of debonding + diamond bur + enamel microabrasion would result in an enamel loss that, somehow, could affect the enamel properties. However, after 18 years, the treatment demonstrated in the current case report showed great clinical results, notably polished, healthy, and shining enamel (Figures 12 and 13).


Figure 13. *(a): Patient with residual bonded resin on the maxillary and mandibular teeth. (b and c)" Eighteen years after resin removal, enamel microabrasion, and teeth bleaching. Note the polished, healthy, and shiny enamel.*

Indeed, the association of enamel microabrasion with dental bleaching produced satisfactory esthetics to patients over 18 years of clinical analysis.

## CONCLUSION

Enamel microabrasion was effective for creating a more natural enamel surface texture after the removal of resin bonded material when using a fine-tapered diamond bur. Long-term follow-ups and SEM analyses attested to the safety and efficacy of the applied technique.

### Regulatory Statement

This study was conducted at the Aracatuba Dental School – State University of São Paulo UNESP.

### Conflict of Interest

The authors 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.

*(Accepted 10 March 2015)*

### REFERENCES


1. Øgaard B, & Fjeld M (2010) The enamel surface and bonding in orthodontics *Seminars in Orthodontics* **16(1)** 37-48.
2. Alessandri Bonetti G, Zanarini M, Incerti Parenti S, Lattuca M, Marchionni S, & Gatto MR (2011) Evaluation of enamel surfaces after bracket debonding: An in-vivo study with scanning electron microscopy *American Journal of Orthodontics and Dentofacial Orthopedics* **140(5)** 696-702.
3. Ulusoy C (2009) Comparison of finishing and polishing systems for residual resin removal after debonding *Journal of Applied Oral Science* **17(3)** 209-215.
4. Joo HJ, Lee YK, Lee DY, Kim YJ, & Lim YK (2011) Influence of orthodontic adhesives and clean-up procedures on the stain susceptibility of enamel after debonding *Angle Orthodontist* **81(2)** 334-340.
5. Brauchli LM, Baumgartner EM, Ball J, & Wichelhaus A (2011) Roughness of enamel surfaces after different bonding and debonding procedures: An in vitro study *Journal of Orofacial Orthopedics* **72(1)** 61-67.
6. Banerjee A, Paolinelis G, Socker M, McDonald F, & Watson TF (2008) An in vitro investigation of the effectiveness of bioactive glass air-abrasion in the 'selective' removal of orthodontic resin adhesive *European Journal of Oral Sciences* **116(5)** 488-492.
7. Brosh T, Strouthou S, & Sarne O (2005) Effects of buccal versus lingual surfaces, enamel conditioning procedures and storage duration on brackets debonding characteristics *Journal of Dentistry* **33(2)** 99-105.
8. Eliades T, Gioka C, Eliades G, & Makou M (2004) Enamel surface roughness following debonding using two resin grinding methods *European Journal of Orthodontics* **26(3)** 333-338.
9. Retief DH, & Denys FR (1979) Finishing of enamel surfaces after debonding of orthodontic attachments *Angle Orthodontist* **49(1)** 1-10.
10. Krell KV, Courey JM, & Bishara SE (1993) Orthodontic bracket removal using conventional and ultrasonic debonding techniques, enamel loss, and time requirements *American Journal of Orthodontics and Dentofacial Orthopedics* **103(3)** 258-266.
11. Pont HB, Özcan M, Bagis B, & Ren Y (2010) Loss of surface enamel after bracket debonding: An in-vivo and ex-vivo evaluation *American Journal of Orthodontics and Dentofacial Orthopedics* **138(4)** 387.e1-9.
12. Ozer T, Başaran G, & Kama JD (2010) Surface roughness of the restored enamel after orthodontic treatment *American Journal of Orthodontics and Dentofacial Orthopedics* **137(3)** 368-374.
13. Zarrinnia K, Eid NM, & Kehoe MJ (1995) The effect of different debonding techniques on the enamel surface: An in vitro qualitative study *American Journal of Orthodontics and Dentofacial Orthopedics* **108(3)** 284-293.
14. Ryf S, Flury S, Palaniappan S, Lussi A, van Meerbeek B, & Zimmerli B (2012) Enamel loss and adhesive remnants following bracket removal and various clean-up procedures in vitro *European Journal of Orthodontics* **34(1)** 25-32.
15. Sundfeld RH, Rahal V, Croll TP, De Aalexandre RS, & Briso AL (2007) Enamel microabrasion followed by dental bleaching for patients after orthodontic treatment—Case reports *Journal of Esthetic and Restorative Dentistry* **19(2)** 71-77.
16. Sundfeld RH, Croll TP, & Killian CM (2002) Smile recovery VII—Efficacy and versatility of enamel microabrasion technique *Jornal Brasileiro de Dentística Estética* **1(1)** 77-86.
17. Sundfeld RH, Mauro JS, Briso ALF, Komatsu J, Castro MAM, Vidotti MAL, & Martins FC (1999) Smile recovery II—Effect of microabrasion and bleaching techniques *Revista Brasileira Odontológica* **56(6)** 311-318.
18. Croll TP, & Bullock GA (1994) Enamel microabrasion for removal of smooth surface decalcification lesions *Journal of Clinical Orthodontics* **28(6)** 365-370.
19. Sundfeld RH, Franco LM, Gonçalves RS, de Alexandre RS, Machado LS, & Neto DS (2014) Accomplishing esthetics using enamel microabrasion and bleaching—A case report *Operative Dentistry* **39(3)** 223-227.
20. Sundfeld RH, Sundfeld-Neto D, Machado LS, Franco LM, Fagundes TC, & Briso AL (2014) Microabrasion in tooth enamel discoloration defects: Three cases with long-term follow-ups *Journal of Applied Oral Science* **22(4)** 347-354.
21. Pini NIP, Sundfeld-Neto D, Aguiar FHB, Sundfeld RH, Martins LRM, Lovadino JR, & Lima DANL (2015) Enamel microabrasion: An overview of clinical and scientific considerations *World Journal of Clinical Cases* **3(1)** 34-41.
22. Sundfeld RH, Croll TP, Briso AL, de Alexandre RS, & Sundfeld Neto D (2007) Considerations about enamel microabrasion after 18 years *American Journal of Dentistry* **20(2)** 67-72.

23. Shuler FS, & van Waes H (2003) SEM-evaluation of enamel surfaces after removal of fixed orthodontic appliances *Amercian Journal of Dentistry* **16(6)** 390-394.

24. Campbell PM (1995) Enamel surfaces after orthodontic bracket debonding *Angle Orthodontist* **65(2)** 103-110.

25. Oliver RG, & Griffiths J (1992) Different techniques of residual composite removal following debonding—Time taken and surface enamel appearance *British Journal of Orthodontics* **19(2)** 131-137.

26. Ahrari F, Akbari M, Akbari J, & Dabiri G (2013) Enamel surface roughness after debonding of orthodontic brackets and various clean-up techniques *Journal of Dentistry (Tehran)* **10(1)** 82.93.

27. Hong YH, & Lew KK (1995) Quantitative and qualitative assessment of enamel surface following five composite removal methods after bracket debonding *European Journal of Orthodontics* **17(2)** 121-128.

28. Eminkahyagil N, Arman A, Cetinşahin A, & Karabulut E (2006) Effect of resin-removal methods on enamel and shear bond strength of rebounded brackets *Angle Orthodontist* **76(2)** 314-321.

29. Sundfeld RH, Komatsu J, Russo M, Holland C Jr, Castro MAM, Quintella LPAS, & Mauro SJ (1990) Removal of enamel stains: Clinical and microscopic study. *Revista Brasileira de Odontologia* **47(3)** 29-34.

30. Croll TP (1997) Enamel microabrasion: Observations after 10 years *Journal of the American Dental Association* **128(Supplement)** 45S-50S.

31. Croll TP (1991) *Enamel Microabrasion* Quintessence, Chicago, IL.

32. Wang Y, Sa Y, Liang S, & Jiang T (2013) Minimally invasive treatment for esthetic management of severe dental fluorosis: a case report *Operative Dentistry* **38(4)** 358-362.

33. Nashan FP, da Silva LM, Bassegio W, Franco EB, Francisconi PA, Mondelli RF, & Wang L (2011) Conservative approach for a clinical resolution of enamel white spot lesions *Quintessence International* **42(5)** 423-426.

34. Koprowski R, Machoy M, Woźniak K, & Wróbel Z (2014) Automatic method of analysis of OCT images in the assessment of the tooth enamel surface after orthodontic treatment with fixed braces *Biomedical Engineering Online* **13(48)**.

35. Donly KJ, O'Neill M, & Croll TP (1992) Enamel microabrasion: A microscopic evaluation of the "abrosion effect" *Quintessence International* **23(3)** 175-179.

36. Croll TP, & Helpin ML (2000) Enamel microabrasion: A new approach *Journal of Esthetic and Restorative Dentistry* **12(2)** 64-71.

37. Segura A, Donly KJ, & Wefel JS (1997) The effects of microabrasion on demineralization inhibition of enamel surfaces *Quintessence International* **28(7)** 463-466.

38. Sundfeld RH, Rahal V, de Alexandre RS, Briso AL, & Sundfeld Neto D (2011) Smile restoration through use of enamel microabrasion associated with tooth bleaching *Compendium of Continuing Education in Dentistry* **32(3)** e53-e57.