EVALUATION "IN SITU" OF TAG FORMATION IN DENTAL ENAMEL SUBMITTED TO MICROABRASION TECHNIQUE. EFFECT OF TWO ETCHING TIMES

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ABSTRACT

The objective of this study was to analyze the formation of resin tags on enamel surfaces submitted or not to enamel microabrasion technique. Thirteen undergraduate dental students received removable acrylic palatal appliances on which four sections from intact premolars were fixed, measuring 4.0 mm X 4.0 mm. Two sections received the application of a microabrasive system and the remaining sections did not receive any surface treatment. The patients were instructed to wear the acrylic palatal appliances for 4 months during the day. After this time, the sections were etched with 37% phosphoric acid for 15 seconds (sections 1 and 2) and 60 seconds (sections 3 and 4), followed by adhesive system and composite resin applications. All the sections were prepared for light microscopy analysis to observe the degree of resin penetration (x400). The results were submitted to a three-way analysis of variance with a significance level of 5%. The difference between groups was verified by the Tukey test, at a significance level of 5%. The results showed that microabraded enamel required a longer period of acid etching for longer resin tags.

Key words: microscopy, enamel microabrasion, dental etching.

AVALIAÇÃO "IN SITU" DA FORMAÇÃO DOS TAGS NO ESMALTE DENTAL SUBMETIDO À TÉCNICA DA MICROABRASÃO. EFEITO DE DOIS TEMPOS DE CONDICIONAMENTO

RESUMO

O objetivo deste estudo foi analisar a formação de tags resinosos em esmalte dental submetido ou não à técnica de microabrasão. Treze estudantes de Odontologia receberam a aplicação de um aparelho ortodôntico removível contendo quatro secções de esmalte com dimensões de 4.0 mm X 4.0 mm. Duas seções receberam a aplicação de um composto microabrasivo e as demais não receberam nenhum tratamento. Os pacientes foram instruídos a usar os aparelhos ortodônticos durante o dia e por quatro meses. Após este período, as secções foram condicionadas com ácido fosfórico 37% por 15 segundos (seções 1 e 2) e por 60 segundos (secções 3 e 4), seguido pela aplicação do sistema adesivo e de resina composta. Todas as secções foram preparadas para análise em microscopia óptica comum para observar o grau de penetração do material resinoso (x400). Os resultados foram submetidos à análise de variância a três critérios, ao nível de 5%. A diferença entre os grupos foi verificada pelo teste de Tukey, ao nível de 5%. Os resultados mostraram que maiores tempos de condicionamento ácido do esmalte dental são exigidos para uma maior penetração do sistema adesivo.

Palavras chave: microscopia, microabrasão do esmalte, condicionamento ácido.

INTRODUCTION

Teeth with localized or generalized enamel stains, with or without surface irregularities that significantly affect the esthetics, may be treated with microabrasive materials containing a low-concentration acidic substance associated with silicon carbide fillers[1-6]. However, these stains should be located on the outermost layers of dental enamel, present intrinsic etiology, hard texture and any color[1, 3-6].

Over the years, with the utilization of enamel microabrasive systems[3] to remove the stained enamel, it has been demonstrated that there is simultaneous compactation of byproducts abraded and erosion on the enamel surface, thus forming a dense, highly mineralized layer[7,8]. This process, called "abrasion effect" by Berg and Donly[7,9], assigns greater smoothness, increased shine over time[1,3], as well as decreased susceptibility to demineralization by lactic acid and higher resistance to bacterial colonization by *Streptococcus mutans*[9, 10].

However, despite these clinical advantages, teeth submitted to microabrasion techniques may require restorative procedures that rely on adhesive systems[3,6]. Therefore, this *in situ* study was conducted to investigate whether the formation of a "highly mineralized layer" as a result of the so-called "abrasion effect" is the reason for the limitation of microabraded enamel to the formation of adhesive tags.

MATERIAL AND METHOD

Enamel specimen preparation

This study was revised and approved by the Institutional Review Board of Umuarama Dental School (UNIPAR). The study was conducted on 40 premolars extracted for orthodontic purposes, from patients aged 11 to 16 years. The teeth were cleaned and stored in distilled water until utilization. The crowns of teeth were sectioned in a metallographic cutter (ISOMET® 2000, Buehler Ltd, Lake Bluff, IL, USA), with a diamond coated disc, under water refrigeration to prevent overheating of the enamel. Forty lingual and 40 buccal enamel sections measuring 4.0 mm x 4.0 mm were obtained. A layer of dentin was maintained under the enamel to enhance the fixation of these sections to the removable acrylic palatal appliances.

Utilization of enamel sections

The study was conducted on 13 undergraduate dental students, of both genders, aged 18 to 24 years, with good oral health conditions, such as absence of caries lesions and periodontal diseases, good systemic condition and healthy oral soft tissues. Impressions were poured with dental stone Jeltrate (Dentsply Indústria e Comércio Ltda, Petrópolis, RJ, Brasil) to provide molds for the subsequent manufacture of removable acrylic palatal appliances. Palatal appliances were made with self-curing acrylic resin, following laboratorial procedures described elsewhere. Four sections of previously autoclaved dental enamel[11] were fixed to each acrylic palatal appliance with self-curing acrylic resin (Fig. 1). Contamination of the enamel surface with acrylic resin was avoided.

Sections were numbered from 1 to 4 prior to treatments. Sections 1 and 3 were not submitted to microabrasion, and corresponded to the control group, while sections 2 and 4 received the application of the microabrasive system Prema Compound (Premier Dental Products Co, Norristown, PA, USA). The system was applied to the teeth and rubbed for 30 seconds with the manual applicator supplied by the manufacturer, rinsed with water and dried. A total 10 applications were made. After microabrasion, the specimens received the application of neutral 2% sodium fluoride gel (Flutop Gel Cristal, SS White Burs, Inc. Lakewood, NJ USA) for 4 minutes. The dental students were instructed to wear the acrylic palatal appliances for 4 months during the day, including meals. When removed from the oral cavity, the appliance was stored in a flask with water. During oral hygiene, both the removable palatal appliance and the enamel sections were subjected to regular brushing with dentifrice.

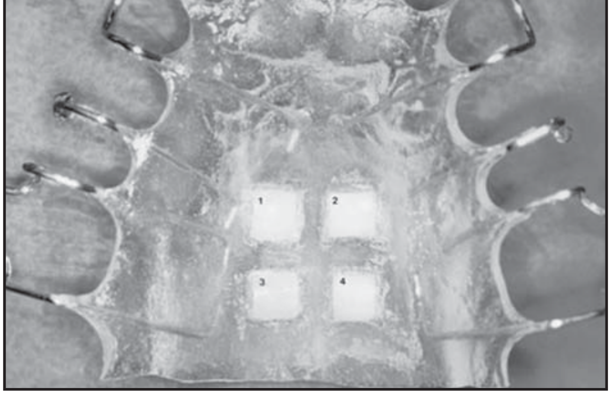

Fig. 1: Acrylic palatal appliances with enamel sections. Sections 1 and 3; 2 and 4, correspond to sections not submitted (control) or submitted to enamel microabrasion (experimental), respectively.

Evaluation of penetration of the adhesive system in dental enamel

After 4 months, all enamel specimens were prepared for application of the adhesive system (Prime & Bond 2.1, Dentsply Caulk, Milford, DE, USA) and a composite resin (TPH SPECTRUM, Dentsply Caulk, Milford, DE, USA). Prophylaxis of the enamel specimens was performed with pumice and water using a rubber cup at low speed, for 5 seconds. After rinsing and drying, the specimens were etched with 37% phosphoric acid (Dentsply Caulk, Milford, DE, USA), for 15 seconds (sections 1 and 2) and 60 seconds (sections 3 and 4) followed by thorough rinsing and air-drying. After clinical observation of enamel demineralization, the adhesive system was applied following the manufacturer's instructions. Next, a 2-

mm thick increment of composite resin, shade B1, was applied and light-cured for 40 seconds.
The acrylic palatal appliances were stored in individual flasks containing distilled water for 1 week and then sectioned in 2 slices in a metallographic cutter (ISOMET® 2000, Buehler Ltd, Lake Bluff, IL, USA), with a diamond coated disc, under water refrigeration. Before analysis, sectioned surfaces were ground with 80, 360, and 600 grit silicon carbide paper (3M do Brasil, Sumaré, SP, Brazil) to a thickness of 100 micrometers.
The sections were then decalcified in 40% nitric acid (Farmácia Aphoticário, Araçatuba, SP, Brazil), thus leaving only the resin material and resin tags. The specimens were immersed in distilled water and mounted on a glass slide covered with a cover slip and fixed with synthetic Canada oil.
The sections were analyzed and measured under a light microscope (Axiophot ZEISS DSM-940 A, Oberkochen, Germany) at a magnification of 400x. The resin tags of each resin section were measured by careful analysis of the entire extent of each section by a single examiner, with a micrometric 40/075 eyepiece. Three measurements were taken for each section. Consequently, for each section analysed, the length of the resin tags corresponds to the mean of the three measurements performed. Two means were obtained for each specimen. The length of tags corresponding to each section of each group were submitted to statistical analysis using three-way analysis of variance with a confidence level of 5%. The difference between groups was verified by the Tukey test, at a significance level of 5%.

Results and statistical analysis

The results of the length of resin tags for the adhesive system Prime & Bond 2.1 were submitted to a three-way analysis of variance at the significance level of 5%, which revealed significant difference in the penetration of the adhesive system in dental enamel, when the factors period of acid etching and performance or not of microabrasion were considered individually. The Tukey test applied at the significance level of 5% to the means of resin tags revealed greater penetration for the 60-second period than for the 15-second period (Table 1), and the enamel submitted to microabrasion exhibited smaller penetration of the adhesive system in dental enamel (Table 2, Fig. 2).

Table 1: Application of the Tukey test to the mean values of resin tags, in micrometers, for the different periods of enamel acid etching.

PERIOD	*MEAN*	*N*	*DECISION*
1 (15 seconds)	7.21	26	B
2 (60 seconds)	15.25	26	A

T = 2.87 minimum significant difference = 2.21
Significance level 5%
Different letters indicate different means

Table 2: Application of the Tukey test to the mean values of resin tags, in micrometers, for the conditions submitted or not to enamel microabrasion.

CONDITION	*MEAN*	*N*	*DECISION*
1 (without enamel microabrasion)	13.14	26	A
2 (with enamel microabrasion)	9.33	26	B

T = 2.87 minimum significant difference = 2.21
Significance level 5%
Different letters indicate different means

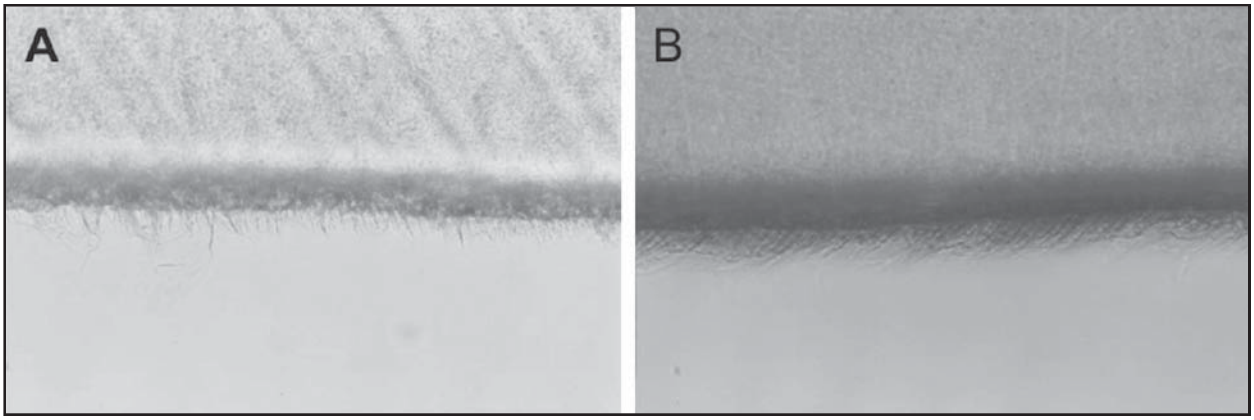

Fig. 2: Resin tags representing the groups of teeth submitted (A) or not (B) to enamel microabrasion. 400X magnification.

Table 3: Means and standard deviations of resin tags, according to the periods of acid etching, for the conditions submitted or not to enamel microabrasion.

TIME* CONDITION	MEAN	N	STANDARD DEVIATION
2*1	17.03	13	5.00
2*2	13.46	13	4.18
1*1	9.23	13	3.56
1*2	5.19	13	1.89

The interactions are statistically different from each other at the 5% level
Time 1- enamel acid etching for 15 seconds
Time 2- enamel acid etching for 60 seconds
Condition 1- enamel not submitted to enamel microabrasion
Condition 2- enamel submitted to enamel microabrasion

Interaction of the factors period of acid etching and microabrasion revealed the effect of one factor on the other (Table 3), i.e. sections submitted to acid etching for 60 seconds exhibited greater penetration of adhesive system in dental enamel than sections etched for 15 seconds, regardless of the whether or not enamel microabrasion had been performed.

DISCUSSION

Initially, the performance of this "in situ" study is justified because we attempted to reproduce the conditions of the oral cavity as much as possible.
Concerning the application of the microabrasion technique, Croll[12], Croll and Cavanaugh[13] and Sundfeld, et al.[3-6] clinically observed optical changes in the enamel submitted to microabrasion, which yields a smooth, shiny enamel surface with time. These characteristics are related to the dense mineralized layer created by the action of the microabrasive system, which contains low concentration hydrochloric acid and a hard abrasive agent. Thus, mineral crystallites removed from the enamel submitted to microabrasion and particles of the abrasive agent are compacted onto the tooth surface, reducing the interprismatic spaces and creating the so-called "glazed enamel" as a reference to the shine observed on a glazed porcelain surface[7]. In addition to increased shine, Segura[10] in 1993 noted that surfaces submitted to microabrasion exhibited higher resistance to colonization by *Streptococcus mutans*. In addition to the optical alteration, which would cause the increased shine, according to Croll[12], the enamel submitted to microabrasion may also present higher resistance to demineralization by phosphoric acid, due to formation of a fluorapatite-rich surface layer. According to Cury et al., 2004[14], the fluorapatite-rich surface layer is more resistant to acid dissolution as compared to hydroxyapatite.
The assumptions of Croll[12] were confirmed by the present results, since all enamel sections submitted to treatment with the microabrasive system and phosphoric acid etching 4 months after microabrasion for 15 or 60 seconds provided the formation of shorter resin tags as compared to the control group. This finding may be related to the difficult demineralizing action of phosphoric acid on the enamel submitted to microabrasion, possibly due to the surface changes that may have occurred during the 4 months after enamel microabrasion.
Considering the period of enamel acid etching, there is currently a tendency to use shorter periods. In the literature, the results obtained by different periods of acid etching of enamel not submitted to microabrasion were compared by different authors[15-18], who observed the same etching patterns, without the characteristic difference in the retention levels obtained by utilization of the different periods. The authors also highlighted that the increase in the period of acid etching caused greater tissue loss. However, this was not observed by Main et al.[19] (1983), who observed shallower etching when enamel acid etching was performed for 10 seconds compared to 60 seconds; and by Hoeppner et al.[20] (1998), who analyzed the penetration of a pit and fissure sealant in dental enamel etched for different periods (15, 30 and 60 seconds) and reported that etching for 60 seconds allowed greater penetration of the resin material in the enamel.
The present results revealed the influence of the system Prema Compound on the demineralizing action of the etchant, 4 months after its application, and also that acid etching for 15 seconds was less favorable for the formation of long resin tags compared to etching for 60 seconds. However, establishment of the actual influence of the length of resin tags on the bond strength of composites to dental enamel after accomplishment of enamel microabrasion requires additional studies.

CONCLUSION

According to the present methodology and results obtained, we concluded that the enamel surface submitted to microabrasion technique required a longer period of acid etching in order to achieve longer resin tags.

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