Comparison between two methods for resin removing after bracket debonding

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Objective: The aim of this study was to assess — using scanning electron microscopy (SEM) — the effectiveness of two abrasive discs, one made from silicon and one from aluminum oxide, in removing adhesive remnants (AR) after debonding orthodontic brackets. **Methods:** Ten randomly selected bovine teeth were used, i.e., 2 in the control group, and the other 8 divided into two groups, which had orthodontic brackets bonded to their surface with Concise Orthodontic Adhesive (3M). The following methods were employed - in one single step - to remove AR after debracketing: Group A, Optimize discs (TDV) and Group B, Onegloss discs (Shofu), used at low speed. After removing the AR with the aforementioned methods, the teeth were prepared to undergo SEM analysis, and photographs were taken of the enamel surface with 50x magnification. Six examiners evaluated the photographs applying the Zachrisson and Årtun enamel surface index (ESI) system (1979). **Results:** Group A exhibited minor scratches on the enamel surface as well as some AR in some of the photographs, while Group B showed a smoother surface, little or no AR and some abrasion marks in the photographs. No statistically significant differences were found between the two methods and the control group. **Conclusions:** The two abrasive discs were effective in removing the AR after bracket debonding in one single step.

Keywords: Orthodontics. Scanning electron microscopy. Brackets debonding. Orthodontic brackets. Tooth enamel.

Objetivo: o objetivo deste trabalho foi avaliar, por microscopia eletrônica de varredura, a eficácia de dois discos abrasivos de silicone e óxido de alumínio para a remoção da resina remanescente após a descolagem de braquetes ortodônticos. **Métodos:** foram utilizados 10 dentes bovinos selecionados aleatoriamente, sendo 2 para o grupo controle e os demais divididos em dois grupos, os quais receberam colagem de braquetes ortodônticos com resina ortodôntica Concise (3M). Os métodos de remoção da resina após a descolagem dos acessórios ortodônticos em apenas uma etapa foram: Grupo A – disco Optimize (TDV); e Grupo B – disco Onegloss (Shofu), empregados em baixa rotação. Após a remoção da resina remanescente pelos métodos mencionados, os dentes foram preparados para serem submetidos à análise em microscopia eletrônica de varredura, obtendo-se fotografias da superfície do esmalte com aumento de 50X. Seis examinadores avaliaram as fotografias seguindo a escala de avaliação de Zachrisson e Arthun (1979). **Resultados:** no Grupo A, observou-se pequenos arranhões na superfície do esmalte, bem como pouco remanescente de resina em algumas das fotografias; enquanto, no Grupo B, observou-se maior lisura, pouco ou nenhum remanescente de resina e alguns riscos nas fotografias. Não houve diferença estatisticamente significativa entre os dois métodos avaliados e o grupo controle. **Conclusão:** os dois discos abrasivos mostraram-se eficientes para remoção da resina remanescente após a descolagem de braquete em única etapa.

Palavras-chave: Ortodontia. Microscopia eletrônica de varredura. Descolagem. Braquetes ortodônticos. Esmalte dentário.

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INTRODUCTION

The original bracket bonding technique was introduced in orthodontic practice by Newman,[19] who proposed the use of composite resins to bond brackets after etching the enamel to strengthen the mechanical retention of direct bonded brackets. This direct enamel bonding technique contributed substantial benefits to orthodontic treatment, including less chair time and streamlined use.

After the orthodontic treatment is completed, removal of orthodontic brackets and AR should be performed responsibly and carefully, causing as little damage as possible to the outer layer of the enamel. Moreover, most of the fluorine rich layer is located in the outermost 20 µm portion of the enamel.[5,6]

Removal of AR from the enamel should be performed in such manner as to ensure that the enamel surface resembles as much as possible pretreatment conditions in terms of brightness, smoothness and enamel topography without causing iatrogenic damage to the enamel.[5] This can only be achieved by proper bonding and careful removal of orthodontic brackets. Different AR removal methods have been suggested by many studies,[7,9,10,11,13,14,15,17,21-24,26,28] but controversy persists regarding the most appropriate method for this procedure in terms of preserving enamel surface quality.

The following AR removal methods have been suggested: Orthodontic pliers, manual reamer, surgical scalpel blade, ultrasonic instruments, aluminum oxide sandblasting, rotary tools such as rubber discs and low and high rotation burs,[8,10,12,16,22,24,25,27] and CO_2 laser radiation.[23]

The purpose of this study was to compare two brands of abrasive discs containing silicon and aluminum oxide, respectively, which were used to remove adhesive remnants (AR) after debonding of orthodontic brackets, without the need to polish with pumice. This is a streamlined one-step technique that eliminates the need for different burs and accessories, thus reducing chair time and costs in this phase. The effectiveness of these abrasive discs on the surface of bovine enamel was assessed by scanning electron microscopy (SEM) by 6 raters.

MATERIAL AND METHODS

Ten bovine incisors were used in this study. The teeth were stored in a solution of 0.1% thymol at room temperature until ready for the experiment. Of the 10 teeth used, two were randomly selected for the control group and the eight remaining teeth were divided into two groups.

Initially, all teeth were cleaned by rubber cup prophylaxis (K.G. Sorensen, São Paulo, Brazil) at low speed, using fine-grained pumice (Herjos - Vigodent) and water for 10 seconds. After prophylaxis, the eight teeth of the study group were washed and dried with a dental 3-way air/water syringe for 20 seconds. Next, the center of the buccal tooth surface was etched with 37% phosphoric acid in gel form for 60 seconds. Thereafter, the teeth were washed for 30 seconds and then dried for another 30 seconds. The Enamel Bonding System marketed by 3M ESPE Brazil, Sumaré / SP, reference 1929S, was applied after etching the enamel with the aid of a microbrush (Vigodent SA Indústria e Comércio, Rio de Janeiro - RJ), after mixing a drop of fluid resin A with one drop of fluid resin B, according to the manufacturer's instructions. Orthodontic brackets (Dental Morelli Ltda, Sorocaba - SP, ref. S2CO3K) were bonded to the center of the tooth surfaces with Concise Orthodontic adhesive (3M ESPE do Brasil, Sumaré / SP) with the aid of a bracket placement instrument (Dental Morelli Ltda, Sorocaba / SP) after mixing paste A with paste B.

After the brackets were bonded, the teeth were stored in a plastic container with cotton soaked in distilled water to ensure an environment with 100% humidity at room temperature. After 24 hours, the brackets were debonded by applying force to the top and bottom of each bracket with a ligature cutter (Quinelato, Rio Claro / SP). Adhesive remnants (AR) were observed on the enamel surface of all specimens, indicating a score of 3 on the Adhesive Remnant Index (ARI) proposed by Bergland and Årtun.[2]

The adhesive remnants were removed in one single step without the need for burs and without finishing and polishing the enamel to prevent potential interference with the results. Two different brands of abrasive discs — silicon and aluminum oxide, respectively — were used at low speed with air-cooling and without water to remove the adhesive remnants (AR). Each disc was used on one tooth only.

In Group A, Optimize abrasive discs ref. 3022D (TDV Dental Ltda, Pomeroy / SC) were used, while in Group B, Onegloss No. 183 (Shofu Dental Corporation - USA) abrasive discs were utilized (Figs 1 and 2).

After AR removal, the teeth were sectioned and the crowns prepared and examined under scanning electron microscopy (Fig 3). Photographs were obtained of the buccal surfaces with 50x magnification.

Visual analysis of the photographs was performed by six experienced orthodontists with scores being assigned according to the same Zachrisson and Årtun enamel surface index (ESI) system,[26] as defined below:

» ESI score (0): Perfect surface with no scratches.

» ESI score (1): Satisfactory surface, minor scratches.

» ESI score (2): Acceptable surface, several scratches, some of which deeper.

» ESI score (3): Imperfect surface, several coarse, distinct scratches.

» ESI score (4): Unacceptable surface, very coarse, deep scratches.

The control group photographs were submitted to the examiners and identified as such, whereas the other photographs bore no identification as to which group they belonged. Evaluations were performed in one single step using the enamel surface index (ESI) system described above. The images were duplicated and placed in random order, which yielded the first score. The same photographs were then repeated sequentially, but in a different order (second score) in order to determine the method error. The raters were not informed that the images had been duplicated. Subsequently, the data underwent nonparametric statistical analysis at a significance level of 5%. Rater opinion concerning the different discs, as well as the scores assigned to each disc and rater agreement were investigated.

RESULTS

In the control group, the enamel surface remained intact, with the presence of typical surface striae and some scratches caused by clinical abrasion of the enamel surfaces (Fig 4).

Photographs in Group A showed teeth with minor scratches on the enamel surface and little AR in some of the photos (Fig 5). According to the Zachrisson and Årtun[26] ESI system, the raters assigned the scores presented in Table 1.

Photographs for in Group B presented smoother teeth, with little or no AR and abrasion marks in some photographs (Fig 6). According to the raters, who based their scores on the Zachrisson and Årtun[26] ESI system, the scores in Table 2 were assigned:

Table 3 shows that in evaluations 1 and 2 some of the scores exhibited differences in the frequency assigned by the raters. The Wilcoxon test yielded p=0.0196.

Table 1 - Scores for Group A photographs.

Raters	1	2	3	4	5	6
Photograph 01:	(3 - 3)	(2 - 2)	(2 - 2)	(1 - 2)	(3 - 3)	(3 - 4)
Photograph 02:	(2 - 2)	(1 - 1)	(1 - 1)	(0 - 1)	(1 - 1)	(2 - 3)
Photograph 03:	(4 - 4)	(2 - 2)	(2 - 2)	(1 - 1)	(2 - 2)	(4 - 4)
Photograph 04:	(2 - 2)	(2 - 2)	(3 - 3)	(2 - 3)	(3 - 4)	(3 - 3)

Figure 1 - Optimize (TDV) abrasive disc.

Figure 2 - Onegloss (Shofu) abrasive disc.

Figure 3 - Bovine teeth prepared for scanning electron microscopy (SEM).

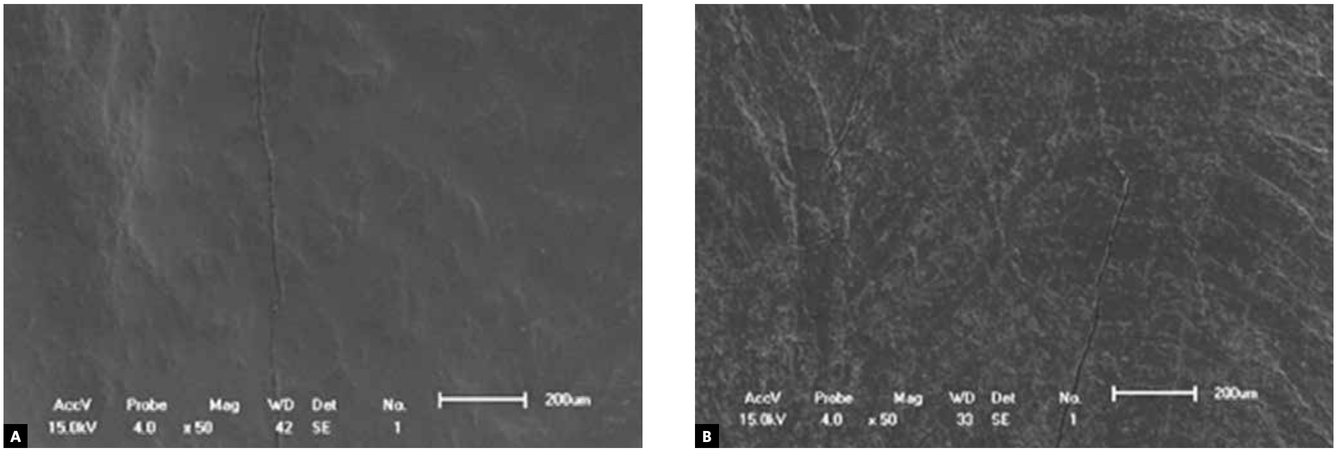

Figure 4 - SEM photomicrographic aspects of the control group with 50x magnification.

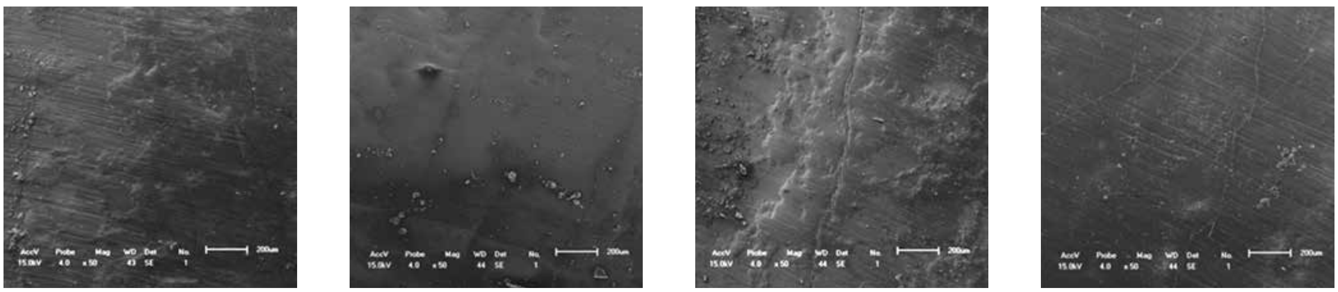

Figure 5 - SEM photomicrographic aspects of the Optimize group with 50x magnification.

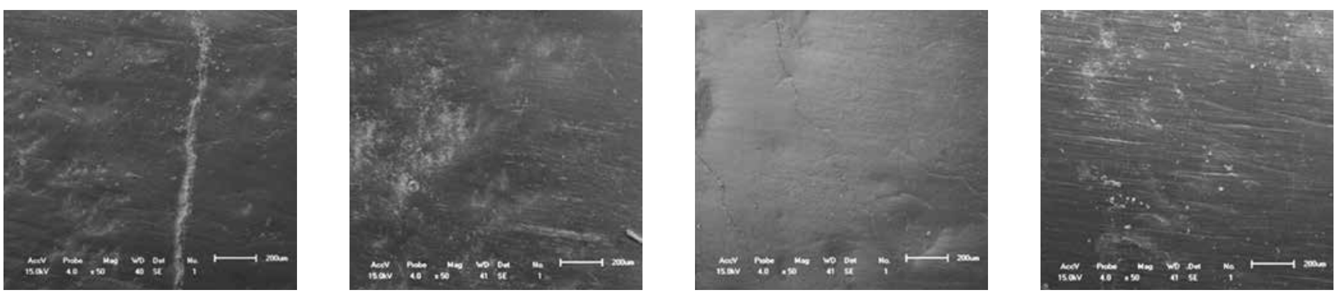

Figure 6 - SEM photomicrographic aspects of the Onegloss group with 50X magnification.

Therefore, at 5% significance level there is evidence that the raters differed in their opinion regarding the Optimize abrasive discs.

Onegloss abrasive disc (Table 4) showed $p = 0.7768$ by the Wilcoxon test, i.e., there is no evidence that the raters differed in their opinions on the effectiveness of this disc.

Table 2 - Scores for Group B pictures

Raters:	1	2	3	4	5	6
Photograph 05:	(2 - 3)	(2 - 1)	(1 - 1)	(1 - 1)	(1 - 1)	(2 - 3)
Photograph 06:	(2 - 1)	(1 - 1)	(2 - 1)	(1 - 1)	(1 - 1)	(1 - 1)
Photograph 07:	(1 - 1)	(0 - 1)	(0 - 0)	(0 - 0)	(0 - 0)	(2 - 2)
Photograph 08:	(2 - 2)	(3 - 3)	(3 - 3)	(3 - 2)	(4 - 4)	(3 - 3)

Table 5 shows the distribution of scores assigned by the raters to both discs, considering the first evaluation. Evaluations of the two discs by the Mann-Whitney test and the chi-square test for homogeneity were not statistically different.

To check whether or not the raters agreed on their assessment of each abrasive disc, Table 6 makes reference to the evaluations shown in Tables 3, 4 and 5. The Friedman test revealed that the raters disagreed in their evaluations for the Optimize abrasive disc, whereas rater analyses of the Onegloss abrasive discs were consistent. By means of multiple comparisons, statistically significant differences were found between raters 2 and 6, as well as between raters 4 and 6 in their evaluations of the Optimize abrasive disc.

By applying the Zachrisson and Årtun[26] ESI system and graphically representing the analyses of the photographs performed by the raters, disagreements were found between the raters in some photographs and agreements in others, considering the first score assigned by each rater (Fig 7). According to the chart, raters 2 and 3 assigned similar scores, while raters 1, 5 and 6 were the most critical and different in the scores assigned to the two groups.

DISCUSSION

This study investigated two different commercial brands of abrasive discs that can be used to remove adhesive remnants (AR) after debonding of orthodontic brackets in a one-step procedure. No statistically significant differences were found between the two methods and the control group in the opinion of orthodontists who assessed photographs of the surface of the tooth specimens, obtained from scanning electron microscopy (SEM).

Assessment of the two methods, i.e., Onegloss and Optimize abrasive discs at low speed, showed that both were effective in removing adhesive remnants. In most specimens the enamel layer remained intact or showed minor scratches. Teeth in Group A (Optimize) photographs exhibited small quantities of adhesive remnants and more scratches than Group B photographs. Disagreements found among some observers in evaluations 1 and 2 of the same Group A photograph may have been affected by these factors at the time of visual analysis. In Group B (Onegloss) enamel surfaces were more compatible with those of the control group, and thus the raters were more consistent in their initial and final scores for this group. Interviews with clinical orthodontists disclosed that over 80% of these professionals regarded as acceptable some scratches on the enamel surface.[7]

Some damage to the enamel inevitably occurs throughout orthodontic treatment,[1] including during debracketing. No ideal method exists capable

Table 3 - Score frequencies in the two evaluations for Group A (Optimize abrasive disc).

Score	Evaluation 1	Evaluation 2
0	1	0
1	5	5
2	10	9
3	6	6
4	2	4
Wilcoxon test	p = 0.0196	
Total	24	24

Table 4 - Score frequencies in the two evaluations for Group B (Onegloss abrasive disc).

Score	Evaluation 1	Evaluation 2
0	4	3
1	8	12
2	7	3
3	4	5
4	1	1
Wilcoxon test	p = 0.7768	
Total	24	24

Table 5 - Enamel surface evaluation for Groups A and B.

	Frequency					Statistical test	
Score	0	1	2	3	4	Mann-Whitney	Chi-square
Group A (Optimize)	1	5	10	6	2	P=0.0789	P=0.4402
Group B (Onegloss)	4	8	7	4	1		

Table 6 - Comparison between the six examiners in their assessment of the two methods.

Group	p
A (Optimize)	0.0003
B (Onegloss)	0.1577

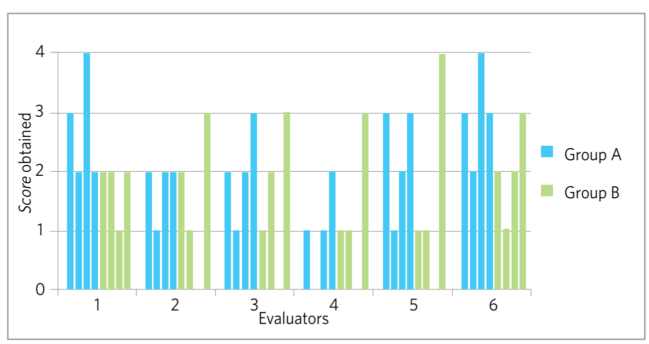

Figure 7 - Scores assigned by the raters to each photograph in Groups A and B according to the Zachrisson and Årtun enamel surface index (ESI) system (1979).

of perfectly removing all adhesive remnants without leaving marks[5] and scratches.[7] It is up to the orthodontist, however, to learn methods to minimize damage to the tooth enamel.

Orthodontic bracket debonding consists in the removal of the orthodontic accessories and the adhesive remnants from the tooth surface, imparting to the latter the same smoothness and brightness it featured prior to orthodontic treatment. For this purpose, different bracket debonding and AR removal methods have been studied.[8,10,14,15,17,24,26,29]

Among the methods to remove AR, Zachrisson, Skogan and Hoymyhr[27], in 1980,contraindicated the use of a high speed handpiece, irrespective of the type of bur being utilized. Frossard et al[13] pointed out that removing AR with a tungsten carbide bur at high speed results in significantly greater damage to the enamel surface than using the same bur at low speed.

The use of 30-blade tungsten carbide burs at low speed have been shown to perform very effectively as they preserve the quality of the enamel surface better than any other method.[5,7,13,17,18,26] When this method is employed, however, the best results are achieved when the enamel surface is polished with pumice to reduce the abrasive marks, scratches and grooves produced by the burs.[9,18,24]

Costa[9] assessed the enamel surface of human premolars by scanning electron microscopy after removal of the adhesive remnants with 30-blade tungsten carbide burs at high speed and with Onegloss abrasive at low speed without polishing. The high speed bur left several scratches and removed the entire layer of perikymata observed in the control group and the Onegloss abrasive disc group. The Onegloss abrasive disc kept the enamel layer in a manner more similar to the control group, although with some scratches typical of the abrasive discs used in this study.

The key advantage of using the abrasive discs employed in this study compared to the different methods described above[8,14,24,26,28] is that the discs allow one to perform a one-step procedure which reduces chair time and operational costs while providing satisfactory enamel surface quality after AR removal.

During specimen preparation, Onegloss abrasive discs showed a better performance than Optimize abrasive discs. Both discs generated heat in the specimens. Thus, AR removal with these discs should be carried out with intermittent movements and continuous air-cooling to avert damage to the dental pulp. It should be emphasized that regardless of the method used to remove adhesive remnants after debonding orthodontic accessories, ultimately it is up to the professional to take due care during the procedure.

CONCLUSION

In light of the results described above, it can be concluded that the two abrasive discs containing silicon and aluminum oxide, respectively — when used at low speed — proved effective in removing adhesive remnants in one single step, therefore maintaining the enamel surface of the study groups similar to the enamel surface of the control group.

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