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AVALIAÇÃO DA TOPOGRAFIA DO ESMALTE DENTAL APÓS A REMOÇÃO DE BRÁQUETES ORTODÔNTICOS E AGENTES DE CIMENTAÇÃO COM AUXÍLIO DA LUZ ULTRAVIOLETA

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Dissertação apresentada à Universidade de Uberaba, como parte dos requisitos para a obtenção do título de Mestre em Odontologia, área de concentração em Clínica Odontológica Integrada.

Orientador: Prof. Dr. Thiago Assunção Valentino

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Dissertação apresentada como parte dos requisitos para obtenção do título de Mestre em Odontologia do Programa de Pós-Graduação em Odontologia - Mestrado da Universidade de Uberaba.

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“Grandes realizações não são feitas por impulso, mas
por uma soma de pequenas realizações.”
Vincent Van Gogh

RESUMO

O objetivo deste trabalho, *in vitro* (Capítulo 1) e *in vivo* (Capítulo 2), tiveram como objetivos avaliar a topografia da superfície de esmalte dental com o emprego de técnicas de remoção dos remanescentes de cimentos após a descolagem de bráquetes ortodônticos, com auxílio de luz ultravioleta. Para o capítulo 1, este estudo *in vitro* objetivou comparar os tipos de remoções de remanescentes resinosos após a remoção dos bráquetes ortodônticos e avaliar as características da topografia de esmalte sob a iluminação convencional ou luz ultravioleta. Um total de 100 dentes bovinos hígidos foram selecionados e divididos aleatoriamente em 10 grupos (n=10) de acordo com a forma de remoção de remanescentes resinosos após a remoção de bráquetes ortodônticos utilizando a iluminação convencional ou luz ultra-violeta. Foi analisado a integridade topográfica do esmalte dental e com classificação de 0 a 4 de acordo com os critérios de Zachrisson e Arthun. Este estudo foi realizado de acordo com os 10 grupos experimentais. Nos grupos de 1 a 5 foram utilizados diferentes combinações de brocas associadas com a luz UV, nos grupos 6 a 10 foram as mesmas combinações de brocas associadas com a luz do refletor odontológico. No grupo G1 foi utilizada a broca de zirconia e acabamento com a fresa de silício CA Stain Buster 2504, no G2 foi utilizada a broca de zirconia, no G3 foi utilizada a broca de tungstênio 9 lâminas, no G4 foi utilizada a broca de tungstênio de 24 lâminas e no G5 foi utilizada a broca de tungstênio de 24 lâminas associada a fresa de silício CA Stain Buster 2504. Nos grupos G6, G7, G8, G9 e G10, foram utilizadas as mesmas sequencias e técnicas, porém, associada a luz do refletor odontológico. Os grupos avaliados que obtiveram os melhores resultado foram os G1, G2, G5, G6 e G7, sem diferença estatisticamente significante entre eles. Também não houve diferença significativa no emprego da luz ultravioleta no auxílio da remoção dos agentes de cimentação. A utilização de diferentes brocas foi fundamental na diferença dos resultados dos respectivos grupos. De acordo com os resultados obtidos, a luz UV não foi relevante comparada com a luz do refletor odontológico.

Palavras-chave: Bráquetes Ortodônticos, Ortodontia, Resina Composta, Luz Ultravioleta.

ABSTRACT

These studies, *in vitro* (Table 1) and *in vivo* (Table 2), aimed to evaluate the topography of the surface of dental enamel by applying removal technics of the cement remaining after the departure of orthodontic brackets, with the assistance of ultraviolet light. For the chapter 1, this study *in vitro* aimed to compare the removal types of remaining resinous after the removal of the orthodontic brackets and evaluate the characteristics of the dental enamel topography under conventional or ultraviolet lightning. It has been analyzed the topographic integrity of the dental enamel and the classification from 0 to 4, according to the criteria from Zachrisson and Arthun. This study has been made according to 10 experimental groups. In the groups 1 to 5 different drill matches associated to the light from the dental reflector. In the G1 group it was utilized the zirconia drill, in the G3 it was utilized the tungsten drill of 24 blades associated to the silicon milling cutter CA Stain Buster 2504. In the G6, G7, G8, G9 and G10, it was utilized the same sequences and technics, but, associated to the light from the dental reflector. The evaluated groups who achieved the best results were the G1, G2, G5, G6 and G7, with no significant statistic difference among them. There was not also no significant difference in the appliance of ultraviolet light in the assistance of removal of the cementing agents. Using different drills was paramount in the difference of the results of the respective groups. According to the results achieved, UV light was not relevant compared to the light from the dental reflector.

Key-words: Orthodontic Brackets, Orthodontics, Composite Resin, Ultraviolet Light

SUMÁRIO

In vitro evaluation of the removal of the cementing agents after removal of orthodontic brackets with support of ultraviolet light

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ABSTRACT

OBJECTIVES: This study *in vitro* aimed to compare the forms of removal of remnant resinous after the removal of orthodontic brackets and evaluate the damages in the topography of dental enamel under the conventional and ultraviolet lights. **Methods:** A total of 100 healthy cattle teeth were selected and divided randomly in 10 groups (n=10) according to the form of removal of resinous remainings after the removal of orthodontic brackets using the respective lights. In the groups 1 to 5 it was used different combinations of drills associated with the UV light, in the groups 6 to 10 the same combination with drills associated to the light from the orthodontic reflector. The G1 group used the zirconia drill and finishing with the silicon cutter straw CA Stain Buster 2504, the G2 used the zirconia drill, the G3 used the 9 blades tungsten drill, the G4 used the 24 blades tungsten drill and the G5 used the 24 blades associated to the silicon cutter straw CA Stain Buster 2504. In the groups G6. G7, G8, G9 and G10 it was used the same sequences and technics, but associated to the light from the orthodontic reflector. It was analyzed the integrity of the dental enamel and classified with grades from 0 to 4 according to the Zachrisson and Arthun criteria. The statistical analyzes used was by the non-parametric test Kruskal-Wallis and post hoc Student Newman Keuls, $p<0,05$. **Results:** The evaluated groups who achieved the best results were G1, G2, G5, G6 and G7, with no meaningful statistical difference. There was also no sifinificant difference in applying the ultraviolet light in the assistance of removal of the cementing agents. Using different drills was paramount in the difference of the results of the respective groups, and the experience of the operator is also a ponderous factor. According to the results achieved, the UV light was not relevant compared to the light from the orthodontic reflector. **Conclusion:** Using different drills was paramount in the different of the results of respective groups. According to the results achieved, the UV light did not demonstrate advantages when compared to the light from the orthodontic reflector.

Key-Words: orthodontic brackets, orthodontics, composite resin, ultraviolet light

INTRODUTION

At the ending of the orthodontic treatment, the clinic needs to remove the cementing agent left after the departure of the orthodontic brackets, trying to cause the minimum damage possible to the dental enamel. However, an excessive care may prevent that the whole adhesive is removed, which, on the other hand, may cause two great issues. First is the possible creation of retentive areas that may benefit the gathering of bio-films, while a second issue concern the pigmentation of the remains of adhesive caused by the ageing [1, 2], leading to the discontent of the patient.

Although the task of removing the adhesive may seem simple and easy, it is hindered by the fact that the adhesive has a very similar color to the dental enamel, which has the purpose of conceal the potential excess left during the gluing the brackets [3, 4]. Even though it is one of the safer adhesive removal methods, the use of the multilaminated tungsten cutter of low velocity still causes damages with depth ranging from 0.05 and 50 µm [5, 6]. Therefore, it would seem logical that a method that alters the adhesive color could make the process easier and possibly safer [7].

Damages caused in the enamel by cracks, abrasion or fractures are usually irredeemable, mainly if their most superficial layer is removed. The first twenty micrometer of the enamel shows high concentration of fluoride, important to the maintenance and protection of the enamel [8].

More recently, fluorescent chemical products with ultraviolet light has been added to the adhesives, allowing that the UV light is used as a support to remove the adhesive remains. Besides, healing light devices with UV light filters are already available in the market, allowing this alternative to be clinically applied [9, 10].

The silicon cutter CA Stain Buster 2504 contains a enhanced resin with glass fiber rich in zirconia and remove the adhesive remains from the surface of enamel previously using a drill, according to the manufacturer.

Based in the potential of causing less damage to the dental enamel and the lack of orthodontic studies in this subject, the present study aims to evaluate if the removal of the cementing agent with fluorescent properties under the light UV is more effective and causes less damages to the enamel than the conventional light comparing some cutters and drills in the removal of the cementing agent and prospective damages to the enamel [7].

MATERIAL E METHODS

Experimental Details

A total of 100 healthy bovine teeth were selected, washed in distilled water and cleaned with periodontal scoop to remove debris and remains of periodontal ligament. The teeth had their roots cut in the cementoenamel junction using a double-faced diamonded disk (KG-Sorensen, Rio de Janeiro, RJ, Brazil) and their vestibular faces sanded with water sandpaper 600 (3M) in order to plan the surfaces, standardizing them. During the whole process, the teeth were kept in thymol 0,5% in a temperature of 370ºC until the moment of their use (ISO 3696:1987)

After being randomly divided in 10 groups (n=10), the surfaces of enamel were submitted to cementing the orthodontic brackets and organized in groups according to the respective technics of removal of the cementing agents. It was held the Scanning Confocal Electron Microscopy (SCEM) for the analyzes of their topography and structural integrity. All the procedures made in this study were held by a single qualified professional. In the groups 1-5 it was used different matches of drills associated with UV light, in the groups 6-10 the same matches of drills associated to the light from the orthodontic reflector. In the group G1 it was used the zirconia drill and finalizing with the silicon cutter CA Stain Buster 3504, in the G2 it was used the zirconia drill, the G3 used the 9 blades tungsten drill, the G4 used the 24 tungsten drill associated to the silicon cutter CA Stain Buster 2504. The groups G6, G7, G8, G9 and G10 used the same sequences and technics, but associated to the light from the orthodontic reflector. It was analyzed the integrity of the dental enamel and classified with grades from 0 to 4 according to the Zachrisson and Arthun criteria.

Orthodontic Bracket Cementing

The brackets used in this present study were metallic brackets with slot 22'', prescription Roth (Morelli, Sorocaba, SP, Brazil). The dental enamel surface of the cattle teeth received previous prophylaxis with extra thin pumice stone (SS Whute Duflex, Juiz de Fora, MG, Brazil) mixed with distilled water, with help of the Robson brush (American Burrs, Palhoça, SC, Brazil). The vestibular surface of the enamel received the conditioning with phosphoric acid in 35% by 30s (Ultra-Etch, Ultradent products INC, South Jordan, UT, USA) and washing with distilled water by 30s, after, the surface of the enamel was dried by jets of

air free of water aind oil. For the adhesive technic, it was used the adhesive system Assure (Reliance Orthodontics,
Itasca, IL, USA) which was applied in active way for 10s over the enamel surfaces conditioned without immediate photo activation, according to the manufacturer's recommendation. The cementing agent used for the gluing of the orthodontic brackets was resinous cement Light Bond Medium Paste (Reliance Orthodontics, Itasca, USA) which was applied in the surface of the brackets. After the positioning over the dental enamel, the adhesive system set and the cementing agent were photo activated for 10 seconds with the help of a photo activator (VALO® Ortho Cordless, South Jordan, UT,USA), in irradiancy mode of 3.200 mW/cm².

Removal Technics of the Resinous Cementing Agent

The removal of the brackets was held with orthodontic plier 346R (Quinelato, Rio Claro, SP, Brazil) placed in the gingival incision (vertical), afterward, the removal of the remaining adhesives in the enamel surface of respective teeth in study was held according to the experimental groups.

For group 1 (G1), zirconia drill (Morelli, Sorocaba, SP, Brazil) was used in low rotation associated to the ultraviolet light (Opal Ultradent, South Jordan, UT. USA). Next, it was performed the finishing with silicon cutter CA Stain Buster 2504 (Abrasive Technology, Lewis Center, Ohio, USA). (Table 1).

For group 2 (G2), it was used the zirconia drill (Morelli, Sorocaba, SP, Brazil) in low rotation associated to the use of ultraviolet light (Opal Ultradent, South Jordan, UT, USA) (Table 1).

For group 3 (G3), it was used the 9 blades tungsten drill (Orthometric, Marília, SP, Brazil) in low rotation associated to the use of ultraviolet light (Opal Ultradent, South Jordan, UT, USA). (Table 1).

For group 4 (G4), it was used the 24 blades tungsten drill (Orthometric, Marília, SP, Brazil) in high rotation associated to the use of ultraviolet light. (Table 1).

For group 5 (G5), it was sued the 25 blades tungsten drill (Orthometric, Marília, SP, Brazil) in high rotation associated to the use of ultraviolet light. It was finished with the silicon cutter CA Stain Buster 2504. (Table 1).

For group 6 (G6), it was used the zirconia drill in low rotation associated to the use of light from the orthodontic reflector. It was finished with the silicon cutter CA Stain Buster 2504. (Table 1).

For group 7 (G7), it was used the zirconia drill in low rotation associated to the use of light from the orthodontic reflector. (Table 1).

For group 8 (G8), it was used the 9 blades tungsten drill in low rotation associated to the use of light from the orthodontic reflector. (Table 1).

For group 9 (G9), it was used the 24 blades tungsten drill in high rotation associated to the use of light from the orthodontic reflector. (Table 1).

For group 10 (G10), it was used the 24 blades tungsten drill in high rotation associated to the use of light from the orthodontic reflector. It was finished with the silicon cutter CA Stain Buster 2504. (Table 1).

Scanning Confocal Electron Microscopy (SCEM) Analysis of Dental Enamel Topography

After removing the resinous cementing agent from the enamel surface, the specimens were stored in distilled water in 37ºC before being prepared and metallized for 180 seconds in gold (Bal-tec SCD 050, Lichtenstein, Germany) and analyzed in SCEM (JEOL, Japan) in voltage of 20 Kilovolt [Kv] and 50 Miliampere [mA] for the topography and integrity analyzes of the dental enamel in a growth of 200x.

The photomicrographs obtained were classified according to the criteria stablished by Zachrisson and Arthun [11], by only one operator.

Score 0: perfect surface (no scratches, intact enamel)

Score 1: regular surface (little scratches and some healthy enamel)

Score 2: acceptable surface (many deep scratches, absent healthy enamel)

Score 3: defective surface (big and deep scratches, absent healthy enamel)

Score 4: unacceptable surface (big and deep scratches, marked enamel surface)

Statistical Analysis

Descriptive statistic with medium scores, standard deviation and medium position of the scores of the photomicrographs. Table 2. The statistical analysis used was by the non-parametrical Kruskal-Wallis test and post hoc Student Newman Keuls, $p<0,05$.

RESULTS

Results were observed according to the drills used in groups, but we did not obtained meaningful statistical differences (P<0,05) in applying the ultraviolet light supporting the removal of the cementing agents.

According to the qualitative statistical analysis (medium position), the evaluated groups which achieved the vest results were groups: G1, in which used the zirconia drill associated to ultraviolet light and was finished with the silicon cutter CA Stain Buster 2504 (Figure 1). G2, in which used the zirconia drill in low rotation associated to the ultraviolet light (Figure 1). G5, in which used the 24 blades tungsten drill in high rotation associated to ultraviolet light. It was finished with silicon cutter CA Stain Buster 2504. (Figure 1)

G6, in which used the zirconia drill in low rotation associated to the use of light from the orthodontic reflector. It was finished with the silicon cutter CA Stain Buster and G7, which used the zirconia drill in low rotation associated to the use of light from the orthodontic reflector. (Figure 1). There was no statistical meaningful difference among them (p<0,05) (Table 2). In those groups it was not observed scratches in the morphology of the enamel and the enamel have remained intact. The groups G3, G4, G8, G9 and G10 obtained a statistical meaningful difference with groups G1, G2, G5, G6 and G7 (p<0,05). (Table 2).

DISCUSSION

Human teeth are covered by enamel, which presents itself as the most mineralized tissue of the human body [12, 13], due to their high content of inorganic substances that organize themselves in prisms with a medium size of 5 μm [14]. One of the challenges in orthodontia is the maintenance of the topographic integrity of the dental enamel after the departure of brackets used in the orthodontic treatment, with the objective of preserving the aprismatic, the enamel, and the enamel topographic [16].

This morphologic integrity of the enamel surface has attracted the attention of researchers, for its alteration can generate bacterial withholding [16], alter the light reflexing and dental aesthetics [17, 18], besides the necessity of restore the dental enamel to reacquire the closest conditions to their natural state. Still, the loss of the superficial enamel associated to the exposition of the enamel prisms can cause a diminishing of the enamel resistance to organic acids deriving from dental biofilm and make the enamel more prone to demineralization [8]. This fact supports the importance of this essay in reference of the study of different ways of preservation of the morphology of the dental enamel after the removal of remaining adhesives consequent from the departure of orthodontic brackets.

One of the most used technics by clinics for the departure of orthodontic brackets is the manual removal with type How plier and, subsequently, the removal of the adhesive remains with diamonded ends [20] and multi-laminated carbide tungsten drills [21], those being considerated the gold standard in literature when used in low and high rotation [21]. However, according to the statistical analysis of this study, using said drills is discouraged, both in the ultraviolet light and in the orthodontic reflector. These findings endorse the data found in the consulted literature, which has been discouraged the use of said cutters due to the excessive abrasion of the dental enamel [22, 23, 24].

There are few papers referring to the removal of resinous remaining by using zirconia drills. The Zirconia (ZrO2) is one of the materials that have excellent chemical resistance, temperature resistance, abrasion resistance and high stiffness. By the fact of showing in its composition super thin grains, it results in the piece a super flat, shining surface and, when needed, sharpened, is a material with abrasion resistance and with superficial stiffness superior to the cementing resinous agents applied in the fixation of the orthodontic brackets, however, with superficial stiffness inferior to the dental enamel [27].

Recently, fluorescent trackers were embodied to the cementing resinous agents, leaving them photosensitive to the contact with ultraviolet light[7]. These photosensitive agents

allow us to identify the debris of the resinous cementing agents acceded to dental enamel after departure of the orthodontic brackets, which works with a guide to direction its removal by orthodontists, with the purpose of preserving the superficial morphology of the enamel, preserving the surface textures and the enamel, as well as avoiding complications of irreversible iatrogenic [22]. In this present study, when the effect of ultraviolet light is compared within each treatment of resinous remains removal, it was not observed meaningful statistical differences (Table 2). Such fact can be explained as it is a project *in vitro* which display is simplified, as well as the responsible operator showing experience in orthodontics.

In vitro studies about the removal of adhesive remains and respective topographic evaluates of dental enamel, using ultraviolet light are quite limited. Future researches must study the best way of keeping the dental enamel integrity after the orthodontic treatment by using ultraviolet light. Still, the lab studies are useful as guidance to the clinic in choosing the best technic to be used in the procedures of removing the cementing agents. Based in the results of this project, it is concluded that the ultraviolet light, even though enhances the view of resinous remains, does not interfere in a significant matter in the removal of resinous remains. The zirconia drill, being a low rotation drill, makes possible a bigger control of the operator. Due to its active end being larger, the pressure applied in the enamel is smaller.

CONCLUSION

Based on the results of this study, it is concluded that the best technics happened when it was used only the zirconia drill or it was associated to the silicon cutter CA Stain Buster, regardless of the applied light, with no meaningful difference statistics. And also the using of the silicon cutter CA Stain Buster, with support of UV light. According to the statistical evaluation of the topography of the dental enamel the using of ultraviolet light has not shown advantages when compared to conventional light. This study must be observed cautiously, since it is about a lab study, even in conditions similar to the buccal cavity.

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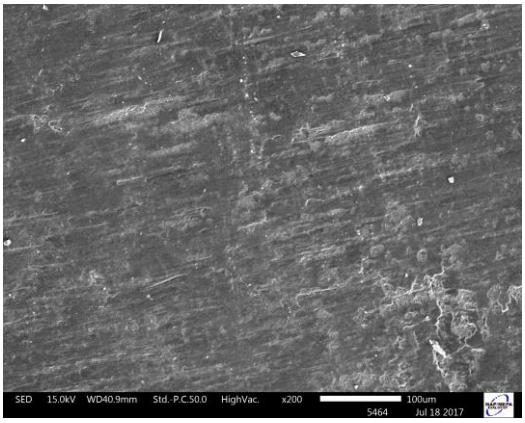
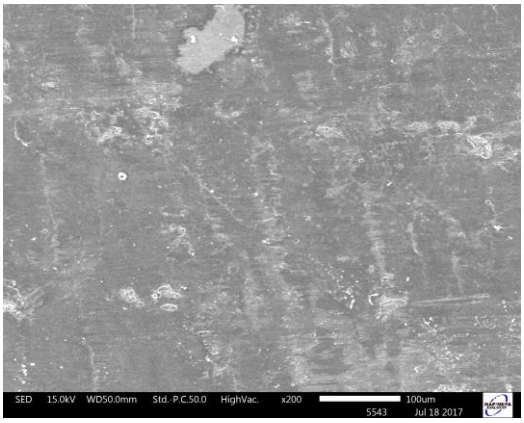
Table 1: Experimental groups subdivided according to the light used, milling cutter used and rotation of the micromotor. (Low Rotation = LR, High Rotation = HR)

	Grupo	Fresa	Rotação	Empresa
	G1	Zirconia - Stain Buster	LR LR	Morelli e Abrasive Technology
	G2	Zirconia	LR	Morelli
Light	G3	Tungstênio 9L	HR	Orthometric
UV	G4	Tungstênio 24L	HR	Orthometric
	G5	Tungstênio 24L - Stain Buster	HR.BR	Orthometric e Abrasive Technology
	G6	Zirconia - Stain Buster	LR LR	Morelli e Abrasive Technology
Light	G7	Zirconia	LR	Morelli
	G8	Tungstênio 9L	HR	Orthometric
Reflector	G9	Tungstênio 24L	HR	Orthometric
Dentistry	G10	Tungstênio 24L e Stain Buster	HR.LR	Orthometric e Abrasive Technology

G1



G2



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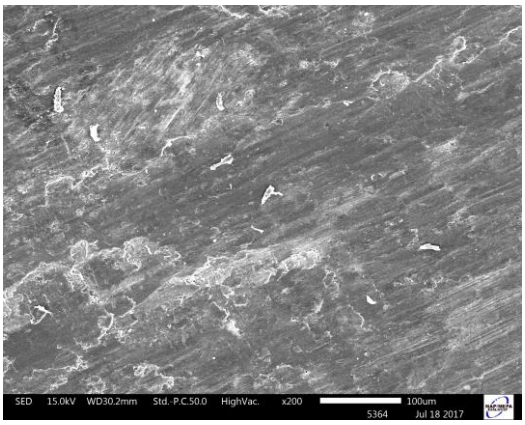

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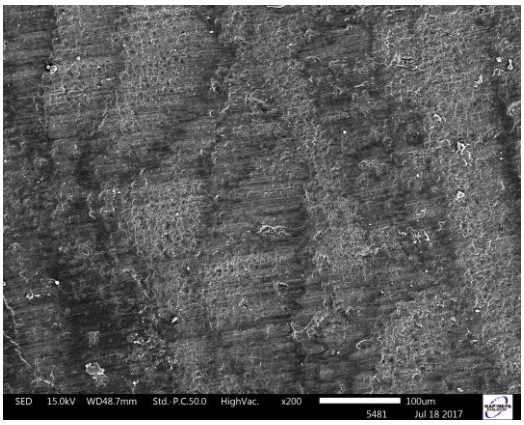
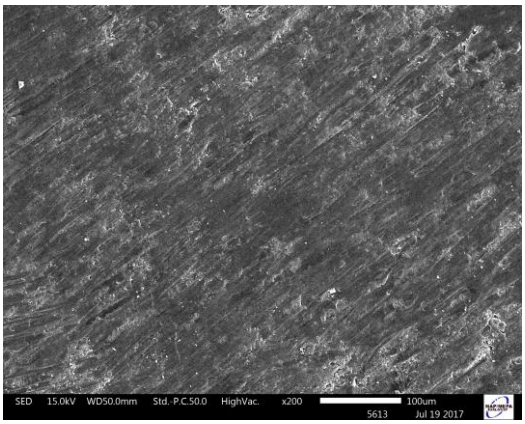
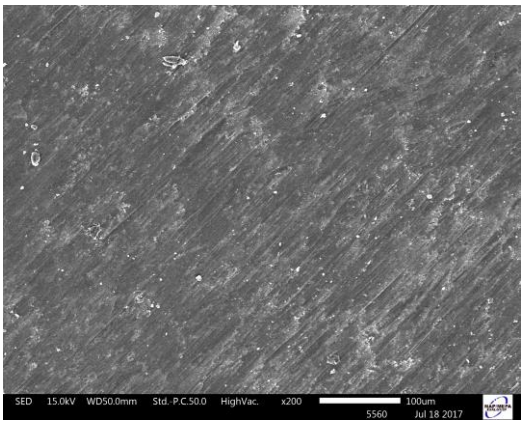


Figure 1: Photographs of the teeth of the excluded groups, after removal of the adhesives. (200x MEV)

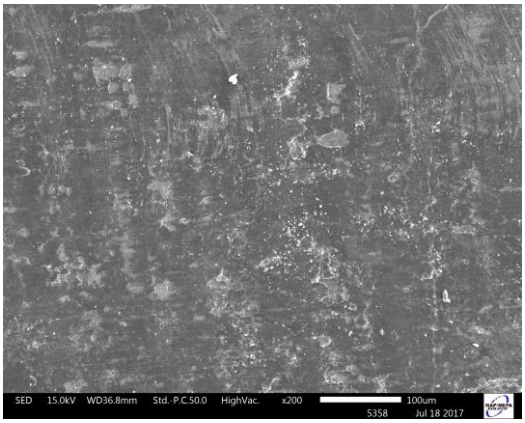
G5



G6



G7



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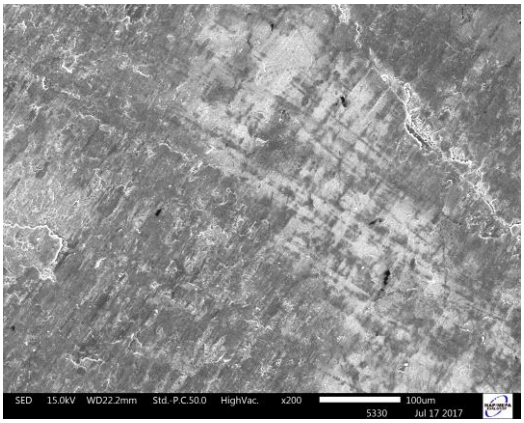
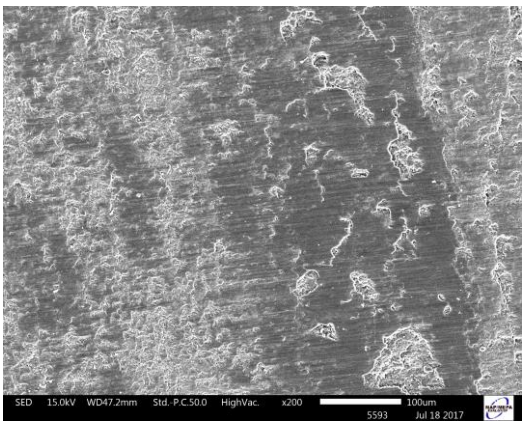


G9



G10

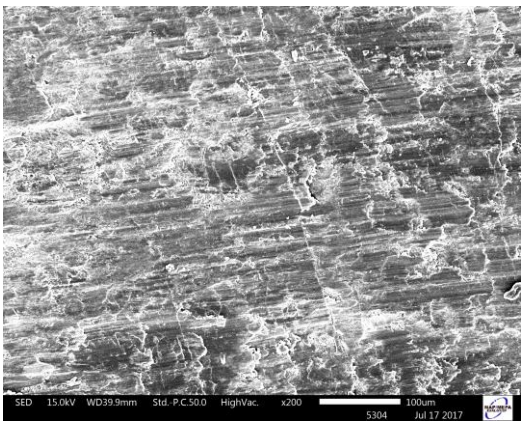


Figure 1: Photographs of the teeth of the excluded groups, after removal of the adhesives. (200x MEV)

Differential letters show statistical difference by the post hoc Student Newman Keuls, $p < 0.05$.

Grupos	Scores Médios	Postos Médios
G1	0,200	8,70 A
G2	0,800	16,800 AB
G3	2,400	36,400 C
G4	3,600	45,800 C
G5	1,000	19,500 AB
G6	0,400	11,400 AB
G7	0,400	11,400 AB
G8	2,800	40,700 C
G9	2,400	36,400 C
G10	1,600	27,900 BC

Table 2. Evaluation of topography of dental enamel according to experimental treatments

ANEXO

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