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LEANDRO DE CASTRO SANTOS

INFLUÊNCIA DO TIPO DE PREPARO DENTAL NA ADAPTAÇÃO MARGINAL E LINHA DE CIMENTAÇÃO DE LAMINADOS CERÂMICOS CIMENTADOS COM RESINA COMPOSTA PRÉ-AQUECIDA E AGENTE DE CIMENTAÇÃO RESINOSO FOTOATIVADO

UBERABA - MG

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Dissertação apresentada ao Programa de Pós-Graduação em Odontologia da Universidade de Uberaba como parte dos requisitos para a obtenção do título de Mestre em Clínica Odontológica Integrada.

Orientador: Prof. Dr. Thiago Assunção Valentino

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Área de concentração: Clínica Odontológica Integrada

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EPÍGRAFE

“Leve na sua memória para o resto de sua vida as coisas boas que surgiram no meio das dificuldades. Elas serão uma prova de sua capacidade em vencer as provas e lhe darão confiança na presença divina, que nos auxilia em qualquer situação, em qualquer tempo, diante de qualquer obstáculo. ”

Chico Xavier

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RESUMO

Este estudo avaliou a influência do tipo de preparo dental na adaptação marginal e linha de cimentação de laminados cerâmicos cimentados com resina composta pré-aquecida e agente de cimentação resinoso fotoativado. Sessenta terceiros molares humanos hígidos foram limpos e aleatoriamente divididos em 6 grupos experimentais (n=10) de acordo com o tipo de preparo dental para laminado cerâmico e tipo de agente de cimentação empregado. Os dentes receberam 3 modos de preparos dentais com desgastes de 0,5mm de profundidade, com desgastes de 0,2 mm de profundidade e sem desgastes dentais. Os dentes foram moldados com silicone polimerizado por adição e confeccionados modelos de gesso especial tipo IV. Laminados cerâmicos de di-silicato de lítio e.max Press cor HT A1 IPS Empress foram confeccionados e cimentados com agente de cimentação resinoso fotoativado cor A1 e com resina composta pré-aquecida IPS Empress Esthetic, cor A1, aquecida em um dispositivo específico. Após 24 horas da cimentação, foram realizados modelos em resina epóxi dos laminados cerâmicos para análise da adaptação marginal e linha de cimentação em 10 pontos diferentes da interface de união, com aumentos de 50, 100 e 500X. Os preparos dentais para laminados cerâmicos sem desgaste, apresentaram valores de desadaptação marginal inferiores quando comparados com os grupos que receberam preparos dentais com redução de 0,2mm e 0,5mm, embora tenham apresentado uma linha de cimentação maior em relação aos dentes que receberam preparos dentais ($p<0,05$). O agente de cimentação fotoativado e a resina composta pré-aquecida apresentaram valores de desadaptação marginal similares para os grupos de dentes sem preparos e com preparos dentais com redução de 0,2mm. Para os preparos com redução de 0,5mm, a resina composta pré-aquecida apresentou valores de adaptação marginal melhores em relação ao grupo que utilizou agente de cimentação fotoativado ($p<0,05$). Desta forma, conclui-se que preparos dentais para laminados cerâmicos sem desgaste apresentaram valores de desadaptação marginal inferiores quando comparados com os grupos que receberam preparos dentais e uma linha de cimentação maior foi observada para os dentes que sem preparos dentais. O agente de cimentação fotoativado e a resina composta pré-aquecida apresentaram valores de desadaptação marginal similares para os grupos de dentes com preparos e sem preparos.

Palavras-chave: Laminados. Cerâmica. Cimento Resinoso.

ABSTRACT

This study evaluated the influence of the dental preparation type on the marginal adaptation and cementation line of ceramic laminates cemented with preheated composite resin and photoactivated resin luting agent. Sixty healthy human third molars were cleaned and randomly divided into 6 experimental groups (n = 10) according to the dental preparation type for ceramic laminate and the type of resin luting agent employed. The teeth received 3 modes of dental preparations, with wear of 0,5mm depth, 0,2mm depth and without dental wear. After dental preparation, the teeth were molded with polyvinylsiloxane (Virtual, Ivoclar-Vivadent , USA) and made of special type IV gypsum models (Fuji Rock, GC, Japan). Laminated ceramic silicate di-lithium e.max Press HT (IPS Empress, Ivoclar), shade A1, were obtained and cemented with a photoactivated resin luting agent (Variolink® esthetic, Ivoclar-Vivadent), shade A1, and with composite resin pre-heated IPS Empress Esthetic (heated on a specific device Ena Heat , Micerium SpA , Avegno GE, Italy), shade A1. After 24 hours of cementation, epoxy resin models of the ceramic laminates were made for analyzed the marginal adaptation and cementation line at 10 different points of the bonding interface, with magnification of 50, 100, and 500X. The dental preparations for ceramic laminates without wear had lower marginal maladaptation values when compared to the groups that received dental preparations with a reduction of 0,2mm and 0,5mm, although they presented a greater cementation line in relation to the teeth that received preparation ($p < 0.05$). The photoactivated resin luting agent and the preheated composite resin showed similar marginal maladaptation values for the groups of teeth without preparation and dental preparations with a reduction of 0,2mm. For pre-heated 0,5mm preparations, the pre-heated composite had better marginal adaptation values than the group that used photoactivated cementation agent ($p < 0.05$). In this way, it was concluded that dental preparations for ceramic laminates without wear had lower marginal maladaptation values when compared to the groups that received dental preparations and a larger cementation line was observed for the teeth than without dental preparations. The photoactivated luting agent and the preheated composite resin presented similar marginal maladjustment values for the groups of teeth without preparation and preparation.

Keywords: Laminates. Ceramic. Resin Cement.

LISTA DE ABREVIATURAS E SIGLAS

Al_2O_3 – Óxido de alumínio

^oC – Grau Celsius.

g – Grama.

HF – Ácido fluorídrico.

Kv – Kilovolt.

MEV – Microscópio eletrônico de varredura.

ml – Mililitro.

mm – Milímetro.

n – Número de dentes

PVC – Policloreto de polivinila.

Tg – Transição vítrea.

µm – Micrometro.

W – Watts.

SUMÁRIO

1 INTRODUÇÃO E REFERENCIAL TEÓRICO

Os laminados cerâmicos foram idealizados por Charles Pincus em 1938 e se apresentam em constante evolução na Odontologia, em virtude do progresso tecnológico na confecção das cerâmicas e dos materiais adesivos presentes no processo de cimentação. A popularidade no uso de laminados cerâmicos ocorre pelo fato de serem restaurações estéticas, com capacidade de reconstituir cor, forma e função dos dentes. Além disto, os laminados são confeccionados por métodos conservadores e são capazes de manter a biomecânica do elemento dental restaurado à uma taxa de aproximadamente 93% com 15 anos de serviço clínico (FRIEDMAN, 1998; RADZ, 2011). Encontra-se com grande estima nos dias atuais devido a suas particularidades, tais como, fechamento de diastemas, reparo de dentes fraturados, correção de esmalte alterado, alteração estética para atender anseios de beleza, bem como reparo de restaurações como coroas e próteses fixas (STRASSLER, 2007). Para atingir sucesso e previsibilidade, conhecimento técnico e científico sobre os materiais disponíveis tanto nas etapas de confecção, quanto de ajuste, cimentação, proservação e promoção de saúde, é indispensável (LIN et al., 2012).

Nessa perspectiva, as cerâmicas denominadas vítreas por suas características estéticas e adesivas são os materiais de eleição para a confecção dos laminados cerâmicos (LAYTON e WALTON, 2012). Por outro lado, os agentes de cimentação resinosos também representam os materiais adequados, por promoverem união funcional com a estrutura dental, bem como com as cerâmicas vítreas (CHO et al., 2015; RUNNACLES et al., 2014; TURGUT e BAGIS, 2013).

Atualmente, não há um consenso na literatura do melhor tipo de preparo dental para a confecção de laminados cerâmicos. Preparos minimamente invasivos tem sido realizado a partir de preparos restritos em esmalte, com técnicas de preparos confinados no terço cervical e até restaurações sem nenhum preparo prévio (PINI *et al*., 2012; KARAGÖZOĞLU *et al*., 2016; MORIMOTO *et al*., 2016). Técnicas que preservam maior quantidade de esmalte possuem maior resistência frente às forças de cisalhamento. Nessa perspectiva, preparos minimamente invasivos possuem maior longevidade do que os demais preparos (ALAVI *et al*., 2017). Nos casos de remodelação estética sem alteração de cor dos substratos dentais, restaurar sem realização de preparo é atrativo por se tratar de procedimento conservador e remoção mínima de estrutura dentária (MATERDOMINI e FRIEDMAN, 1995). Este tratamento é popularmente conhecido como lente de contato dental, e tem sido extensivamente utilizado (MATERDOMINI e FRIEDMAN, 1995; OKIDA *et al*., 2012).

Entretanto, não se pode considerar sucesso apenas uma boa união ao esmalte dental e resultado estético imediato, muito mais que isso é necessário para que não somente a restauração esteja desempenhando suas funções, mas que não ocorra alteração de cor na linha de cimentação que muitas vezes fica em região visível (DE ANDRADE *et al*., 2013). O procedimento sem nenhum preparo utiliza restauração muito fina que chega a 0,25mm de espessura na linha de término (OKIDA *et al*., 2012; STRASSLER, 2007). Contudo, mesmo com essa reduzida espessura o resultado pode ser um sobre contorno (PETO, 2015). Além desse sobre contorno, o procedimento de acabamento e polimento da restauração durante a etapa de confecção realizada em laboratório pode gerar micro trincas que poderiam comprometer a adaptação especialmente na linha de término (DENRY, 2013).

Embora tenha na literatura um consenso de que os laminados cerâmicos devem ser cimentados com agentes de cimentação fotoativados, não há, de forma contundente, estudos que correlacionem agentes de cimentação com maior ou menor percentual de carga de partículas inorgânicas, bem como suas viscosidades. Ainda, características como módulo de elasticidade dos agentes de cimentação resinosos são relacionadas a este percentual de partículas de carga inorgânica (SPAZZIN *et al*., 2016; BABU *et al*., 2012) e o baixo percentual de carga pode estar ligado a uma maior deformação elástica e falha no desempenho clínico dos agentes de cimentação. Um módulo de elasticidade com valor médio entre o da restauração e do dente é desejável, pois poderia reduzir a concentração de tensão interfacial. Logo, os materiais para cimentação de laminados cerâmicos deveriam ser compósitos resinosos de elevada quantidade de partículas de carga, baixa contração de polimerização, módulo de elasticidade compatível com o da estrutura dental e alta fluidez (BABU *et al*., 2012).

Na literatura pertinente, há muita controvérsia em relação ao melhor tipo de preparo dental para a confecção de laminados cerâmicos em relação à necessidade ou não de desgaste dentais com o intuito de obter uma melhor adaptação marginal para minimizar o acúmulo de biofilme e pigmentação de margem. Além disto, trabalho que correlacionem a cimentação de laminados cerâmicos com e sem preparos dentais cimentados com resina composta pré-aquecida e com agente de cimentação resinoso fotoativado não existe estudos contundentes na literatura. Desta forma, este estudo avaliou a influência do tipo de preparo dental na adaptação marginal e linha de cimentação de laminados cerâmicos reforçados por di-silicato de lítio cimentados com resina composta pré-aquecida e com agente de cimentação resinoso fotoativado. A hipótese nula testada neste estudo foi que (1) o tipo de preparo dental e (2) o

material utilizado para a cimentação adesiva não apresentam diferenças estatísticas significantes na adaptação marginal e linha de cimentação.

2 OBJETIVOS

Este estudo avaliou a influência do tipo de preparo dental, em 3 níveis, com desgaste dental de 0,5mm; 0,2mm e sem desgaste dental, na adaptação marginal e linha de cimentação de laminados cerâmicos cimentados com resina composta pré-aquecida ou com agente de cimentação resinoso fotoativado.

3. CAPÍTULO ÚNICO

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Title: INFLUENCE OF THE TYPE OF DENTAL PREPARATION ON MARGINAL ADAPTATION AND CEMENTATION LINE OF CERAMIC LAMINATES BONDED WITH PRE-HEATED COMPOSITE RESIN AND PHOTOACTIVATED RESIN CEMENT AGENT

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Short title: INFLUENCE OF THE TYPE OF DENTAL PREPARATION ON MARGINAL ADAPTATION AND CEMENTATION LINE OF CERAMIC LAMINATES

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3.1 ABSTRACT

This study evaluated the influence of the dental preparation type on the marginal adaptation and cementation line of ceramic laminates bonded with pre-heated composite resin and photoactivated resin luting agent. Sixty healthy human third molars were cleaned and randomly divided into 6 experimental groups (n = 10) according to the dental preparation type for ceramic laminate and the type of resin luting agent employed. The teeth received 3 modes of dental preparations, with wear of 0,5mm depth, 0,2mm depth and without dental wear. After dental preparation, the teeth were molded with polyvinylsiloxane (Virtual, Ivoclar-Vivadent, USA) and made of special type IV gypsum models (Fuji Rock, GC, Japan). Laminated ceramic silicate di-lithium e.max Press HT (IPS Empress, Ivoclar), shade A1, were obtained and bonded with a photoactivated resin luting agent (Variolink® Esthetic, Ivoclar-Vivadent), shade A1, and with pre-heated composite resin (IPS Empress Esthetic, Ivoclar Vivadent) heated on a specific device (Ena Heat , Micerium SpA , Avegno GE, Italy), shade A1. After 24 hours of cementation, epoxy resin models of the ceramic laminates were made for analyzed the marginal adaptation and cementation line at 10 different points of the bonding interface, with magnification of 50, 100, and 500X. The dental preparations for ceramic laminates without wear had lower marginal maladaptation values when compared to the groups that received dental preparations with a reduction of 0,2mm and 0,5mm, although they presented a greater cementation line in relation to the teeth that received preparation ($p < 0.05$). The photoactivated resin luting agent and the preheated composite resin showed similar marginal maladaptation values for the groups of teeth without preparation and dental preparations with a reduction of 0,2mm. For pre-heated 0,5mm preparations, the pre-heated composite had better marginal adaptation values than the group that used photoactivated cementation agent ($p < 0.05$). In this way, it was concluded that dental preparations for ceramic laminates without wear had lower marginal maladaptation values when compared to the groups that received dental preparations and a larger cementation line was observed for the teeth than without dental preparations. The photoactivated luting agent and the pre-heated composite resin presented similar marginal maladjustment values for the groups of teeth without preparation and preparation.

Keywords: Laminates. Ceramic. Resin Cement.

3.2 INTRODUCTION

The ceramic laminates were designed by Charles Pincus in 1938 and are in constant evolution in Dentistry, due to the technological progress in the preparation of the ceramics and adhesive materials present in the cementation process. The popularity in the use of ceramic laminates is due to the fact that they are aesthetic restorations, with the capacity to reconstitute the color, shape and function of the teeth. In addition, laminates are made by conservative methods and are capable of maintaining the biomechanics of the dental element restored at a rate of approximately 93% with 15 years of clinical service .[1,2] It is highly esteemed in the present day due to its particularities, such as, diastema closure, fractured teeth repair, altered enamel correction, aesthetic alteration to meet beauty yearnings, as well as repair of restorations such as crowns and fixed prostheses.[3] In order to achieve success and predictability, technical and scientific knowledge about the materials available in the manufacturing, adjustment, cementation, proservation and health promotion stages is indispensable. [4]

In this perspective, ceramics called vitreous because of their aesthetic and adhesive characteristics are the materials of choice for the manufacture of ceramic laminates. [5] On the other hand, the resinous cementing agents also represent the suitable materials, because they promote functional union with the dental structure, as well as the vitreous ceramics. [6,7,8]

Currently, there is no consensus in the literature on the best type of dental preparation for the manufacture of ceramic laminates. Minimally invasive preparations have been performed from enamel-restricted preparations, with techniques of preparation confined in the cervical third and even restorations without previous preparation. [9,10,11] Techniques that preserve more enamel have greater resistance to shear forces. In this perspective, minimally invasive preparations have greater longevity than the other preparations. [12] To restore aesthetics without altering the color of dental substrates, restoring without preparation is attractive because it is a conservative procedure and minimal removal of dental structure. [12,1] This treatment is popularly known as dental contact lens, and has been extensively used. [12,1,14]

However, a good bond to dental enamel and instant esthetic result can not be considered successful, much more so that it is necessary that not only the restoration is performing its functions, but that there is no change in color in the cementation line that many times is located in a visible region. [15] The procedure with no preparation uses very fine restoration that reaches 0,25mm of thickness in the end line. [3,14] However, even with this reduced thickness the result can be an over-contour.[16] In addition to this, the procedure of finishing and polishing of the

restoration during the preparation stage in the laboratory can generate microcracks that could compromise the adaptation especially in the end line. [17]

Although there is a consensus in the literature that ceramic laminates should be cemented with photoactivated cementation agents, there are not conclusively studies that correlate cementing agents with a greater or lesser percentage of inorganic particle loading, as well as their viscosities. In addition, the elastic modulus of the resinous cementing agents is related to this percentage of inorganic filler particles[18,19] and the low percentage of filler may be related to a higher deformation and failure in the clinical performance of cementing agents. A modulus of elasticity with an average value between the restoration and the tooth is desirable, as it could reduce the concentration of interfacial tension. Therefore, the materials for cementation of ceramic laminates should be resinous composites with a high amount of charge particles, low polymerization contraction, modulus of elasticity compatible with dental structure and high fluidity. [19]

In the pertinent literature, there is much controversy regarding the best type of dental preparation for the preparation of ceramic laminates in relation to the necessity or not of dental wear in order to obtain a better marginal adaptation to minimize the accumulation of biofilm and margin pigmentation. In addition, a study that correlates the cementation of ceramic laminates with and without cementitious dental preparations cemented with preheated composite resin and photoactivated resin cementation agent, there are no robust studies in the literature. In this way, this study evaluated the influence of the dental preparation type on the marginal adaptation and cementation line of lithium di-silicate-reinforced ceramic laminates cemented with preheated composite resin and photoactivated resin cement. The null hypothesis tested in this study was that (1) the type of dental preparation and (2) the material used for adhesive cementation did not present significant statistical differences in the marginal adaptation and cementation line.

3.3 MATERIAL AND METHODS

3.3.1 Preparation of Samples

Sixty-three caries-free, recently extracted third molars were selected from the University of Uberaba's tooth bank, which controls all legal means of obtaining at university undergraduate and graduate clinics, as well as receiving external donations. This study was approved by the research ethics committee of Uberaba University under CAAE 56020016.3.0000.5145. The

teeth were cleaned with periodontal curettes to remove debris and remnants of periodontal ligament, and then received prophylaxis with pumice stone and water with the aid of Robson brush coupled in a low-rotation handpiece.

3.3.2 Preparation of cavity preparation

The teeth were randomly divided according to the type of cavity preparation used to make ceramic laminates. The teeth were prepared for ceramic laminates with wear of 0,5mm depth, teeth with wear of 0,2mm depth and teeth without dental wear. All the preparations were performed on the vestibular face of the teeth with diamond tips (# 1012, KG Sorensen, Barueri, SP, Brazil), and fine diamond tip finishing (# 1012 FF, KG Sorensen, Barueri, Brazil) each diamond tip was changed every four cavities. The prepared surfaces were then finished with a cylindrical multilaminate tip (30 blades), (# 9572-1.0, Jet, Beavers Dental Divison Canada, Morrisburg, Canada).

3.3.3 Molding Procedure

Each prepared tooth was molded with addition polymerized silicone (Virtual, Ivoclar-Vivadent, USA) by means of the double molding technique with the aid of trays made of a PVC (Tiger) ring, 40mm internal diameter per 50mm length. The tooth moldings were initially made with material in the mass consistency, with the preparation covered by two layers of PVC film (Tiger). After five minutes, the trays were removed and the relief material discarded. The corresponding space was filled with fluid forming material in the ultra-light consistency which was manipulated by means of a proportioner and automatic dispenser.

The molds were removed after five minutes, remaining at rest for 60 minutes for elastic recovery and hydrogen release, following manufacturer's recommendations. All molding procedures were performed under conditions of controlled temperature (23 ± 2 ° C) and relative humidity (50 ± 10%), according to the Council on Dental Materials and Devices (1977). Both the prepared teeth and the material used in the molding procedure remained for a minimum of two hours under the abovementioned ambient conditions prior to use.

3.3.4 Obtaining Working Models

The molds obtained were sprayed with surfactant (Tensilab, Zermach, Italy), allowed to dry for 5 minutes and cast with special type IV gypsum (Fuji Rock, GC, Japan) provided according to the manufacturer's recommendations (20mL of water for 100g of powder) and mechanically

manipulated in a vacuum manipulator (Polidental, Cotia, SP) for 30 seconds. The molds were filled under vibration, with a die being coupled to a wall, to form the die base. The troches were removed after thirty minutes and numbered according to the respective specimen, and a period of 24 hours was waited before being used in the manufacture of ceramic laminates.

3.3.5 Making of Ceramic Laminates

The specimens received the spacer application (Megafit, Allentown USA) and, after drying, laminates made of special wax for sculpture (Wax ArtWax Press, Krumbach, Germany) with 0,5mm thickness in the occlusal region and 0,2mm thick in the cervical region. The thicknesses were verified with the use of special specimens for wax (Wilcos do Brasil, São Paulo, SP). After finishing and polishing with a soft brush of the laminates sculpted in wax, they were fixed in groups of 3 in a plastic crucible-shaped base (50 x 56 x 20 mm) with feed conduits (3 mm in diameter x 3 mm in length). The wax-sculpted laminates were positioned with a slope of approximately 60 ° and then a silicone ring was positioned at the base.

The phosphate-agglutinated coating (SpeedPress, Ivoclar-Vivadent Ltda., Barueri) was mechanically handled with a vacuum scalpel (Polidental Ltda., Cotia) in the ratio of 100 grams of powder to 16 ml of liquid (Ivoclar) and 11 ml of distilled water. The coating was slowly poured into the wax laminates in order to include them thus avoiding the formation of bubbles. A plastic cap (50 mm internal diameter x 56 mm outside diameter x 20 mm height) with a central perforation of 8mm diameter was positioned at the top of the ring to form a necessary flat surface. After the coating was secured, the silicone ring, conduit former and bases were removed. Then, the coating block was taken to the electric furnace EDG 3000 (EDG Equipamentos e Controles Ltda., São Carlos) and the ceramic laminates were made as follows:

a) the wax was removed from the coating block using an EDG 3000 - 1P electric furnace raising the oven temperature to 250 ° C and with a power of 60 W, after that temperature has been reached for 30 minutes. Then the temperature was raised to 500 ° C and the power was 70W and waiting 30 minutes. Finally the temperature was raised to 850øC and the potency to 80W was maintained for 30 minutes;
b) after which the coating block was removed from the oven and immediately an insert of the e.max Press ceramic, HT 1 color (Ivoclar), was placed in the conduit together with an aluminum oxide plunger and taken to the EP 3000 oven (Ivoclar-Vivadent), the oven automatically raised the temperature to approximately 910 ° C and remained in the oven for approximately 24 minutes, which is the time to reach the glass transition (Tg) of the

c) ceramic. After the Tg was reached automatically the oven applied a pressure of 5 bar, for 4 minutes;

d) the coating ring was removed from the oven and it was expected to reach room temperature. After the coating block reached room temperature, the aluminum oxide plunger was removed and, with the aid of a silicon carbide disc, the coating block was cut to the desired height. The coating material was then removed by blasting using the Renfert Basic Master apparatus (Renfert, Hilzingen) with glass particles 50 μm in diameter, 6 bar pressure for gross coating removal and 2 bar for removal of the coating near the samples, followed by removal of the diamond disc feed conduit (006, Brassler);

e) the ceramic laminates were left on ultrasound for 5 minutes bathed in 1% HF acid (Ivoclar) for final coating removal. Shot blasting with 50μm glass beads was applied to remove any coating residues;

f) after removal of the coating, the ceramic laminates had the excess of ceramic removed and were polished on only one side following assembled tip orders indicated by Ivoclar-Vivadent. DYP-15G (removal of excess ceramic), DYP-15M (removal of the final ceramic excess), L26Dxg (precoating - thick), L26Dg (prepolishing - medium), L26dmf polishing - fine), H8D (final gloss);

g) the ceramic laminates received the glaze mass on the external face that received the polish and were taken to the Ivoclar Vivadent EP300 kiln in the P32 program for glaze firing. To receive the glaze, the polished face was sandblasted with Al2O3 at 1 bar and subjected to a steam-forming equipment in order to clean the surface. With the dry surface the paste glaze IPS e.max Ceram Glaze Paste (Ivoclar Vivadent) was applied and taken to the oven EP3000 where the P32 program for glaze firing was selected.

3.3.6 Adhesive Cementation of Ceramic Laminates

After the preparation of the ceramic laminates, for each type of preparation, it was subdivided according to the type of cementing agent employed, totaling 6 experimental groups (n = 10). All ceramic laminates were conditioned with 10% hydrofluoric acid (Dentsply, RJ, Brazil) for 20 seconds to create micromechanical retentions, followed by the application of 2 layers of hydrolyzed silane (Prosil, FGM, SC, Brazil) and 1 layer (Variolink Esthetic, Ivoclar-Vivadent) in the A1 color and the composite resin IPS Empress (Adper Schotchbond Multi-Purpose Plus, 3M ESPE, Dental Products, USA). After the cementation, the excesses of the cementing agents

were removed with the aid of a brush and photoactivated for 40s at an irradiance of 1,200 mW / cm2 (Bluephase Vivadent, Lietchtenstein, Germany).

3.3.7 Preparation of Samples for Scanning Electron Microscopy

For each experimental group, 3 specimens were randomly selected, which were sectioned in the middle in the vestibular-lingual direction with the aid of a precision cutting machine (ISOMET 1000, Buehler) placed in PVC rings that received polystyrene resin (Polibalbino, São Paulo, SP, Brazil). After 24 hours, the specimens were submitted to scanning electron microscopy.

The established polishing protocol adhered to the # 400, # 600, # 1200 and # 2000 granulation sizing sequence. Subsequently, the samples were polished with felts (ERIOS, São Paulo) and diamond pastes in order of decreasing granulation of 6μ, 1μ, ¼ μ and 0,05π. At each change of felt disc the specimens were submitted to an ultrasonic bath for 10 minutes. After polishing, the specimens were submerged in 50% phosphoric acid solution for 5 seconds, then washed with deionized water for 30 seconds. The samples were then submerged in 1% sodium hypochlorite solution for 5 minutes, then washed with deionized water for 60 seconds and then immediately placed in a silica gel-containing vessel and stored until scanning electron microscopy.

3.3.8 Analysis of the Marginal Adaptation and Cement Line of Ceramic Laminates

The restored teeth were molded with addition polymerized silicone (Virtual, Ivoclar-Vivadent, USA) and the molds were cast with epoxy resin (Buehler Ltd, Lake Bluff, IL, USA).

After the polymerization of the epoxy resin the models were removed from the molds and fixed in stubs) so that it allowed analysis of the restorative tooth interface.

The teeth fixed to the stubs were covered with gold in a suitable equipment called sputter coater (Balzers-SCD 050; Balzers Union Aktiengeselischaft Furstentun, Liechtentein) for 180 seconds with a voltage of 40mA (milliampers) and interface (cement line and edges between cement and ceramics and between cement and enamel) were analyzed at three equidistant points 1,5mm in a scanning electron microscope (LEO 435 VP, Cambridge, England) operated at 20 Kv by a single operator.

Statistical analysis

The values of marginal adaptation and cement line were tabulated and submitted to non-parametric Kruskal-Wallis and post hoc Dunn analysis, both with significance of 5% ($p < 0.05$).

3.4 RESULTS

Dental preparations for non-wearing ceramic laminates presented lower marginal maladaptation values when compared to groups that received dental preparations with 0,2mm and 0,5mm wear, although they presented a greater cementation and over-contour line than teeth that received dental preparations ($p < 0.05$). (Table 1).

In comparison to the material used for the cementation of the ceramic laminates, the photoactivated cementation agent and the pre-heated composite showed similar marginal mal adjustment values for the groups of teeth without preparation and dental preparations with reduction of 0,2mm. For pre-heated 0,5mm preparations, the pre-heated composite had better marginal adaptation values than the group that used photoactivated cementation agent ($p < 0.05$).

In relation to the cementation line present after the cementation of the ceramic laminates, the teeth that received ceramic laminates without dental preparation had a higher cementation line when compared to the groups that received dental reduction preparations of 0,2mm and 0,5mm.

3.5 DISCUSSION

In the present study, preparation with and without dental enamel wear and the use of resinous cementing agents and preheated composite resin influenced the marginal adaptation and cementing line values of ceramic laminates (Table 1). In this way, the null hypothesis tested that (1) the dental preparation type and (2) the material used for adhesive cementation did not present significant statistical differences in the marginal adaptation and the cement laminate cementation line was denied.

The type of dental preparation, the cementing technique and the finishing procedures adopted are considered important for the longitudinal success and aesthetic result of the restorations with ceramic laminates. [12] It has been shown that the modality of unprepared laminates is the choice of many professionals due to the conservation of dental structure associated with "great

aesthetic results" compared to conventional laminates with dental wear. Although there is a consensus in the literature that ceramic laminates with conventional preparations offer a successful treatment that preserves the dental structure, it provides excellent aesthetic results and great acceptance of the patient. [20]

According to the results, it was possible to notice that the groups that did not receive dental preparations, although they presented better marginal adaptation, presented greater cementing agent excess in the cementation line due to the presence of over-contour, independent of the type of agent used. This fact is justified by the fact that unprepared teeth allow the excess from the flow of the cementing agent to accumulate in the step between the cementation line and the over-contour generated by the thickness of the ceramic, this can result in accumulation of biofilm, pigmentation of the cementation line with aesthetic compromise, development of caries lesions and periodontal problems. [21]

Thus, both the marginal adaptation and the thickness of the cement film play crucial roles in the success of the indirect restorations and every stage of the process from the preparation to the cementation, seek a marginally clinically acceptable adaptation.[15] In addition, adaptation, especially in the finishing line, can be compromised due to the appearance of microcracks that may arise in the processes of confection, machining, finishing and polishing of the restoration during its preparation in the laboratory. [17] However, in the present study no bubbles or microcracks were observed in the finished lines of the tested ceramic laminates.

When comparing the bonding interface formed by a photoactivated cementation agent and a composite resin in the cementing of ceramic laminates, it is noticed that the bonding interface of the composite resins presents a greater number of failures since the flowability of this material is reduced and generates excesses, poor marginal adaptation and thicker hybrid layer when compared to the photoactivated resin cementation agent. [18] This fact can be justified because pre-heated composite resins present higher amount of load and higher viscosity when compared to resin cements that are more fluid because of the reduced amount of load. [22] In addition, the higher amount of charge particles present in preheated composite resins exhibits greater resistance to shear forces, a desirable fact in the longevity and clinical performance of ceramic laminates.[11] In this study, the use of the preheated composite resin did not show significant statistical differences regarding the marginal adaptation in relation to the photoactivated resinous cementation agent and future research should correlate the use of this material for the cementation of ceramic laminates.

The remaining amount of enamel structure after the preparation of the dental preparation is important for the bond strength, biomechanical behavior and longevity of indirectly cemented adhesive restorations.[12] In the literature, there is no consensus on the best type of preparation for the preparation of ceramic laminates, with a preparation of 0,5mm, with preparation of 0,2mm or without dental preparation. In the present study, it was observed that the preparations with dental wear of 0,2mm obtained similar marginal adaptation values for the teeth without dental preparations, although the cementation line observed for the teeth without preparation was larger due to the over contour. This fact can be explained due to the fact that teeth with definite terms need fitting of the laminate in the finishing line performed during dental preparation, a fact that does not apply to teeth without dental preparation. In this way, the clinician should be aware of the different clinical steps during the execution of ceramic laminates, besides selecting and indicating the type of preparation and the suitable materials for the adhesive cementation of a rehabilitation with ceramic laminates.

3.6 CONCLUSIONS

Within the limitations of the present study, it can be concluded that:

a) regardless of the type of preparation with reduction of 0,2mm and 0,5mm, both the photoactivated resinous cementation agent and the preheated composite resin presented similar marginal adaptation values.

b) cemented ceramic laminates in unprepared teeth presented better marginal adaptation than cemented ceramic laminates in teeth with minimally invasive preparations.

c) cemented ceramic laminates in unprepared teeth presented a greater cementation line and greater on contour than ceramic laminates cemented in teeth with minimally invasive preparations.

3.7 REFERENCES

1. Friedman, MJ (1998) 15 Year Review of Porcelain Veneer Failure - A Clinician's Observations. *Compendium of Continuing Education in Dentistry* **19(6)**, 625-8.

2. Radz, G (2011) Minimum Thickness Anterior Porcelain Restorations. *Dental Clinics of North America* **55(2)** 353-370.

3. Strassler, HE (2007) Minimally invasive porcelain veneers: indications for a conservative esthetic dentistry treatment modality. *General Dentistry* **55(7)** 686-94,695-6, 712.

4. Lin, TM. et al (2012) Fracture resistance and marginal discrepancy of porcelain laminate veneers influenced by preparation design and restorative material in vitro. *Journal of Dentistry* **40(3)** 202-209.

5. Layton, DM, Walton, TR (2012) The up to 21-year clinical outcome and survival of feldspathic porcelain veneers: accounting for clustering. *The International Journal of Prosthodontics* **25(6)** 604-12.

6. Cho, SH. et al (2015) Effect of Different Thicknesses of Pressable Ceramic Veneers on Polymerization of Light-cured and Dual-cured Resin Cements. *The Journal of Contemporary Dental Practice* **16(5)** 347-52.

7. Runnacles, P. et al (2014) Degree of conversion of a resin cement light-cured through ceramic veneers of different thicknesses and types. Brazilian Dental Journal **25(1)** 38-42.

8. Turgut, S, BAGIS (2013) Effect of resin cement and ceramic thickness on final color of laminate veneers: an in vitro study. *The Journal of Prosthetic Dentistry* **109(3)** 179-86.

9. Pini, NP. et al (2012) Advances in dental veneers: materials, applications, and techniques. *Clinical, Cosmetic and Investigational Dentistry* **10(4)** 9-16.

10. Karagozoglu, İ, Toksavul, S, Tomam, M (2016) 3D quantification of clinical marginal and internal gap of porcelain laminate veneers with minimal and without tooth preparation and 2-year clinical evaluation. *Quintessence International* **47(6)** 461-71.

11. Morimoto, S. et al (2016) Main Clinical Outcomes of Feldspathic Porcelain and Glass-Ceramic Laminate Veneers: A Systematic Review and Meta-Analysis of Survival and Complication Rates. *The International Journal of Prosthodontics* **29(1)** 38-49.

12. Alavi AA, Zeinab B, Farid NE (2017) The Shear Bond Strength of Porcelain Laminate to Prepared and Unprepared Anterior Teeth. *Journal of Dentistry* **18(1)** 50-55.

13. Materdomini, D, Friedman, MJ (1995) The contact lens effect: enhancing porcelain veneer esthetics. *Journal of Esthetic Dentistry* **7(3)** 99-103.

14. Okida, RC. et al (2012) The use of fragments of thin veneers as a restorative therapy for anterior teeth disharmony: a case report with 3 years of follow-up. *The Journal of Contemporary Dental Practice* **13(3**) 416-20.

15. De Andrade, Os et al (2013) The Area of Adhesive Continuity: A New Concept for Bonded Ceramic Restorations *Quintessence of Dental Technology* **36(9)**.

16**.** Peto, D (2015) Periodontal considerations in veneer cases *Journal of California Dental Association* **43(4)** 193-8.

17. Denry, I. (2013) How and when does fabrication damage adversely affect the clinical performance of ceramic restorations*? Dental Materials: official publication of the Academy of Dental Materials* **29(1)** 85-96.

18. Spazzin, AO. et al (2016) Strengthening of porcelain provided by resin cements and flowable composites. *Operative Dentistry* **41(2**) 179-88.

19. Babu, MR et al (2012) Comparative analysis for selection of resin luting cements based on filler content: an in vitro study. *Journal of Contemporary* Dental Practice **13(4):**481-6.

20. Shetty, A. et al (2011) Survival rates of porcelain laminate restoration based on different incisal preparation designs: An analysis. *Journal of Conservative Dentistry* **14(1)** 10-15.

21. Cardoso, Paula de Carvalho et al (2014) Facetas Cerâmicas: Como Remover os Excessos do Cimento Resinoso? *International Journal of Brazilian Dentistry* Florianópolis **10(2)** 214-25.

22. Namoratto, LR et al (2013) Cimentação em cerâmicas: evolução dos procedimentos convencionais e adesivos. *Revista Brasileria de Odontologia Rio de Janeiro* **70(2)** 142-7.

TABLES

Table 1. Marginal mismatch values, expressed in µm, for ceramic laminates cementated with photoactivated resin cement agent and pre-heated photoactivated composite resin.

	CEMENT RESIN PHOTOATIVATED	COMPOSITE RESIN PRE-HEATING
WHITHOUT DENTAL WEAR	78,42(23,70)B	50,40(27,28)B
DENTAL WEAR 0,2mm	83,00(45,16)A	73,95(36,80)A
DENTALWEAR 0,5mm	93,98(56,48)A	49,58(23,00)B

Different upper case letters indicate significant statistical difference according to Kruskal-Wallis non-parametric statistical analysis and Dunn post hoc statistical analysis, both with significance of 5%.

FIGURES

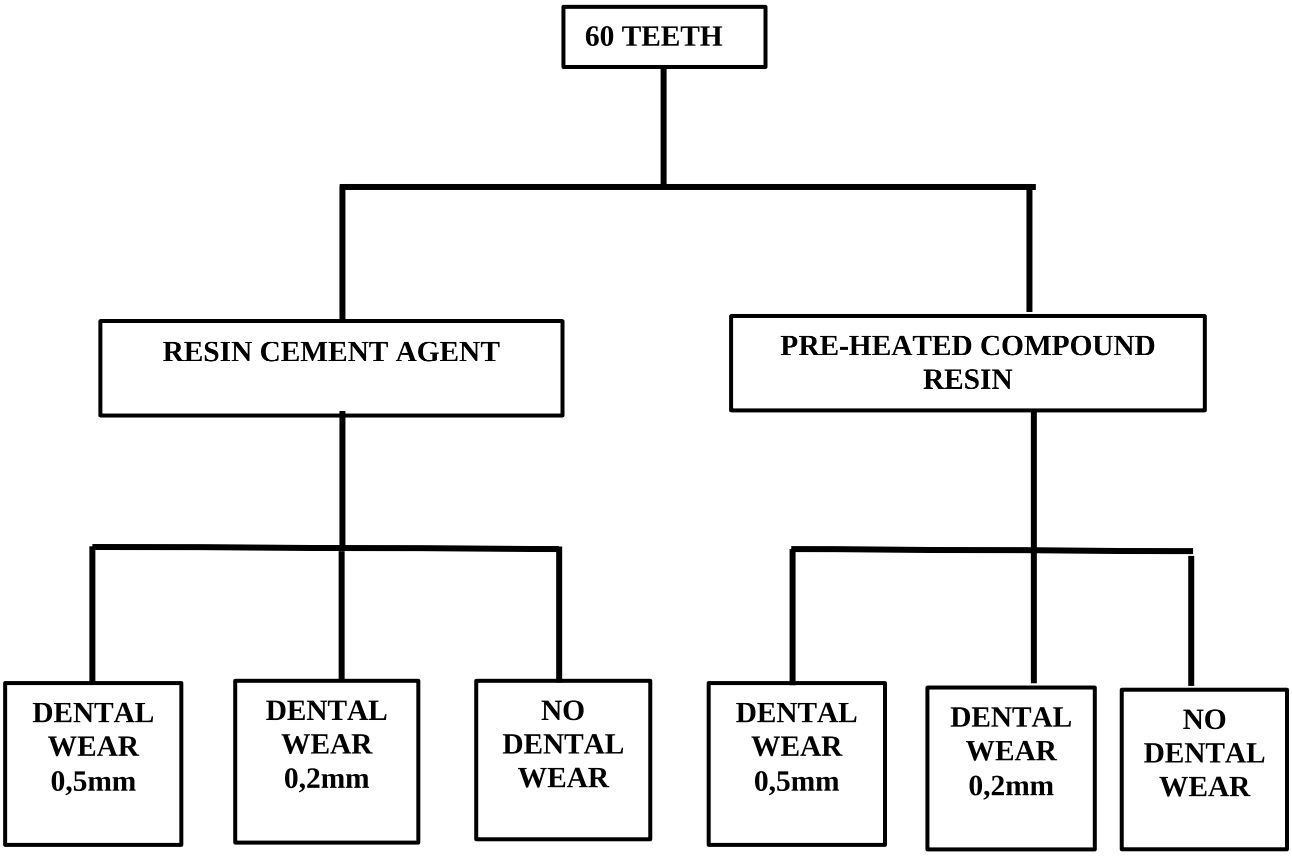

Figure 1. Schematic diagram of the division of groups

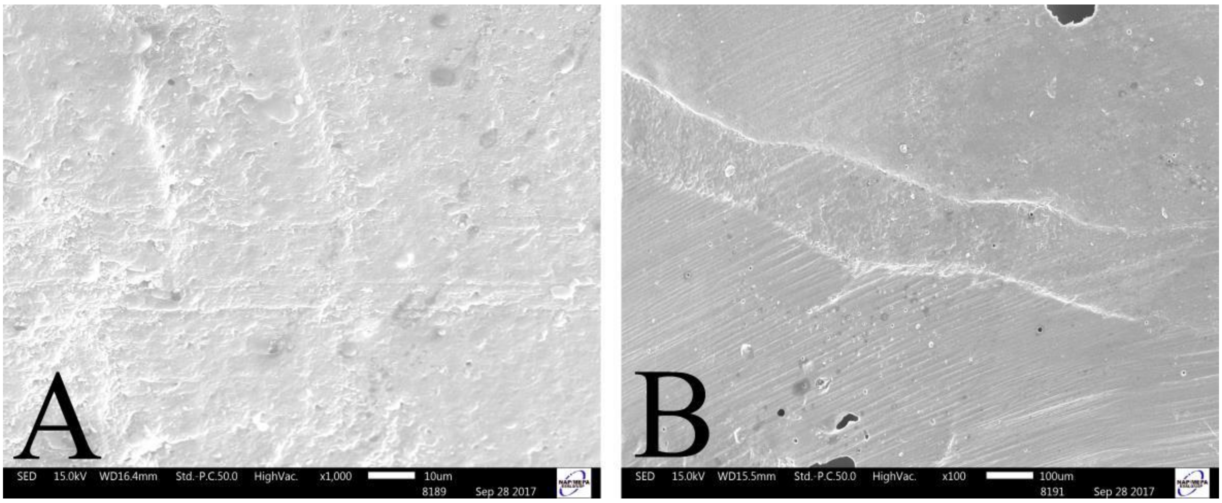

Figure 2. Comparison of cementation line of specimen A with dental preparation of 0,2mm and B with dental preparation of 0,5mm of dental wear. Both cemented with photoactivated resinous cementing agent.

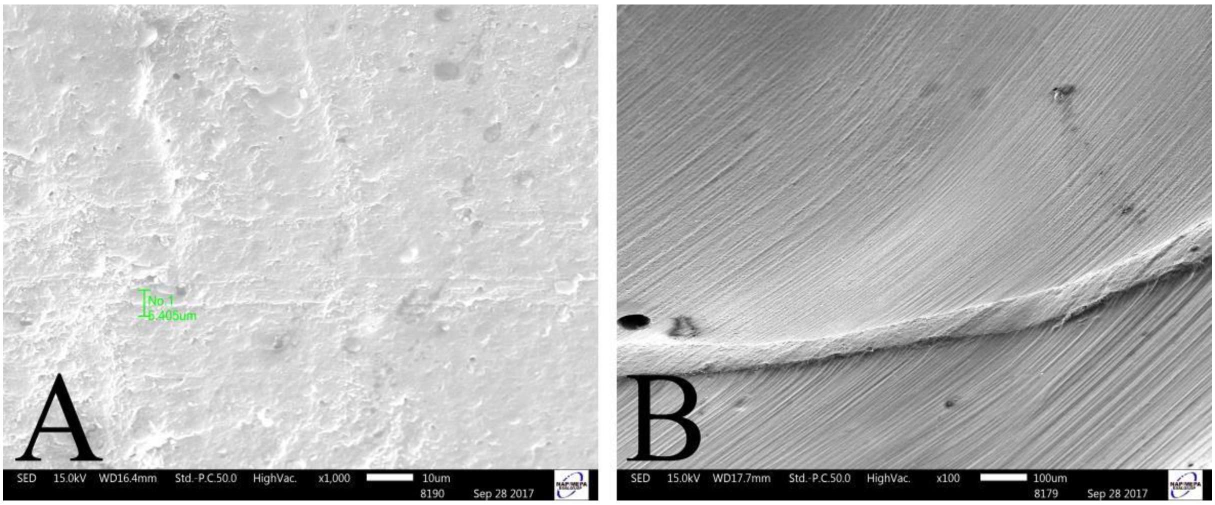

Figure 3. Comparison of cementation line of specimen A with dental preparation of 0,2mm and B without dental preparation. Both cemented with photoactivated resin cementation agent

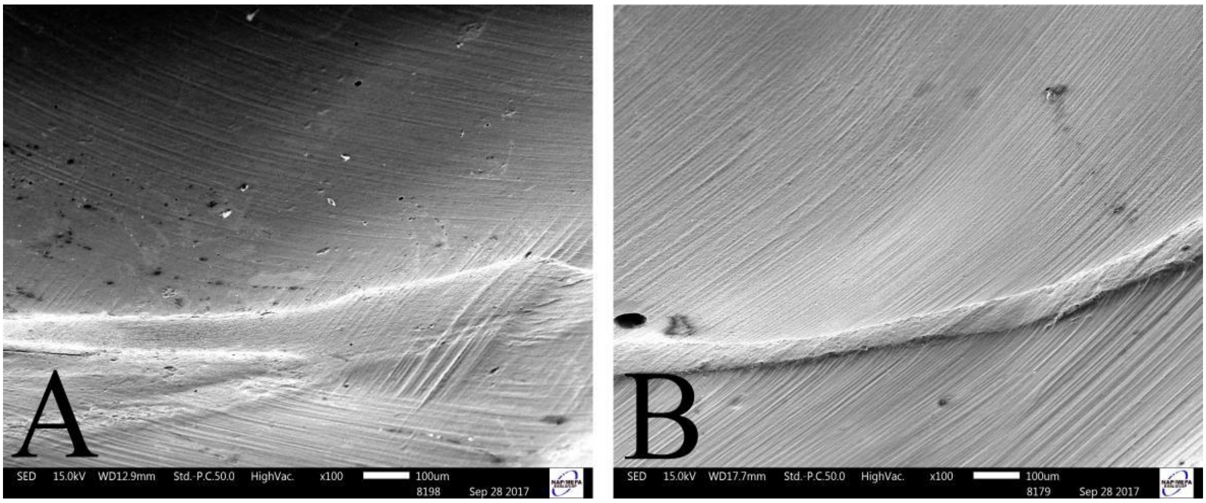

Figure 4. Comparison of cementation line of specimen A cemented with preheated composite resin and specimen B cemented with photoactivated resin cement. Both did not receive dental care.

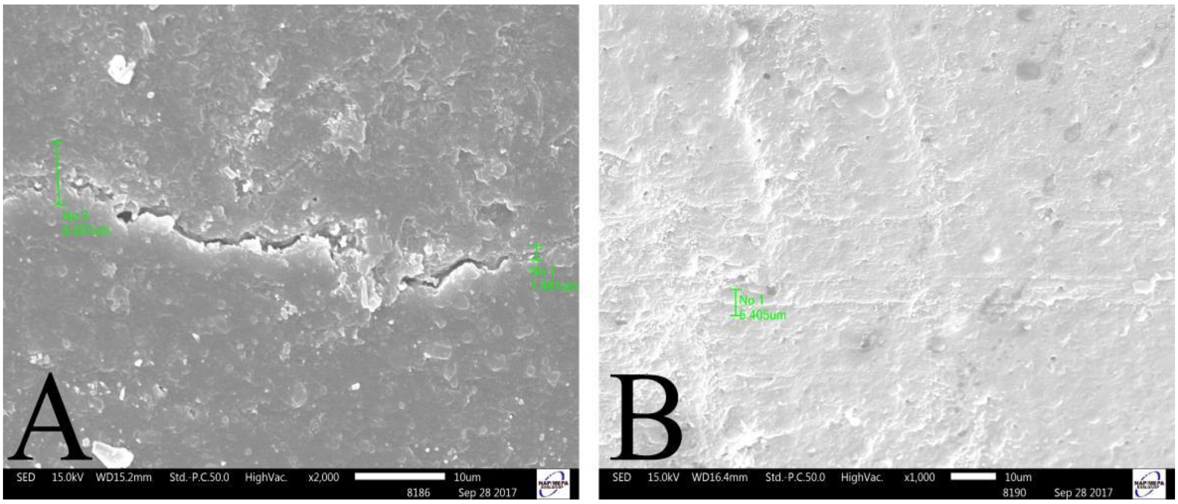

Figure 5. Comparison of cementation line of specimen A cemented with preheated composite resin and specimen B cemented with photoactivated resin cement. Both were treated with 0,2mm wear.

4 CONCLUSÃO GERAL

Dentro das limitações do presente estudo, pode-se concluir que:

a) independentemente do tipo de preparo com redução de 0,2mm e 0,5 mm, tanto o agente de cimentação resinoso fotoativado quanto a resina composta pré-aquecida apresentaram valores de adaptação marginal semelhantes.

b) laminados cerâmicos cimentados em dentes sem preparo apresentaram melhor adaptação marginal que os laminados cerâmicos cimentados em dentes com preparos minimamente invasivos.

c) laminados cerâmicos cimentados em dentes sem preparo apresentaram maior linha de cimentação e maior sobre contorno que os laminados cerâmicos cimentados em dentes com preparos minimamente invasivos.

REFERÊNCIAS

ALAVI, AA; ZEINAB, Behroozi; FARID, NE. The Shear Bond Strength of Porcelain Laminate to Prepared and Unprepared Anterior Teeth. **Journal of Dentistry**, [S.l], v. 18, n. 1, p. 50–55, mar. 2017.

BABU, MR et al. Comparative analysis for selection of resin luting cements based on filler content: an in vitro study.**Journal of Contemporary Dental Practice** 2012;13(4):481-6

CARDOSO, Paula de Carvalho; et al. Facetas Cerâmicas: Como Remover os Excessos do Cimento Resinoso? **International Journal of Brazilian Dentistry**, Florianópolis, v. 10, n. 2, p. 214-25, abr-jun. 2014.

CHO, SH. et al. Effect of Different Thicknesses of Pressable Ceramic Veneers on Polymerization of Light-cured and Dual-cured Resin Cements. **The Journal of Contemporary Dental Practice**, [S.l], v. 16, n. 5, p. 347-52, mai. 2015.

DE ANDRADE, OS et al. The Area of Adhesive Continuity: A New Concept for Bonded Ceramic Restorations. **Quintessence of Dental Technology**, [S.l], v. 36, p. 9, feb. 2013.

DE ANDRADE, OS et al. Ultimate Ceramic Veneers: A laboratory-Guided Preparation Technique for Minimally Invasive Restourations. **Quintessence of Dental Technology**, [S.l], v. 3, n. 1, p. 8-22, 2012.

DENRY, I. How and when does fabrication damage adversely affect the clinical performance of ceramic restorations? **Dental Materials: official publication of the Academy of Dental Materials**, [S.l], v. 29, n. 1, p. 85-96, jan. 2013.

LAYTON, DM; WALTON, TR. The up to 21-year clinical outcome and survival of feldspathic porcelain veneers: accounting for clustering. **The International Journal of Prosthodontics**, [S.1], v. 25, n. 6, p. 604-12, nov-dez. 2012.

LIN, TM. et al. Fracture resistance and marginal discrepancy of porcelain laminate veneers influenced by preparation design and restorative material in vitro. **Journal of Dentistry**, [S.l], v. 40, n. 3, p. 202-209, mar. 2012. 26

FRIEDMAN, MJ. 15 Year Review of Porcelain Veneer Failure - A Clinician's Observations. **Compendium of Continuing Education in Dentistry**, [S.l], v. 19, n. 6, p. 625-8, jun. 1998.

KARAGÖZOĞLU, İ; TOKSAVUL, S; TOMAN, M. 3D quantification of clinical marginal and internal gap of porcelain laminate veneers with minimal and without tooth preparation and 2-year clinical evaluation. **Quintessence International**, [S.l], v. 47, n. 6, p. 461-71, mar. 2016.

NAMORATTO, LR et al. Cimentação em cerâmicas: evolução dos procedimentos convencionais e adesivos. **Revista Brasileria de Odontologia**. Rio de Janeiro, v. 70, n. 2, p. 142-7, jul-dez. 2013.

MATERDOMINI, D; FRIEDMAN, MJ. The contact lens effect: enhancing porcelain veneer esthetics. **Journal of Esthetic Dentistry**, [S.1], v. 7, n. 3, p. 99-103. 1995.

MORIMOTO, S. et al. Main Clinical Outcomes of Feldspathic Porcelain and Glass-Ceramic Laminate Veneers: A Systematic Review and Meta-Analysis of Survival and Complication Rates. **The International Journal of Prosthodontics**, [S.l], v. 29, n. 1, p. 38-49, jan-fev. 2016.

OKIDA, RC. et al. The use of fragments of thin veneers as a restorative therapy for anterior teeth disharmony: a case report with 3 years of follow-up. **The Journal of Contemporary Dental Practice**, [S.l], v. 13, n. 3, p. 416-20, mai. 2012.

PETO, D. Periodontal considerations in veneer cases. **Journal of California Dental Association**, [S.l], v. 43, n. 4, p. 193-8, abr. 2015.

PINI, NP. et al. Advances in dental veneers: materials, applications, and techniques. **Clinical, Cosmetic and Investigational Dentistry**, [S.l], v. 10, n. 4, p. 9-16, fev. 2012.

RADZ, G. Minimum Thickness Anterior Porcelain Restorations. **Dental Clinics of North America**, [S.l], v. 55, n. 2, p. 353-370, abr. 2011. 27

RUNNACLES, P. et al. Degree of conversion of a resin cement light-cured through ceramic veneers of different thicknesses and types. **Brazilian Dental Journal**, [S.1], v. 25, n. 1, p. 38-42, jan-fev. 2014.

SHETTY, A. et al. Survival rates of porcelain laminate restoration based on different incisal preparation designs: An analysis. **Journal of Conservative Dentistry**, [S.l], v. 14, n. 1, p. 10-15, jan-mar. 2011.

SPAZZIN, AO. et al. Strengthening of porcelain provided by resin cements and flowable composites. **Operative Dentistry**.2016 Mar-Apr;41(2):179-88

STRASSLER, HE. Minimally invasive porcelain veneers: indications for a conservative esthetic dentistry treatment modality. **General Dentistry**, [S.l], v. 55, n. 7, p. 686-94; quiz 695-6, 712, nov. 2007.

TURGUT, S; BAGIS, B. Effect of resin cement and ceramic thickness on final color of laminate veneers: an in vitro study. **The Journal of Prosthetic Dentistry**, [S.1], v. 109, n. 3, p. 179-86, mar. 2013.

6. APÊNDICE A

MATERIAIS E MÉTODOS

1.1 Preparo das Amostras

Sessenta terceiros molares humanos livres de cárie e extraídos recentemente foram selecionados do banco de dentes da Universidade de Uberaba, o qual controla todos os meios legais de obtenção nas clínicas de graduação e pós-graduação da universidade, bem como recebe doações externas. Este estudo foi aprovado pelo comitê de ética em pesquisa da Universidade de Uberaba sob o CAAE 56020016.3.0000.5145. Os dentes foram limpos com curetas periodontais para remoção de debris e restos de ligamento periodontal, em seguida, receberam profilaxia com pedra pomes e água com auxílio de escova Robson acoplada em peça de mão em baixa rotação.

1.2 Confecção do Preparo Cavitário

Os dentes foram aleatoriamente divididos de acordo com o tipo de preparo cavitário empregado para confecção de laminados cerâmicos. Os dentes receberam preparos para laminados cerâmicos com desgaste de 0,5mm de profundidade, dentes com desgaste de 0,2mm de profundidade e dentes sem desgastes dentais. Todos os preparos foram realizados na face vestibular dos dentes com pontas diamantadas (#1012, KG Sorensen, Barueri, SP, Brasil), e acabamento com ponta diamantada fina (#1012 FF, KG Sorensen,Barueri,SP,Brasil) cada ponta diamantada foi trocada a cada quatro cavidades. Em seguida, as superfícies preparadas receberam acabamento final com ponta multilaminada cilíndrica (30 lâminas) (# 9572-1.0, Jet, Beavers Dental Divison Canada, Morrisburg, Canadá).

Figura 1. Desgaste sendo realizado com ponta diamantada (1012,KG Sorensen, Baueri,SP)

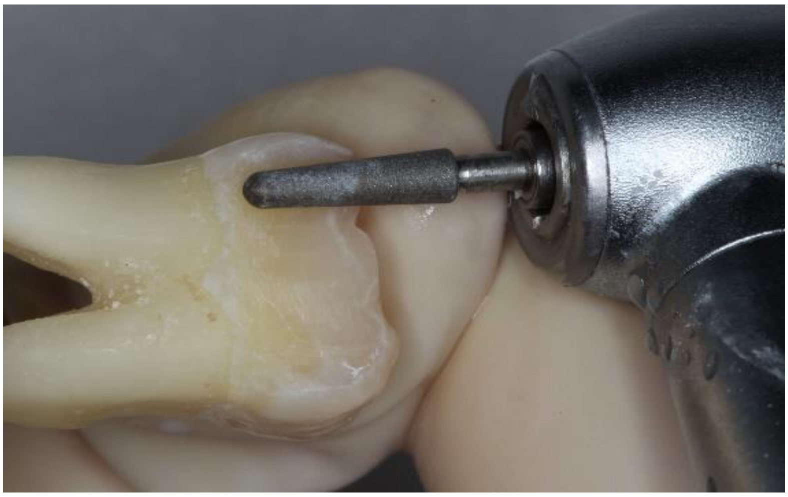

Figura 2. Acabamento do preparo com ponta diamantada (3195FF KG Sorensen, Baueri,SP)

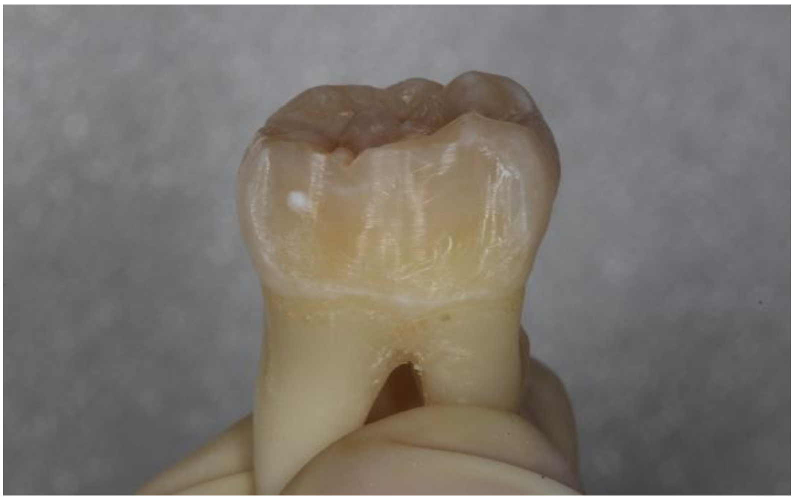

Figura 3. Preparo concluído

1.3 Procedimento de Moldagem

Cada dente preparado foi moldado com silicone polimerizado por adição (Virtual, Ivoclar-Vivadent, EUA) por meio da técnica de moldagem dupla com auxílio de moldeiras confeccionadas em um anel de PVC (Tigre), com 40 mm de diâmetro interno por 50 mm de comprimento. As moldagens dos dentes foram realizadas inicialmente com material na consistência de massa, com o preparo recoberto por duas camadas de filme de PVC (Tigre). Decorridos cinco minutos, as moldeiras foram removidas e o material de alívio descartado. O espaço correspondente foi preenchido com material de moldagem fluido na consistência ultra-leve que foi manipulado por meio de um proporcionador e dispensador automático.

Os moldes foram removidos após cinco minutos, permanecendo em repouso por 60 minutos para recuperação elástica e liberação de hidrogênio, seguindo recomendações do fabricante. Todos os procedimentos de moldagem foram realizados sob condições de temperatura (23 ± 2ºC) e umidade relativa controladas (50 ± 10%), de acordo com o Council on Dental Materials and Devices (1977). Tanto os dentes preparados, quanto o material utilizado no procedimento de moldagem, permaneceram por um período mínimo de duas horas nas condições ambientes acima citadas antes de serem utilizados.

1.4 Obtenção dos Modelos de Trabalho

Os moldes obtidos foram borrifados com agente surfactante (Tensilab, Zermach, Itália), deixados para secar por 5 minutos e vazados com gesso especial tipo IV (Fuji Rock, GC, Japão) proporcionado de acordo com as recomendações do fabricante (20mL de água para 100g de pó) e manipulado mecanicamente em um manipulador a vácuo (Polidental, Cotia, SP) por 30 segundos. Os moldes foram preenchidos sob vibração, estando acoplada a moldeira, uma muralha em silicone para formação da base do troquel. Os troqueis foram removidos após trinta minutos e numerados de acordo com o respectivo espécime, sendo aguardado um período de 24 horas, antes de serem utilizados na confecção laminados cerâmicos.

1.5 Confecção dos Laminados Cerâmicos

Os troqueis receberam a aplicação de espaçador (Megafit, Allentown EUA,) e, após secagem do mesmo, laminados confeccionados em cera especial para escultura (Cera ArtWax Press, Krumbach, Alemanha) com 0,5 mm de espessura na região oclusal e 0,2 mm de espessura na região cervical. As espessuras foram verificadas com o uso de especímetro especial para cera (Wilcos do Brasil, São Paulo, SP). Após acabamento e polimento com escova macia dos laminados esculpidos em cera, os mesmos foram fixados em grupos de 3 em uma base plástica formadora de cadinho (50 x 56 x 20mm) com condutos de alimentação (3 mm de diâmetro x 3 mm de comprimento). Os laminados esculpidos em cera foram posicionados com uma inclinação de 60° aproximadamente e, em seguida, um anel de silicone foi posicionado na base.O revestimento aglutinado por fosfato (SpeedPress, Ivoclar-Vivadent Ltda., Barueri) foi manipulado mecanicamente com um espatulador a vácuo (Polidental Ltda., Cotia) na proporção de 100 grama de pó para 16 ml de líquido (Ivoclar) e 11 ml de água destilada. O revestimento foi vertido lentamente nos laminados em cera a fim de incluí-los assim evitando a formação de bolhas. Uma tampa plástica (50 mm de diâmetro interno x 56 mm de diâmetro externo x 20 mm de altura) com uma perfuração central de 8 mm de diâmetro foi posicionada na parte superior do anel para formar uma superfície plana necessária. Após a presa do revestimento, o anel de silicone, o formador do conduto e as bases foram removidos. Em seguida, o bloco de revestimento foi levado ao forno elétrico EDG 3000 (EDG Equipamentos e Controles Ltda., São Carlos) e a confecção dos laminados de cerâmica foram feitas da seguinte forma:

a) a cera foi eliminada do bloco de revestimento utilizando um forno elétrico EDG 3000 - 1P elevando a temperatura do forno em 250° C e com potência de 60 W, após atingida essa temperatura aguarda-se 30 minutos. Em seguida, a temperatura foi elevada para 500° C e a potência para 70 W e aguardando 30 minutos. Finalmente a temperatura foi elevada até 850° C e a potência para 80 W e mantido por 30 minutos;

b) após, o bloco de revestimento foi removido do forno e imediatamente uma pastilha da cerâmica e.max Press, cor HT A1 (Ivoclar), foi posicionada no conduto juntamente com um êmbolo de óxido de alumínio e levados ao forno EP 3000 (Ivoclar-Vivadent), automaticamente o forno elevou a temperatura até aproximadamente 910° C e permaneceu no forno por aproximadamente 24 minutos que é o tempo para se atingir a transição vítrea (Tg) da cerâmica. Após a Tg ser atingida automaticamente o forno aplicou uma pressão de 5 bar, por 4 minutos;

c) o anel de revestimento foi removido do forno e esperou-se o mesmo atingir a temperatura ambiente. Após o bloco de revestimento atingir a temperatura ambiente, o êmbolo de óxido de alumínio foi removido e, com auxílio de um disco de carbeto de silício, o bloco de revestimento foi cortado na altura desejada. Em seguida, o material de revestimento foi removido dos discos, por meio de jateamento, utilizando o aparelho Renfert Basic Master (Renfert, Hilzingen) com partículas de vidro com 50 μm de diâmetro, pressão de 6 bar para remoção bruta do revestimento e 2 bar para remoção do revestimento próximo das amostras, seguido da remoção do conduto de alimentação com disco de diamante (006, Brassler);

d) os laminados cerâmicos ficaram no ultrassom durante 5 minutos banhados por ácido HF 1% (Ivoclar) para remoção final do revestimento. Jateamento com pérolas de vidro de 50 μm foi aplicado para remoção de quaisquer resíduos de revestimento;

e) após remoção do revestimento, os laminados cerâmicos tiveram o excesso de cerâmica removido e receberam polimento em apenas um lado seguindo ordens de pontas montadas indicadas pela Ivoclar-Vivadent. As pontas montadas utilizadas foram: DYP-15G (remoção do excesso grosso de cerâmica), DYP-15M (remoção do excesso final de cerâmica), L26Dxg (pré-polimento - grosso), L26Dg (pré polimento - médio), L26dmf (pré polimento - fino), H8D (brilho final);

f) os laminados cerâmicos receberam a massa de glaze na face externa que recebeu o polimento e foram levadas ao forno EP300 da Ivoclar Vivadent no programa P32 para queima de glaze. Para receber o glaze, a face polida recebeu jateamento com Al_2O_3 a 1 bar e foram submetidas a um equipamento formador de vapor afim de limpar a superfície. Com a superfície seca a massa glaze IPS e.max Ceram Glaze Paste (Ivoclar Vivadent) foi aplicada e levada ao forno EP3000 onde o programa P32 para queima de glaze foi selecionado.

1.6 Cimentação Adesiva dos Laminados Cerâmicos

Após a confecção dos laminados cerâmicos, para cada tipo de preparo recebeu uma subdivisão de acordo com o tipo de agente de cimentação empregado, totalizando 6 grupos experimentais (n=10). Todos os laminados cerâmicos foram condicionados com ácido fluorídrico a 10% (Dentsply, RJ, Brasil) por 20 segundos para a criação de retenções micromecânicas, seguido da aplicação de 2 camadas de silano hidrolisado (Prosil, FGM, SC, Brasil) e 1 camada de adesivo (Adper Schotchbond Multi-Purpose Plus, 3M ESPE, Dental Products, USA. Em seguida, os laminados cerâmicos receberam o agente de cimentação resinoso fotoativado (Variolink Esthetic, Ivoclar-Vivadent), na cor A1, e a resina composta IPS Empress Esthetic, na cor A1, aquecida a 55^{O}C em um dispositivo específico (Ena Heat, Micerium SpA, Avegno GE, Itália). Após a cimentação, os excessos dos agentes de cimentação foram removidos com auxílio de um pincel e fotoativados por 40s a uma irradiância de 1.200 mW/cm^2 (Bluephase Vivadent, Lietchtenstein, Germany).

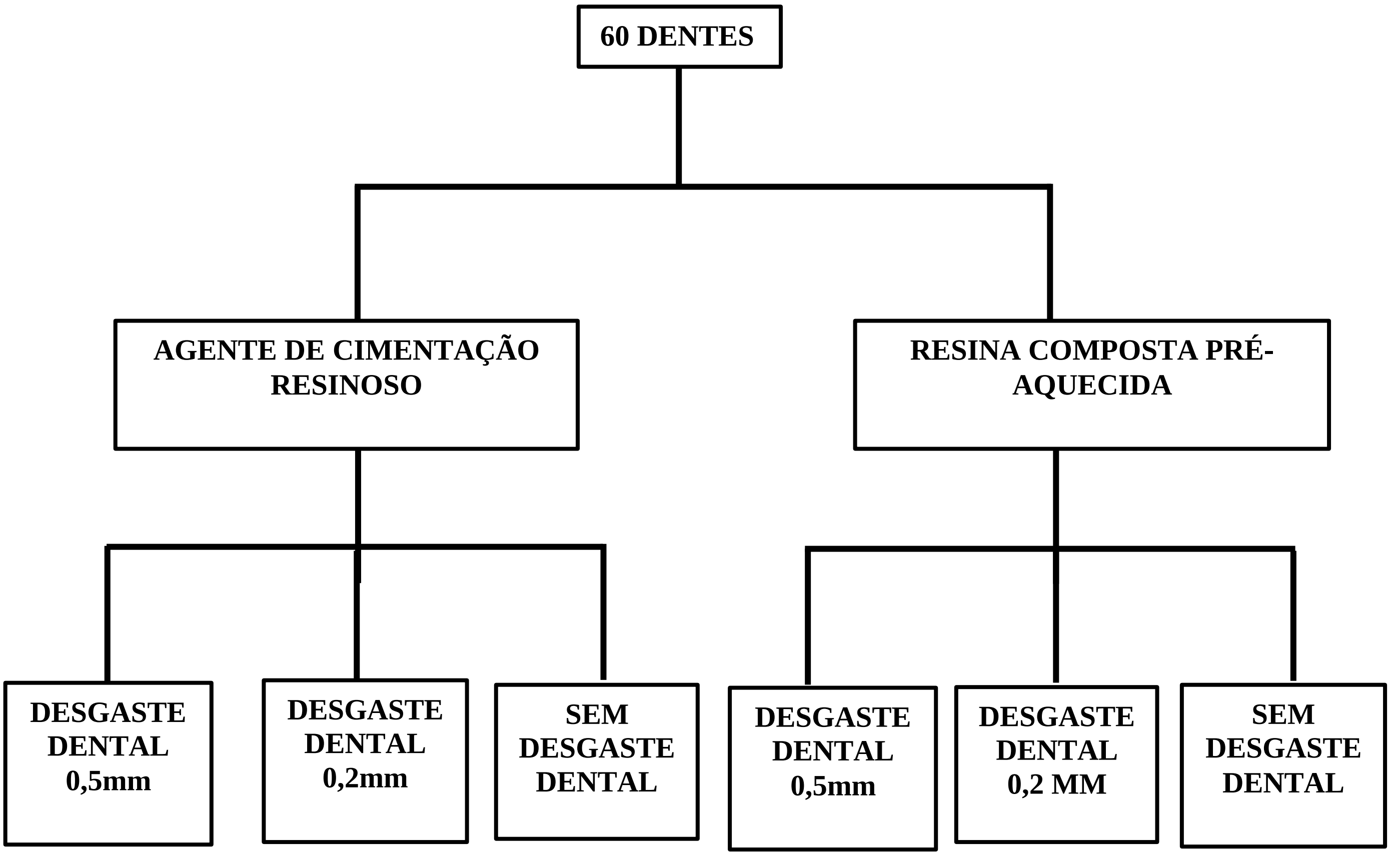

Figura 4. Diagrama esquemático da divisão dos grupos.

1.7 Preparo das Amostras para Microscopia Eletrônica de Varredura

Para cada grupo experimental, foram selecionados aleatoriamente 3 espécimes que foram seccionados ao meio no sentido vestíbulo-lingual com o auxílio de uma máquina de corte de precisão (ISOMET 1000, Buehler) posteriormente, os dentes seccionados foram colocados em anéis de PVC que receberam resina de poliestireno (Polibalbino, São Paulo, SP, Brasil). Após decorridos 24 horas, os espécimes foram submetidos à microscopia eletrônica de varredura.

Figura 5. Seccionamento dos dentes (ISOMET 1000, Buehler)

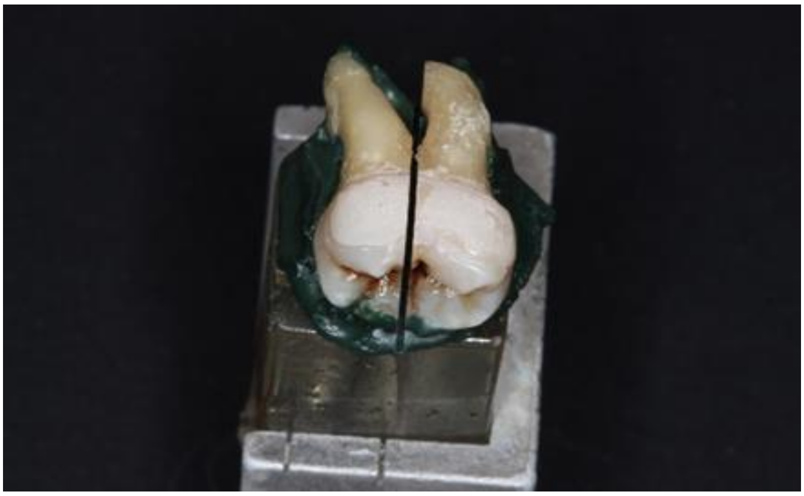

Figura 6. Dente seccionado

O protocolo estabelecido para o polimento respeitou a sequência de lixas de granulações #400, #600, #1200 e #2000. Posteriormente, as amostras foram polidas com feltros (ERIOS, São Paulo) e pastas diamantadas em ordem decrescente de granulação de 6μ, 1μ, ¼ μ e 0,05π. A cada troca de disco de feltro os espécimes foram submetidos em banho de ultrassom por 10 minutos. Após o polimento, os espécimes foram submersos em solução de ácido fosfórico a 50% durante 5 segundos, logo após foram lavados com água deionizada por 30 segundos. Em seguida as amostras foram submersas em solução de hipoclorito de sódio a 1% durante 5 minutos, posteriormente lavadas com água deionizada durante 60 segundos e depois colocadas imediatamente em um recipiente contendo sílica gel e armazenados até o momento de análise em microscópio eletrônico de varredura (Fig. 7).

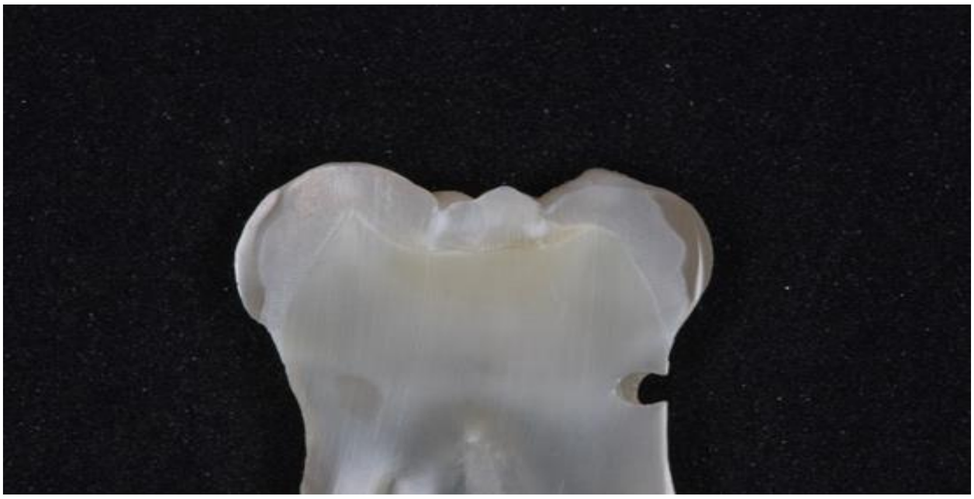

Figura 7. Dente polido para análise em MEV

1.8 Análise da Adaptação Marginal e Linha de Cimentação dos Laminados Cerâmicos

Os dentes restaurados foram moldados com silicone polimerizado por adição (Virtual, Ivoclar-Vivadent, EUA) e os moldes foram vazados com resina epóxi (Buehler Ltd, Lake Bluff, IL, EUA)

Figura 8. Moldagem do laminado

Figura 9. Remoção da moldagem

Figura 10-Moldagem realizada

Figura 11. Molde pronto para colocação da resina epóxi

Figura12. Modelos confeccionados em resina epóxi

Após a polimerização da resina epóxi os modelos foram removidos dos moldes e fixados em stubs) de modo que permitiu análise da interface dente restauração.

Figura 13. Modelos de resina epóxi fixados nos stubs metálicos

Os dentes fixados nos stubs foram cobertos com ouro em um equipamento apropriado denominado *sputter coater* (Balzers-SCD 050; Balzers Union Aktiengeselischaft Furstentun, Liechtentein) por 180 segundos com voltagem de 40mA (miliampers) e a interface (linha de cimento e bordas entre cimento e cerâmica e entre cimento e esmalte) analisada em três pontos equidistantes 1,5 mm em microscópio eletrônico de varredura (LEO 435 VP; Cambridge, Inglaterra) operado em 20 Kv por um único operador.

Figura 14. Metalizador Sputter Coater para recobrimento com ouro para análise em MEV

Figura 15. Dentes metalizados para análise em MEV

7. 1 ANEXO A - NORMAS DE PUBLICAÇÃO - OPERATIVE DENTISTRY

INSTRUCTIONS TO AUTHORS

New Instructions as of 20 September 2008

Operative Dentistry requires electronic submission of all manuscripts. All submissions must be sent to Operative Dentistry using the Allen Track upload site. Your manuscript will only be considered officially submitted after it has been approved through our initial quality control check, and any problems have been fixed. You will have 6 days from when you start the process to submit and approve the manuscript. After the 6 day limit, if you have not finished the submission, your submission will be removed from the server. You are still able to submit the manuscript, but you must start from the beginning. Be prepared to submit the following manuscript files in your upload:

- A Laboratory or Clinical Research Manuscript file must include:
  - a title
  - a running (short) title
  - a clinical relevance statement
  - a concise summary (abstract)
  - introduction, methods & materials, results, discussion and conclusion
  - references (see Below)
  - The manuscript **MUST NOT** include any:
    - identifying information such as:
      - Authors
      - Acknowledgements
      - Correspondence information
    - Figures
    - Graphs
    - Tables
- An acknowledgement, disclaimer and/or recognition of support (if applicable) must in a separate file and uploaded as supplemental material.
- All figures, illustrations, graphs and tables must also be provided as individual files. These should be high resolution images, which are used by the editor in the actual typesetting of your manuscript. Please refer to the instructions below for acceptable formats.
- All other manuscript types use this template, with the appropriate changes as listed below.

Complete the online form which includes complete author information and select the files you would like to send to Operative Dentistry. Manuscripts that do not meet our formatting and data requirements listed below will be sent back to the corresponding author for correction.

GENERAL INFORMATION

- All materials submitted for publication must be submitted exclusively to Operative Dentistry.
- The editor reserves the right to make literary corrections.
- Currently, color will be provided at no cost to the author if the editor deems it essential to the manuscript. However, we reserve the right to convert to gray scale if color does not contribute significantly to the quality and/or information content of the paper.
- The author(s) retain(s) the right to formally withdraw the paper from consideration and/or publication if they disagree with editorial decisions.

- International authors whose native language is not English must have their work reviewed by a native English speaker prior to submission.
- Spelling must conform to the American Heritage Dictionary of the English Language, and SI units for scientific measurement are preferred.
- While we do not currently have limitations on the length of manuscripts, we expect papers to be concise; Authors are also encouraged to be selective in their use of figures and tables, using only those that contribute significantly to the understanding of the research.
- Acknowledgement of receipt is sent automatically. If you do not receive such an acknowledgement, please contact us at editor@jopdent.org rather than resending your paper.
- **IMPORTANT:** Please add our e-mail address to your address book on your server to prevent transmission problems from spam and other filters. Also make sure that your server will accept larger file sizes. This is particularly important since we send page-proofs for review and correction as .pdf files.

REQUIREMENTS

- **FOR ALL MANUSCRIPTS**

1. **CORRESPONDING AUTHOR** must provide a WORKING / VALID e-mail address which will be used for all communication with the journal.
   NOTE: Corresponding authors MUST update their profile if their e-mail or postal address changes. If we cannot contact authors within seven days, their manuscript will be removed from our publication queue.

2. **AUTHOR INFORMATION** must include:
   - full name of all authors
   - complete mailing address for each author
   - degrees (e.g. DDS, DMD, PhD)
   - affiliation (e.g. Department of Dental Materials, School of Dentistry, University of Michigan)

3. **MENTION OF COMMERCIAL PRODUCTS/EQUIPMENT** must include:
   - full name of product
   - full name of manufacturer
   - city, state and/or country of manufacturer

4. **MANUSCRIPTS AND TABLES** must be provided as Word files. Please limit size of tables to no more than one US letter sized page. (8 ½ ” x 11”)

5. **ILLUSTRATIONS, GRAPHS AND FIGURES** must be provided as TIFF or JPEG files with the following parameters
   - line art (and tables that are submitted as a graphic) must be sized at approximately 5” x 7” and have a resolution of 1200 dpi.
   - gray scale/black & white figures must have a minimum size of 3.5” x 5”, and a maximum size of 5” x 7” and a minimum resolution of 300 dpi and a maximum of 400 dpi.
   - color figures must have a minimum size of 2.5” x 3.5”, and a maximum size of 3.5” x 5” and a minimum resolution of 300 dpi and a maximum of 400 dpi.
   - color photographs must be sized at approximately 3.5” x 5” and have a resolution of 300 dpi.

- **OTHER MANUSCRIPT TYPES**

1. **CLINICAL TECHNIQUE/CASE STUDY MANUSCRIPTS** must include:
   - a running (short) title
   - purpose

- description of technique
- list of materials used
- potential problems
- summary of advantages and disadvantages
- references (see below)

2. **LITERATURE AND BOOK REVIEW MANUSCRIPTS** must include:
   - a running (short) title
   - a clinical relevance statement based on the conclusions of the review
   - conclusions based on the literature review…without this, the review is just an exercise
   - references (see below)

- **FOR REFERENCES**

REFERENCES must be numbered (superscripted numbers) consecutively as they appear in the text and, where applicable, they should appear after punctuation.

The reference list should be arranged in numeric sequence at the end of the manuscript and should include:

1. Author(s) last name(s) and initial (ALL AUTHORS must be listed) followed by the date of publication in parentheses.
2. Full article title.
3. Full journal name in italics (no abbreviations), volume and issue numbers and first and last page numbers complete (i.e. 163-168 NOT attenuated 163-68).
4. Abstracts should be avoided when possible but, if used, must include the above plus the abstract number and page number.
5. Book chapters must include chapter title, book title in italics, editors' names (if appropriate), name of publisher and publishing address.
6. Websites may be used as references, but must include the date (day, month and year) accessed for the information.
7. Papers in the course of publication should only be entered in the references if they have been accepted for publication by a journal and then given in the standard manner with "In press" following the journal name.
8. **DO NOT** include unpublished data or personal communications in the reference list. Cite such references parenthetically in the text and include a date.

EXAMPLES OF REFERENCE STYLE

- Journal article: two authors
  Evans DB & Neme AM (1999) Shear bond strength of composite resin and amalgam adhesive systems to dentin *American Journal of Dentistry* **12(1)** 19-25.

- Journal article: multiple authors
  Eick JD, Gwinnett AJ, Pashley DH & Robinson SJ (1997) Current concepts on adhesion to dentin *Critical Review of Oral and Biological Medicine* **8(3)** 306-335.

- Journal article: special issue/supplement
  Van Meerbeek B, Vargas M, Inoue S, Yoshida Y, Peumans M, Lambrechts P & Vanherle G (2001) Adhesives and cements to promote preservation dentistry *Operative Dentistry***(Supplement 6)** 119-144.

- Abstract:
  Yoshida Y, Van Meerbeek B, Okazaki M, Shintani H & Suzuki K (2003) Comparative study on adhesive performance of functional monomers *Journal of Dental Research* **82(Special Issue B)** Abstract #0051 p B-19.

- Corporate publication:
  ISO-Standards (1997) ISO 4287 Geometrical Product Specifications Surface texture: Profile method – Terms, definitions and surface texture parameters *Geneve: International Organization for Standardization* **1st edition** 1-25.

- Book: single author
  Mount GJ (1990) *An Atlas of Glass-ionomer Cements* Martin Duntz Ltd, London.

- Book: two authors
  Nakabayashi N & Pashley DH (1998) *Hybridization of Dental Hard Tissues* Quintessence Publishing, Tokyo.

- Book: chapter
  Hilton TJ (1996) Direct posterior composite restorations In: Schwarts RS, Summitt JB, Robbins JW (eds) *Fundamentals of Operative Dentistry* Quintessence, Chicago 207-228.

- Website: single author
  Carlson L (2003) Web site evolution; Retrieved online July 23, 2003 from: http://www.d.umn.edu/~lcarlson/cms/evolution.html

- Website: corporate publication
  National Association of Social Workers (2000) NASW Practice research survey 2000. NASW Practice Research Network, 1. 3. Retrieved online September 8, 2003 from:http://www.socialworkers.org/naswprn/default

7.2 ANEXO B - PARECER DO COMITÊ DE ÉTICA EM PESQUISA DA UNIUBE

UNIVERSIDADE DE UBERABA - UNIUBE

COMPROVANTE DE ENVIO DO PROJETO

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Influência do tipo de preparo e de simulação de escovação na nas características de margem de restaurações cerâmicas em dentes anteriores.

Pesquisador: Gilberto Antonio Borges

Versão: 1

CAAE: 56020016.3.0000.5145

Instituição Proponente:

DADOS DO COMPROVANTE

Número do Comprovante: Patrocionador Principal:

SOCIEDADE EDUCACIONAL UBERABENSE

042447/2016 Sociedade Educacional Uberabense

Informamos que o projeto Influência do tipo de preparo e de simulação de escovação na nas características de margem de restaurações cerâmicas em dentes anteriores. que tem como pesquisador responsável Gilberto Antonio Borges, foi recebido para análise ética no CEP Universidade de Uberaba - UNIUBE em 12/05/2016 às 14:04.

Endereço: Av.Nene Sabino, 1801 **Bairro:** Universitário **CEP:** 38.055-500 **UF:** MG **Município:** UBERABA **Telefone:** (34)3319-8811 **Fax:** (34)3314-8910 **E-mail:** cep@uniube.br