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AVALIAÇÃO DA CORRESPONDÊNCIA ENTRE CIMENTOS RESINOSOS E PASTAS DE PROVA E SUA INFLUÊNCIA NA COR FINAL DE LAMINADOS CERÂMICOS

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EDENIZE CRISTINA VAZ

AVALIAÇÃO DA CORRESPONDÊNCIA ENTRE CIMENTOS RESINOSOS E PASTAS DE PROVA E SUA INFLUÊNCIA NA COR FINAL DE LAMINADOS CERÂMICOS

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Dedico este trabalho

Aos meus pais, Ary e Edeti

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RESUMO

O presente estudo teve por objetivo avaliar se há correspondência de cor entre as pastas de prova e seus cimentos correspondentes para duas espessuras de discos cerâmicos. Para isso, a superfície vestibular de 140 dentes bovinos foi preparada. Desses, 70 dentes foram distribuídos aleatoriamente em sete grupos (Grupos 1a a 7a; n = 10 cada) e receberam discos com 0,35 mm de espessura para prova e cimentação, enquanto os outros 70 dentes foram igualmente distribuídos aleatoriamente em sete grupos (Grupos 1b a 7b; n = 10 cada) e receberam discos de 0,70 mm de espessura para prova e cimentação. As pastas de prova e os cimentos resinosos Variolink Veneer foram utilizados do seguinte modo: Grupos 1a e 1b (cor –3); Grupos 2a e 2b (cor –2); Grupos 3a e 3b (cor –1); Grupos 4a e 4b (cor 0); Grupos 5a e 5b (cor +1); Grupos 6a e 6b (cor +2); Grupos 7a e 7b (cor +3). As leituras de cor foram realizadas com espectrofotômetro Easyshade e as coordenadas L*, a* e b* do sistema CIE L*a*b* foram anotadas e, a partir delas, foram calculados ΔE_0 (prova – substrato), ΔE_1 (cimentação – substrato) e ΔE_2 (cimentação – prova). Os resultados indicaram que não houve diferença estatisticamente significativa entre os grupos ao comparar ΔE_0 e ΔE_1 para os discos cerâmicos de 0,35 mm de espessura, exceto para os Grupos 2a e 5a. Para os discos cerâmicos de 0,70 mm de espessura, também não foram observadas diferenças estatisticamente significativas entre os grupos quando comparados ΔE_0 e ΔE_1. Os valores de ΔE_2 para a espessura de 0,35 mm variaram de 1,77 ± 0,81 a 4,99 ± 3,80; já para a espessura de 0,70 mm, a variação foi de 1,01 ± 0,73 a 4,66 ± 2,96. Na avaliação da diferença das variáveis espessura e cor, para ΔE_0 observou-se interação significativa entre elas (p = 0,006), tendo o Grupo 1a apresentado diferença estatisticamente significativa comparado aos Grupos 3b, 4b, 6b e 7b. O Grupo 4b também apresentou diferença estatisticamente significativa comparado aos Grupos 2a e 6a. Na avaliação das variáveis descritas para ΔE_1, observou-se interação significativa (p = 0,001), tendo o Grupo 1a apresentado diferença estatisticamente significativa em relação aos Grupos 4b e 6b, enquanto o Grupo 4b apresentou diferença estatisticamente significativa comparado aos Grupos 2a, 6a e 1b. Assim, conclui-se que: houve concordância de cor entre a pasta de prova e o cimento resinoso para a maioria das tonalidades investigadas neste estudo; a cor do cimento resinoso pode influenciar a cor final do laminado cerâmico; analisando as variáveis espessura e cor na variação da cor final do laminado cerâmico, a primeira foi mais relevante.

Palavras-chave: Espectrofotometria. Cimentação. Facetas dentárias.

ABSTRACT

EVALUATION OF THE CORRESPONDENCE BETWEEN RESIN CEMENTS AND TRY-IN MATERIALS AND THEIR INFLUENCE ON THE FINAL COLOR OF CERAMIC VENEERS

The present study aimed to assess whether the color of the try-in pastes and the corresponding resin cements match for two different thicknesses of ceramic veneers. For that, the vestibular surface of 140 bovine teeth was prepared. After preparation, 70 teeth were randomly distributed in seven groups (Groups 1a to 7a; n = 10 each) and received 0.35 mm thick ceramic veneers for trying in and final cementation, whereas the remaining 70 teeth were also randomly distributed in seven groups (Groups 1b to 7b; n = 10 each) and received 0.70 mm thick ceramic veneers for trying in and final cementation. Variolink Veneer try-in pastes and resin cements were used as follows: Groups 1a and 1b (color –3); Groups 2a and 2b (color –2); Groups 3a and 3b (color –1); Groups 4a and 4b (color 0); Groups 5a and 5b (color +1); Groups 6a and 6b (color +2); Groups 7a and 7b (color +3). Color measurements were performed in a spectrophotometer Easyshade, the coordinates L*, a*, and b* of the CIE L*a*b* system were registered, and based on them, ΔE_0 (trial – substrate), ΔE_1 (cementation – substrate), and ΔE_2 (cementation – trial) were calculated. The results indicated no statistically significant difference between the groups comparing ΔE_0 and ΔE_1 for 0.35 mm thick ceramic veneers, except for Groups 2a and 5a. For 0.70 mm thick ceramic veneers, no statistically significant differences were observed between the groups comparing ΔE_0 and ΔE_1. ΔE_2 values for 0.35 mm thick ceramic veneers ranged from 1.77 ± 0.81 to 4.99 ± 3.80, while for 0.70 mm thick ceramic veneers, they ranged from 1.01 ± 0.73 to 4.66 ± 2.96. Assessing the difference of the variables thickness and color, for ΔE_0 a significant interaction was observed between them ($p = 0.006$), and Group 1a presented a statistically significant difference compared with Groups 3b, 4b, 6b, and 7b. Group 4b also presented a statistically significant difference compared with Groups 2a and 6a. In the evaluation of the variables described for ΔE_1, a significant interaction was observed ($p = 0.001$), and Group 1a presented a statistically significant difference compared with Groups 4b and 6b, whereas Group 4b showed a statistically significant difference compared with Groups 2a, 6a, and 1b. Therefore we conclude that: a correspondence occurred between the try-in pastes and the respective resin cements for most shades investigated in this study; the color of the resin cement may influence the final color of ceramic veneers; analyzing the variables thickness and color in the variation of the final color of ceramic veneers, the former is more relevant.

Keywords: Spectrophotometry. Cementation. Dental veneers.

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1 INTRODUÇÃO

A preocupação que os profissionais de saúde dispensam ao impacto social e psicológico da aparência facial pode ser vista como resultado do aumento das evidências de que a atratividade física é um importante fator na vida dos indivíduos (DAVIS; ASHWORTH; SPRIGGS, 1998). Em decorrência dessa demanda, os profissionais da saúde passaram a agregar maior conhecimento também na área estética (KREIDLER et al., 2005). Quando se trata de atratividade, a aparência facial e, especificamente, a região oral recebem atenção primordial (DAVIS; ASHWORTH; SPRIGGS, 1998). Baldwin (1980) salientou que as características mais comumente associadas com a atração facial são os olhos, a boca e o sorriso.

Dessa forma, já está bem estabelecido que a aparência dental é de fundamental importância para os pacientes e pode ter efeito significativo em parâmetros psicológicos, como a autoestima (DAVIS; ASHWORTH; SPRIGGS, 1998). Os consultórios odontológicos vêm experimentando gradual crescimento no número de pacientes que procuram melhorar seu sorriso, o que tem incentivado o desenvolvimento e o aprimoramento de novos materiais, de modo a permitir ao profissional selecionar a opção mais adequada para cada caso (PRATA et al., 2011).

O enfoque da odontologia estética tem sido a obtenção de dentes com harmonia de forma e mais claros (CALAMIA; CALAMIA, 2007). Entre os procedimentos aplicados para alcançar esse resultado estão: a correção ortodôntica, o clareamento dental, o uso de facetas diretas de resina composta e de laminados cerâmicos. Considerando as indicações individuais de cada técnica, a cerâmica tem se destacado em função de suas excelentes propriedades ópticas, biocompatibilidade, durabilidade e por ser o material que mais se assemelha à aparência natural dos dentes (CALAMIA; CALAMIA, 2007; KELLY; NISHIMURA; CAMPBELL, 1996).

Em se tratando de restaurações indiretas, do tipo laminado, muitas etapas devem ser cumpridas para atingir o sucesso clínico e a consequente satisfação do paciente. Essas fases incluem o planejamento, a escolha do sistema cerâmico a ser empregado, a técnica a ser utilizada, o momento da prova e da cimentação das

restaurações. Durante o planejamento, considera-se que o desgaste controlado da estrutura dentária pode ser muito mais eficaz em termos estéticos e de durabilidade (DAVIS; ASHWORTH; SPRIGGS, 1998). Considera-se, ainda, que a técnica envolvida na confecção de laminados, na qual o desgaste é reduzido, promove menor agressão do que restaurações do tipo coroa total, além do que, seu desempenho clínico, em termos de reação do periodonto e de biocompatibilidade, é considerado excelente (PEUMANS et al., 2000).

Embora vários estudos relatem o sucesso clínico da utilização dos laminados em dentes anteriores, ao indicar essas restaurações, tem-se como desafio alcançar a estética ideal. Frequentemente, isso inclui alteração de cor com limitado preparo do esmalte (HEYDECKE; ZHANG; RAZZOOG, 2001). Em seu estudo, Beier et al. (2012) relataram que, considerando seu comportamento clínico, a probabilidade de vida média dos laminados cerâmicos ao longo de 10 anos foi de 93,5%.

Os laminados cerâmicos devem ser unidos à estrutura dentária por intermédio de um agente cimentante; para isto, é preferível o uso de cimento fotoativado. A grande vantagem desse tipo de cimento é que ele permite tempo de trabalho maior comparado com o cimento dual ou quimicamente ativado. Isso torna mais fácil a remoção do excesso de cimento antes da polimerização, diminuindo o tempo de acabamento necessário após a cimentação. Além disso, a estabilidade da cor é superior à dos sistemas duais ou quimicamente ativados (PEUMANS et al., 2000). Ademais, a cimentação utilizando sistemas adesivos resinosos aumenta a resistência à fratura do dente e da restauração e, ao mesmo tempo, minimiza a formação de fendas, o que é fator determinante para o sucesso do tratamento (CEKIC et al., 2007).

Considerando a importância da etapa de cimentação das restaurações indiretas, os fabricantes ofertam várias tonalidades de cimentos resinosos, o que permite ao clínico escolher uma cor de cimento para o laminado que leve à estética desejada. Entretanto, o impacto da cor do cimento na estética final dos laminados cerâmicos é descrito como controverso na literatura (XING et al., 2010). Visando a obtenção de melhores resultados estéticos, deve-se realizar a prova dos laminados previamente à sua cimentação. Essa prova pode ser feita com água, gel hidrossolúvel ou pastas de prova, também conhecidas como pastas *try-in* (BALDERAMOS; O'KEEFE; POWERS, 1997). As pastas de prova, que

acompanham os cimentos resinosos, permitem que o cirurgião-dentista e o paciente avaliem a correspondência de cor do laminado, assegurando que a expectativa estética seja alcançada (CHADWICK; McCABE; CARRICK, 2008). Portanto, saber se é possível confiar nas pastas de prova quando se avalia o quesito cor é um fator altamente importante em um tratamento estético com laminados cerâmicos.

2 OBJETIVOS

2.1 Objetivo geral

Avaliar a influência do cimento resinoso na cor final do laminado cerâmico em duas espessuras de cerâmica, bem como verificar a correspondência de cor entre as pastas de prova e os cimentos resinosos.

2.2 Objetivos específicos

1) Analisar o efeito da cor com o uso de diferentes cores de materiais de prova, em duas espessuras de cerâmica.

2) Analisar a cor, em duas espessuras de cerâmica, após a cimentação com as diferentes cores de cimentos resinosos.

3) Comparar a cor obtida após a prova dos discos cerâmicos, em duas espessuras, com a cor obtida após a cimentação em função de diferentes cores de cimentos resinosos.

3 REVISÃO DE LITERATURA

Os laminados cerâmicos utilizados na odontologia estética têm evoluído ao longo dos últimos 60 anos, a partir do uso por estrelas de cinema. No início, eram aderidos temporariamente aos dentes com fixador para prótese total, mas com o aprimoramento das técnicas e dos materiais, restaurações duráveis de porcelana passaram a ser cimentadas aos dentes (CALAMIA, 1985).

A restauração indireta do tipo laminado consiste na "substituição" da porção visível do esmalte por uma lâmina de cerâmica, que é fortemente unida à superfície dental (HORN, 1983). Laminados cerâmicos são idealmente finos e translúcidos (XU et al., 2014), com espessura variando de 0,3 mm a 1,5 mm (MAGNE et al., 1999). Por conseguinte, representam uma abordagem mais conservadora em comparação a todos os outros tipos de restauração em cerâmica (FREIRE; ARCHEGAS, 2010), permitindo, simultaneamente, melhora da estética, preservação do tecido dentário e menores danos ao tecido gengival (PIPPIN; MIXSON; SOLDAN-ELS, 1995).

Os laminados cerâmicos são usados para alterar a cor ou a forma dos dentes anteriores, como aqueles com descolorações ou hipoplasia do esmalte, incisivos fraturados ou dentes nos quais problemas morfológicos ou de alinhamento são características responsáveis por estética insatisfatória (ALGHAZALI et al., 2010). Alguns estudos relatam que os resultados estéticos dos laminados cerâmicos são determinados pela translucidez e opacidade da cerâmica, a cor do agente cimentante e a cor do substrato dentário (CHU; CHOW; CHAI, 2007; VICHI; FERRARI; DAVIDSON, 2000). A situação clínica considerada ideal seria um substrato não escurecido, o que, em muitos casos, não é encontrado. Assim, frequentemente, os cirurgiões-dentistas têm a expectativa de usar cimento para mascarar o substrato e modificar a cor final da restauração (CHANG et al., 2009).

Segundo Balderamos, O'Keefe e Powers (1997), um número substancial de trabalhos publicados descreve problemas de cor na odontologia. Quando o laminado cerâmico não tem correspondência de cor satisfatória com os dentes adjacentes, os profissionais costumam usar cimentos resinosos de diferentes tonalidades na tentativa de mascarar a cor do substrato e modificar a cor final do laminado cerâmico para atingir a cor satisfatória (CHANG et al., 2009).

Em relação à escolha do material para a cimentação dos laminados cerâmicos, os sistemas adesivos atuais e os cimentos resinosos fotoativados permitem interação efetiva entre a cerâmica e a estrutura dental (KAMADA; YOSHIDA; ATSUTA, 1998; LACY et al., 1988; SENSI; BARATIERI; MONTEIRO JUNIOR, 2007).

Os fabricantes vêm gradualmente introduzindo no mercado odontológico vários sistemas de cimentação adesiva para laminados, incluindo variadas cores de cimento e as correspondentes pastas de prova, as quais podem ser usadas como guia na escolha apropriada do cimento resinoso para sua cimentação (VICHI; FERRARI; DAVIDSON, 2000). O uso da pasta de prova antes da cimentação é considerado um método de seleção da cor do cimento (XING et al., 2010). A pasta de prova do cimento resinoso deve ser utilizada de acordo com as instruções do fabricante, de modo que os dentistas possam avaliar com mais precisão a cor final de uma restauração antes da cimentação e, desta forma, melhorar sua capacidade de criar um belo sorriso (AlQAHTANI; AlJURAIS; ALSHAAFI, 2012). De acordo com os fabricantes, essas pastas contêm glicerina solúvel em água, reforçada por elementos minerais e agentes de coloração e, quando aplicadas antes da cimentação definitiva, permitem que o profissional possa avaliar a cor final da restauração (WEE; MONAGHAN; JOHNSTON, 2002). Esses materiais apresentam a mesma consistência do cimento resinoso e simulam o efeito cromático prometido após sua completa polimerização (VICHI; FERRARI; DAVIDSON, 2000).

Qualquer intercorrência durante a seleção da cor pode comprometer a estética final da reabilitação (RIGONI et al., 2012). Nesse cenário, o cimento subjacente à restauração cerâmica pode influenciar na sua cor final (VICHI; FERRARI; DAVIDSON, 2000), principalmente quando a cerâmica de eleição tiver alta translucidez (KARAAGACLIOGLU; YILMAZ, 2008), como a cerâmica IPS e.max HT e LT (Ivoclar Vivadent AG, Schaan, Liechtenstein), que nos últimos anos tem sido preferida para a confecção dos laminados em porcelana por ter estrutura translúcida (TURGUT; BAGIS, 2011). Além disso, a pasta de prova permite que o paciente também avalie a correspondência de cor da restauração, possibilitando atingir a expectativa estética e sua satisfação com o tratamento (CHADWICK; McCABE; CARRICK, 2008).

Balderamos, O'Keefe e Powers (1997) realizaram um estudo *in vitro* para avaliar a correspondência de cor entre cimentos e pastas de prova. Para isso, fizeram uso das três seguintes marcas de cimento: Colorlogic (Ceramco Inc., Burlington, NJ, Estados Unidos da América), Universal Luting System (Sybron Dental Specialties/Kerr, Orange, CA, Estados Unidos da América) e Optec (Jeneric/Petron Inc., Wallingford, CT, Estados Unidos da América). A avaliação foi feita usando somente cimento e cimento colocado sob disco de porcelana. Avaliadas diretamente, todas as amostras de cimento estudadas exibiram diferença de cor com suas pastas de prova homólogas. Quando colocados sob disco cerâmico de 1 mm de espessura, essa diferença de cor entre pasta e cimento diminuiu. O ΔE* variou de 2,59 (Universal Luting System, Yellow) a 14,51 (Colorlogic, Neutral) na análise direta dos materiais; porém, quando os cimentos foram aplicados sob o disco cerâmico, o ΔE* variou de 1,02 (Colorlogic, Brown/Yellow) a 5,13 (Colorlogic, Translucent), tendo sido adotado ΔE* ≤ 3,0 como limite para percepção de alteração de cor no referido estudo.

Wang e Powers (1999) testaram a concordância de cor entre cimentos resinosos e pastas de prova, utilizando três cores de cimento, denominadas cores 100, 200 e 300, e suas respectivas pastas de prova. As coordenadas L*, a* e b* do sistema CIE L*a*b* foram anotadas e o ΔE* foi, então, calculado. Os autores asseveraram que as cores das pastas de prova não foram coincidentes com seus cimentos correspondentes.

Zhang et al. (2007) estudaram a influência das pastas de prova na cor de facetas cerâmicas do Sistema IPS Empress (Ivoclar Vivadent AG, Schaan, Liechtenstein) em amostra composta de dentes escurecidos. Utilizaram cinco cores de pasta de prova antes da cimentação: A1, A3, Translucent (TrT), White Opaque (WOT) e Opaque (B0,5). Para mensuração de cor, foram utilizadas as coordenadas L*, a* e b* do sistema CIE L*a*b*. Os autores salientaram que é mais aconselhável escolher os cimentos com cor WOT ou B0,5 quando os dentes forem escurecidos, ao passo que em dentes não escurecidos, os cimentos nas cores A1, A3 ou TrT podem ser escolhidos, de acordo com os dentes adjacentes.

AlGhazali et al. (2010) avaliaram de que maneira diferentes cores de pasta de prova, cimento não polimerizado e cimento polimerizado influenciam na cor geral do laminado cerâmico. A amostra foi composta de dentes bovinos, os quais foram

clareados para padronização da cor. Foram usadas três marcas de cimento e suas pastas de prova correspondentes, nas cores: Light, Dark e Translucent. Os autores utilizaram disco cerâmico com espessura de 1,2 mm, na cor 1M1 VM7 (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckigen, Alemanha), pois o efeito do cimento pode ser avaliado de maneira mais efetiva sob porcelana clara e translúcida. A mensuração de cor foi feita com espectrofotômetro e as coordenadas L*, a* e b* do sistema CIE L*a*b* foram registradas. Uma avaliação para o significado clínico da diferença de cor também foi feita, comparando-se o limiar de perceptibilidade de 1 unidade de ΔE* com o limiar de aceitação clínica de 5,5 unidades de ΔE*. Os autores concluíram que: a) cores diferentes de pastas de prova e cimentos resinosos produziram alteração de cor, o que é útil clinicamente para mudar a cor do laminado e, assim, obter coincidência com a cor da estrutura dentária adjacente; b) clinicamente, foram encontradas diferenças significativas entre as cores das pastas de prova e dos cimentos polimerizados da mesma tonalidade; c) não houve diferença significativa entre cimentos não polimerizados e cimentos polimerizados; d) deve-se ter cautela na avaliação da cor com as pastas de prova; e) uma avaliação da cor com o cimento não polimerizado é recomendada.

Xing et al. (2010) verificaram a influência de várias tonalidades de cimento resinoso na cor final do laminado de cerômero e analisaram a concordância entre as cores dos cimentos resinosos e de suas correspondentes pastas de prova. Como material restaurador foram usados laminados de cerômero na cor A2 com 1,0 mm, 0,8 mm e 0,5 mm de espessura, e como base foram empregados discos de resina na cor A3, os quais receberam a restauração. Foram testadas cinco tonalidades de cimento resinoso fotopolimerizável e suas respectivas pastas de prova de uma única marca comercial. Os resultados do estudo indicaram que algumas tonalidades de cimento, especialmente a cor White Opaque (WO), produziram perceptível mudança de cor no espécime de cerômero, e que o efeito do cimento na cor final estava relacionado com a espessura do cerômero (material restaurador). Os autores verificaram que algumas cores de cimento resinoso produziram mudança perceptível na cor final dos espécimes de cerômero com espessuras de 0,5 mm ou 0,8 mm, assim como que a cor dos cimentos resinosos e suas correspondentes pastas de prova tiveram alta concordância. As várias tonalidades de pasta de prova podem

ajudar a predizer o efeito do cimento polimerizado no resultado estético final do laminado em cerômero.

Prata et al. (2011) avaliaram quatro métodos de remoção da pasta de prova na superfície cerâmica antes da cimentação e a influência da resistência de união dos cimentos resinosos. Foram empregados corte de dentina humana e cerâmica de dissilicato de lítio para tal investigação. Para o grupo G1, não foi usada pasta de prova e a cerâmica foi cimentada de acordo com as instruções do fabricante. Para a remoção da pasta de prova, foram usados: no grupo G2, banho em cuba ultrassônica com água destilada (5 min); no grupo G3, jato de ar-água (1 min); no grupo 4, ácido fosfórico (2 min) e, em seguida, jato de ar-água (30 s); no grupo G5, ácido fluorídrico, em seguida, ácido fosfórico e, por fim, jato de ar-água (30 s). As imagens em microscopia mostraram partículas de resíduo menores quando a técnica aplicada foi o banho em cuba ultrassônica, mas os autores sugeriram que, provavelmente, o tempo de 5 min deva ser reavaliado. Os resultados mostraram, ainda, que a ação mecânica do jato ar-água para a remoção da pasta de prova foi menos eficiente do que o banho em cuba ultrassônica. Concluíram que, embora nenhuma técnica avaliada tenha sido totalmente eficaz para a remoção da pasta de prova, a presença de resíduos deste material não influenciou a força de união das restaurações.

Xu et al. (2011) investigaram os efeitos do cimento na cor final de laminados cerâmicos IPS e.max (Ivoclar Vivadent AG, Schaan, Liechtenstein) e avaliaram a similaridade entre as pastas de prova e a cor final dos cimentos correspondentes. No estudo, foram utilizadas cinco cores de cimento e suas correspondentes pastas de prova (TR, B0,5, A1, A3 e WO); discos cerâmicos foram fabricados e cimentados sobre discos de resina em quatro diferentes cores: A2, A3, A4 e A5. Para mensuração de cor, foi utilizado espectrofotômetro e as coordenadas L*, a* e b* foram anotadas e usadas para o cálculo de ΔE*. Os pesquisadores concluíram que a cor da restauração final foi mais afetada quando foram utilizados discos de resina nas cores A2 e A3 do que nas cores A4 e A5. Também observaram que a melhor correspondência de cor entre pasta de prova e cimento ocorreu para o disco de resina A2.

Rigoni et al. (2012) conduziram estudo *in vitro* para avaliar a concordância entre a cor de cimentos resinosos e suas respectivas pastas de prova. Foram

confeccionados 30 discos em resina, com 5 mm de espessura, na cor A2 (Llis, FGM Produtos Odontológicos Ltda, Joinvile, SC, Brasil), para simular a dentina. Também foram fabricados 30 discos em cerâmica IPS e.max Ceram de nanofluorapatita vítrea (Ivoclar Vivadent AG, Schaan, Liechtenstein), com 0,5 mm de espessura, na cor A2, para simular os laminados. As marcas e as cores de pasta *try-in* e cimento resinoso foram: Vitique cor A2,5 (DMG, Hamburg, Alemanha), Variolink II cor A1 (Ivoclar Vivadent AG, Schaan, Liechtenstein) e Choice 2 cor A2 (Bisco Inc., Schaumburg, Il, Estados Unidos da América). Todas as leituras de cor do conjunto formado por disco resinoso, pasta de prova e disco cerâmico resultaram na cor A2. As marcas Vitique (cor A2,5) e Choice 2 (cor A2) apresentaram, após aferição, cor compatível com a indicada pelos fabricantes, ao passo que a Variolink II (cor A1) apresentou cor discordante. Os autores relataram que não houve similaridade de cor entre as cerâmicas fixadas com a pasta de prova e as cerâmicas cimentadas com o respectivo cimento.

Em um estudo *in vitro*, Kürklü et al. (2013) avaliaram os parâmetros de translucidez relativa e a alteração de cor, em termos de perceptibilidade e aceitabilidade, do conjunto formado por cerâmica feldspática e cimento resinoso utilizando duas diferentes espessuras de cerâmica e três diferentes cores de cimento. Para a execução do estudo, foram preparados 30 discos cerâmicos na cor A1 em duas espessuras, 0,5 mm e 1,0 mm, e o cimento resinoso fotoativado utilizado foi o Clearfil EX (Kuraray Co., Osaka, Japão) nas cores: Chroma (CA), Clear (CR) e Opaque White (O). A aferição da cor foi feita sobre fundos preto, cinza e branco e os sistemas CIE L*a*b* (ΔE^*_{ab}) e CIEDE2000 (ΔE_{00}) foram usados para a avaliação das diferenças de cores. Os autores concluíram que, para a variação de espessura entre 0,5 mm e 1,0 mm, não houve alteração de cor inaceitável clinicamente quando foi empregado o cimento na cor Clear com o fundo cinza, o que não aconteceu quando os cimentos nas cores Chroma e Opaque White foram usados. Em adição a isso, a variação na cor do cimento resultou em mudanças perceptíveis, próximo ou acima do que é clinicamente aceitável. Além disso, com a diminuição da espessura da cerâmica de 1,0 mm para 0,5 mm, observou-se aumento significativo da translucidez relativa quando a cerâmica foi cimentada com as cores de cimento utilizadas no estudo.

Wang, Takahashi e Iwasaki (2013) investigaram a relação entre translucidez e espessura para diferentes cerâmicas odontológicas. Em seu estudo, usaram seis discos para cada uma das oito cores de cerâmica vítrea analisadas no estudo, com espessuras variando de 2,0 mm a 0,6 mm, os quais foram desgastados na seguinte ordem de espessura: de 2,0 para 1,8, 1,6, 1,4, 1,2, 1,0, 0,9, 0,8, 0,7 e 0,6 mm. Para cada uma dessas espessuras foi feita a aferição de cor sobre fundos branco e preto. Os autores também empregaram cinco discos para cada uma das cinco cores de cerâmica à base de zircônia investigadas na pesquisa, com espessuras variando de 1,0 mm a 0,4 mm, que foram desgastados na seguinte sequência: de 1,0 para 0,9, 0,8, 0,7, 0,6, 0,5 e 0,4 mm. Para cada uma dessas espessuras foi feita a aferição da cor. Os valores dos parâmetros de translucidez, mensurados com espectrofotômetro, que foi a diferença de cor entre disco e fundo branco e disco e fundo preto, variaram de 2,2 a 25,3 para cerâmica vítrea e de 5,5 a 15,1 para cerâmica à base de zircônia. Os autores concluíram que o parâmetro de translucidez da cerâmica odontológica foi significativamente influenciado tanto pelo material quanto pela espessura. Também verificaram que a translucidez de todos os materiais aumentou com a diminuição da espessura, mas o grau da alteração foi dependente do material, e que todos os discos de cerâmica à base de zircônia avaliados no estudo apresentaram algum grau de translucidez.

Xu et al. (2014) investigaram a influência do cimento na cor final dos laminados cerâmicos e a concordância entre a cor das pastas de prova e de seus respectivos cimentos. Para isso, confeccionaram 10 discos de cerâmica IPS e.max de dissilicato de lítio (Ivoclar Vivadent AG, Schaan, Liechtenstein), com espessura de 1,0 ± 0,01 mm, na cor A3, para representar os laminados cerâmicos, assim como 10 blocos de resina Amelogen Plus (Ultradent Products, Inc., South Jordan, UT, Estados Unidos da América), com 4,0 mm de espessura, na cor A3, para simular o substrato. O sistema adesivo RelyX Veneer (3M ESPE, St. Paul, MN, Estados Unidos da América), com cinco cores de cimento e suas pastas de prova correspondentes, também foi empregado no estudo. Os autores chegaram à conclusão de que a concordância de cor entre a pasta de prova e o cimento correspondente nem sempre é alcançada, especialmente quando se aplicam agentes cimentantes mais escuros e opacos.

Lopes et al. (2014) avaliaram a cor do laminado cerâmico com diferentes materiais de prova, utilizando dentes bovinos preparados (n = 40) e discos cerâmicos de 0,6 mm de espessura. Os autores realizaram o estudo com quatro grupos: Grupo 1 – nenhum material entre substrato dentário e disco cerâmico; Grupo 2 – água foi utilizada como material de prova; Grupo 3 – gel hidrossolúvel; Grupo 4 – pasta de prova com valor = 0. Foi realizada espectrofotometria, as coordenadas do sistema CIELab foram anotados e foi calculado o ΔE*. Os autores concluíram que os diferentes materiais de prova produziram alteração similar de cor no disco cerâmico.

Kampouropoulos et al. (2014) testaram a correspondência de cor para quatro cores de cimento e suas respectivas pastas de prova, imediatamente após a cimentação e após 24 h de armazenamento em ambiente seco e escuro. Os pesquisadores avaliaram tanto o cimento fotopolimerizável quanto cimentos duais. Os discos de cerâmica e os discos de resina (simulando o substrato) tinham 0,8 mm de espessura. As pastas de prova Variolink II (Ivoclar Vivadent AG, Schaan, Liechtenstein) apresentaram maior concordância de cor, com ΔE* < 2,0. Já as pastas de prova Calibra (Dentsply International, York, PA, Estados Unidos da América) e Insure (Cosmedent, Chicago, IL, Estados Unidos da América) apresentaram ΔE* > 3,3, tendo sido relatado pelos autores que não houve concordância de cor, já que consideraram ΔE* < 3,3 para alterações de cor não perceptíveis. Por último, para o sistema Clearfil Esthetic (Kuraray Noritake Dental Inc., Okayama, Japão), os valores de ΔE* variaram entre 2 e 3 unidades. Portanto, os autores concluíram que o laminado cerâmico pode falhar esteticamente no quesito cor quando pastas de prova são usadas para testar a cor da restauração antes da cimentação propriamente dita.

Salameh et al. (2014) avaliaram a influência da translucidez da cerâmica CAD/CAM na cor final de facetas cerâmicas usando dois cimentos com opacidades diferentes. Para confeccionar as restaurações, foram usados os seguintes três tipos de blocos cerâmicos IPS Empress CAD (Ivoclar Vivadent AG, Schaan, Liechtenstein), na cor A1: multicromático, com alta translucidez e com baixa translucidez. As facetas confeccionadas foram polidas e glazeadas e, em seguida, cimentadas em um dente de resina na cor A4, previamente preparado e posicionado em um manequim odontológico. Para aferição da cor com espectrofotômetro nas porções cervical, média e incisal, foi colocado um fundo escuro por trás do dente. As

coordenadas do sistema CIE L*a*b* foram anotadas e utilizadas para o cálculo do ΔE*, sendo considerada como clinicamente perceptível a alteração de cor para ΔE > 3,7. O cimento resinoso utilizado foi o Panavia F 2.0 (Kuraray Co., Osaka, Japão) com alta e baixa translucidez. Os valores de L* aumentaram após a cimentação. Os pesquisadores concluíram que o tipo de cerâmica utilizado não produziu efeito observável na cor final da faceta cerâmica e as diferentes opacidades do cimento resinoso não tiveram efeito significativo na cor final quando observados os valores de ΔE*.

4 MATERIAIS E MÉTODOS

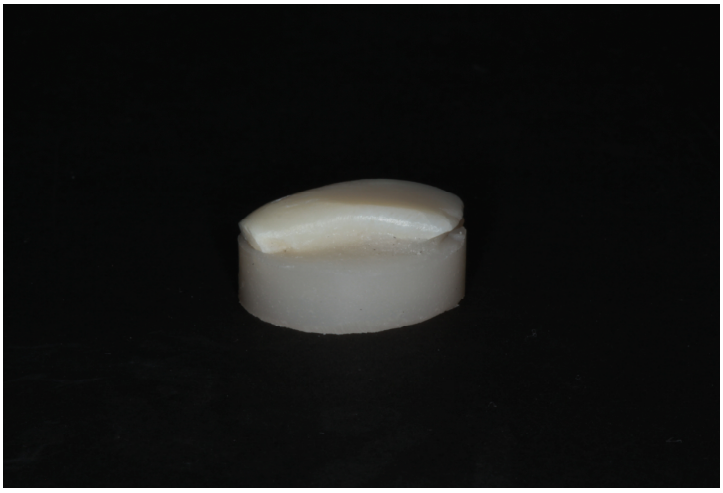
O presente estudo foi aprovado pela Comissão de Ética no Uso de Animais/CEUA da Universidade Federal de Goiás (Anexo A). Descreve-se, a seguir, o percurso metodológico seguido para a execução desta pesquisa.

4.1 Preparo dos dentes

Neste estudo, foram utilizados dentes bovinos, de animais já abatidos em frigorífico. Todos os exemplares foram colocados em solução de timol 0,05% à temperatura ambiente [Farmácia Escola da Universidade Federal de Goiás (UFG), Goiânia, GO]. Após adequada limpeza, foram mantidos por 24 h em água deionizada (Quimidrol – Comércio, Indústria e Importação Ltda, Joinville, SC, Brasil) para hidratação e remoção da solução de timol. Em seguida, foram submetidos à leitura da cor em espectrofotômetro Easyshade (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Alemanha) e somente dentes na cor A3, segundo a escala Vita (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Alemanha), foram selecionados para a presente pesquisa, totalizando 140 dentes.

As raízes foram separadas das suas respectivas coroas com disco diamantado (Komet Brazil, Santo André, SP, Brasil), em baixa rotação e com refrigeração (Dabi Atlante, Ribeirão Preto, SP, Brasil). A face vestibular foi planificada, permanecendo a superfície em esmalte, uma vez que, para simular a situação clínica, laminados cerâmicos minimamente invasivos são cimentados sobre esmalte com pouco ou nenhum preparo (HORN, 1983; KINA, 2007; REZENDE et al., 2009). Para tal procedimento, foi utilizada lixa de granulação 600 3M–211Q (3M do Brasil, Sumaré, SP, Brasil) montada em prato giratório da politriz modelo DP-10 (Struers/Panambra Industrial e Técnica Ltda., São Paulo, SP, Brasil). Com a superfície vestibular planificada, cada dente foi colocado em uma base de resina autopolimerizável (Kota Indústria e Comércio Ltda, São Paulo, SP, Brasil), de modo que a face vestibular preparada ficasse paralela ao solo (Figura 1). Após esse preparo, os dentes foram mantidos em estufa a 37ºC até o momento da execução laboratorial, não tendo este tempo excedido 7 dias.

Figura 1. Dente na base de resina com a superfície vestibular preparada.



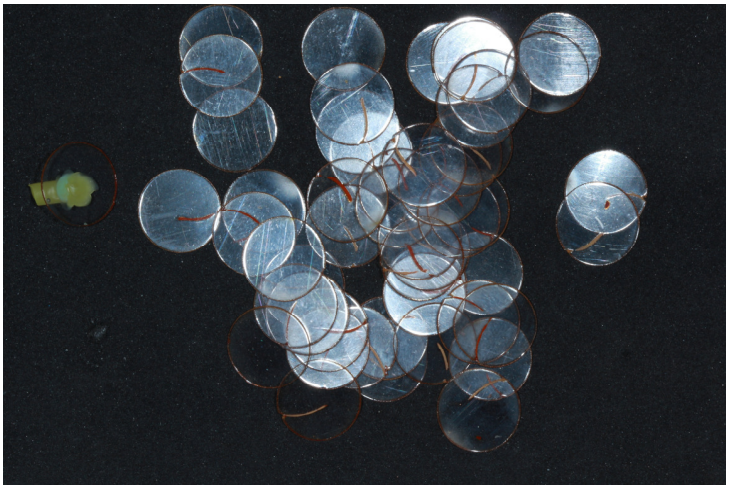
Fonte: Original da autora.

4.2 Obtenção dos discos cerâmicos

Para representar a condição clínica de um laminado cerâmico, foram fabricados discos de cerâmica com as seguintes especificações: IPS e.max HT B1, com espessuras de 0,35 mm (n = 70) e de 0,70 mm (n = 70) (Ivoclar Vivadent AG, Schaan, Liechtenstein). Para isso, inicialmente, placas de clareamento (Bio-Art Equipamentos Odontológicos Ltda., São Carlos, SP, Brasil) foram cortadas a laser (Ghibli, Cutlite do Brasil, Blumenau, SC, Brasil) nas espessuras de 0,30 mm e 0,65 mm, com 10 mm de diâmetro, para servir de padrão para os discos cerâmicos (Figura 2).

Em seguida, condutos de alimentação pré-fabricados de cera, denominados *sprues* de cera (Kota Indústria e Comércio Ltda, São Paulo, SP, Brasil), foram unidos a uma das faces do padrão para viabilizar o processo de injeção, sendo posicionados dentro do anel (Figura 3). O anel foi preenchido por revestimento refratário Bellavest SH (BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen, Alemanha), na proporção de 90 g de pó para 26 mL de líquido, espatulado a vácuo (Easy Mix, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen, Alemanha) por 1 min 30 s e dispensado dentro do anel.

Figura 2. Padrão para os discos cerâmicos.



Fonte: Original da autora.

Figura 3. Padrões afixados nos *sprues* de cera na base do anel de injeção.

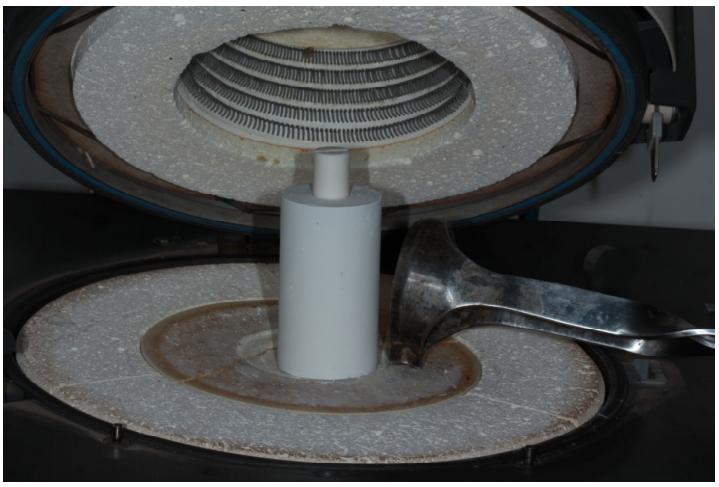
Fonte: Original da autora.

Os conjuntos padrão–*sprue*–anel foram colocados em forno Vulcan 3-550 (Dentsply Ind. e Com. Ltda, Petrópolis, RJ, Brasil), aquecido a 850°C, para a eliminação total da cera e, após 2 h, o molde de revestimento estava pronto para ser injetado. A pastilha de cerâmica foi colocada dentro do anel e o êmbolo foi posicionado sobre a pastilha (Figura 4) a ser injetada. Esse conjunto foi levado ao forno IPS Empress (Ivoclar Vivadent AG, Schaan, Liechtenstein) para prensagem (Figura 5).

Figura 4. Pastilha cerâmica, êmbolo e forno Empress.

Fonte: Original da autora.

Figura 5. Pastilha dentro do anel e colocação no forno para prensagem.



Fonte: Original da autora.

Após 1 h da conclusão do processo de injeção, o material cerâmico foi visualizado com a remoção do revestimento por um jato de óxido de alumínio com 100 µm (Easy Blast, BEGO Bremer Goldschlägerei Wilh. Herbst GmbH & Co. KG, Bremen, Alemanha), sob pressão de 1 bar, em processo denominado demuflagem. Os condutos de alimentação foram, então, cortados com disco de carbeto de silício fino (UltraThin Multipurpose Abrasive Disk®, National Keystone Products Co.,

Philadelphia, PA, Estados Unidos da América), 1 mm aquém da área de união com o disco. Após obtenção dos discos, foi realizado acabamento manual com lixa abrasiva úmida de granulação fina (1200) (3M do Brasil, Sumaré, SP, Brasil) para obter discos com espessura de 0,35 mm (n = 70) e 0,70 mm (n = 70). O controle da espessura foi realizado com o auxílio de paquímetro digital 0–150 mm precisão 500-196-20 (Mitutoyo America Corporation, Aurora, IL, Estados Unidos da América). Em seguida, foi realizado glazeamento em uma das faces do disco cerâmico utilizando IPS e.max Crystal Glaze (Ivoclar Vivadent AG, Schaan, Liechtenstein).

4.3 Delineamento experimental

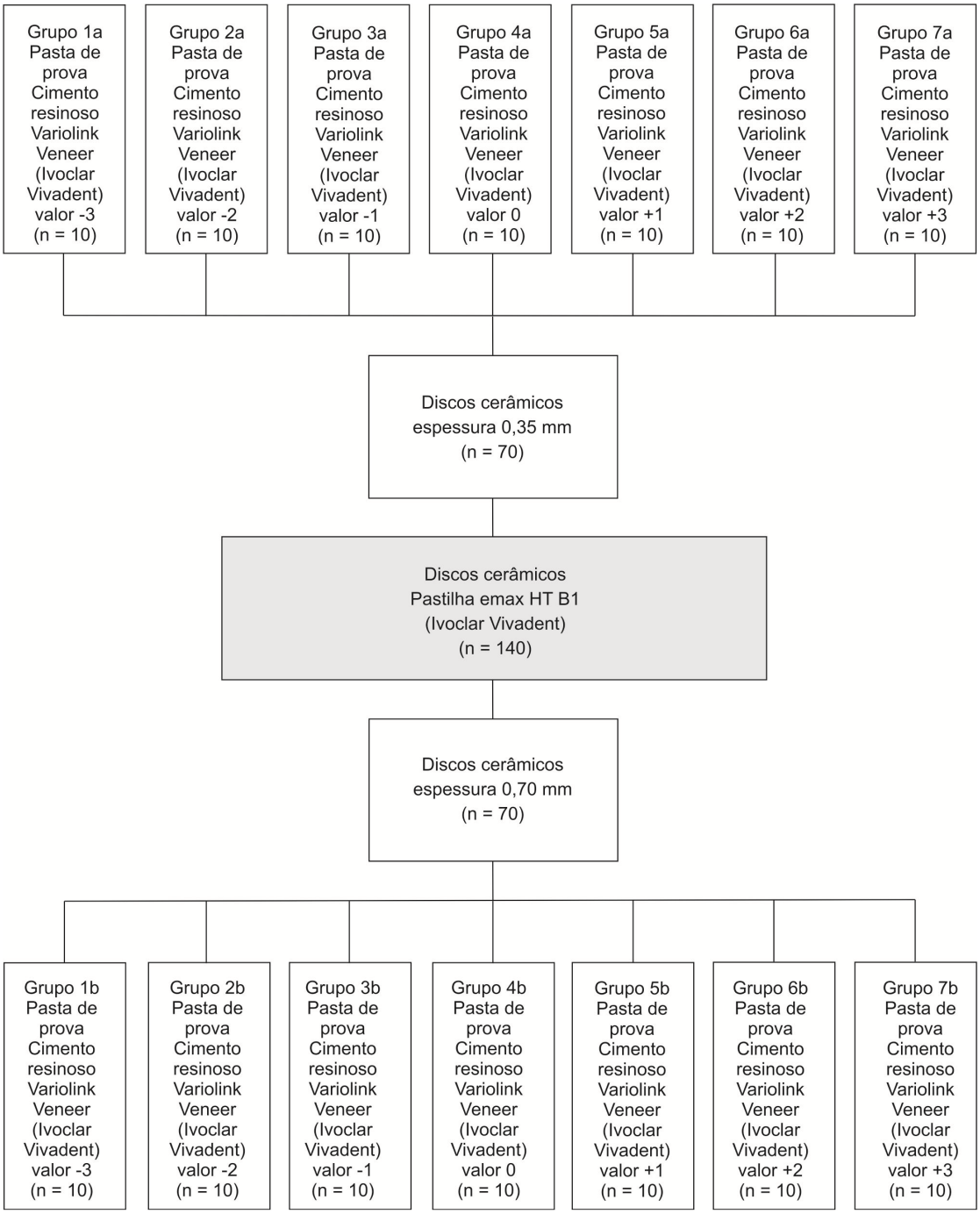
Dentes bovinos (n = 140) selecionados na cor A3, de acordo com a escala Vita, e preparados conforme descrito anteriormente, com a superfície vestibular planificada, foram numerados de 1 a 140. Em seguida, utilizando-se o programa Microsoft Office Excel 2010 (Microsoft Corp., Redmond, WA, Estados Unidos da América), os dentes foram aleatoriamente alocados para os grupos experimentais segundo a sequência de números dada pelo programa.

Os dentes foram divididos de acordo com a espessura dos discos cerâmicos em Grupos de 1a a 7a, com 0,35 mm de espessura e Grupos de 1b a 7b, com 0,70 mm de espessura. Em seguida, foram subdivididos em conformidade com a cor do material de prova e a cor do cimento resinoso, como mostrado na Figura 6.

4.4 Mensuração da cor inicial

Os 140 dentes já preparados, selecionados, aleatorizados e alocados para os grupos experimentais foram submetidos à mensuração da cor inicial, ou seja, a cor do substrato. Para isso, foram colocados sobre bloco de fundo padrão preto (papel cartão preto fosco, Griffe, São Paulo, SP, Brasil) e submetidos à aferição da cor inicial em espectrofotômetro Easyshade (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Alemanha).

Figura 6. Fluxograma do delineamento experimental do estudo.



Fonte: Original da autora.

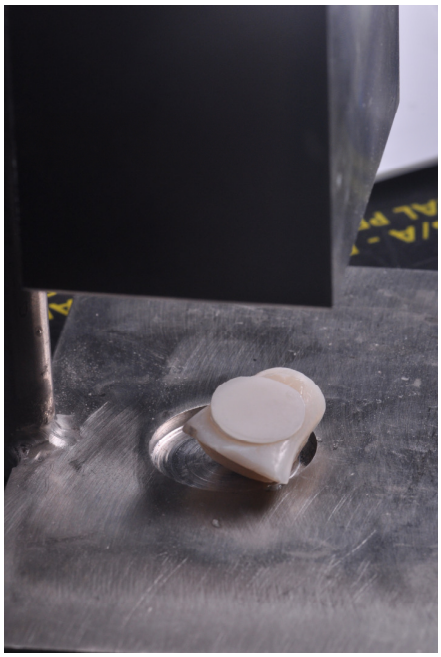
A cor foi determinada por intermédio dos parâmetros do sistema CIE L*a*b*, no qual L* indica a luminosidade e varia de 0 (preto) a 100 (branco), enquanto a* e b* indicam o croma, com a* representando a saturação no eixo vermelho (+) para verde (–) e b* no eixo amarelo (+) para azul (–). Por meio desse sistema, qualquer

cor pode ser especificada com as coordenadas L*, a* e b*. As amostras colocadas sob a ponta do espectrofotômetro receberam luz proveniente de 30 lâmpadas LED, com 10 cores diferentes, dispostas de forma circular, incidindo o feixe de luz em 45° com a superfície do material. Esse feixe foi refletido em 0° de volta para o aparelho e, assim, este captou e registrou os valores de L*, a* e b* de cada amostra. Essas coordenadas foram anotadas em uma tabela construída empregando o programa Excel e denominadas L_0*, a_0* e b_0* nesta leitura.

4.5 Prova dos discos cerâmicos

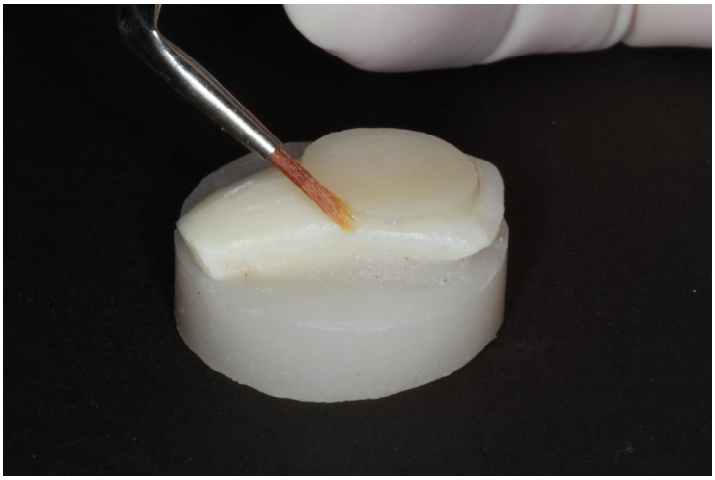
A prova dos discos cerâmicos foi realizada previamente à sua cimentação. Os materiais de prova foram colocados entre os discos e os dentes. A quantidade do material de prova utilizada foi padronizada. O conjunto formado por dente, pasta de prova e disco cerâmico sofreu pressão de um dispositivo do tipo prensa acoplado a um peso de 200 g (Figura 7) e os excessos foram removidos com pincel nº 1 (Cosmedent, Chicago, IL, Estados Unidos da América) (Figura 8).

Figura 7. Conjunto formado por dente, pasta de prova e disco cerâmico sob peso de 200 g.



Fonte: Original da autora.

Figura 8. Remoção do excesso de pasta de prova.



Fonte: Original da autora.

4.6 Mensuração da cor do conjunto: dente–pasta de prova–disco cerâmico

As coordenadas L*, a* e b* foram obtidas pela mensuração de cor utilizando espectrofotômetro Easyshade (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Alemanha), conforme procedimento descrito em 4.4. Essas coordenadas foram anotadas em uma tabela construída empregando o programa Excel e denominadas L_1*, a_1* e b_1* nesta leitura.

4.7 Limpeza dos dentes após a prova e previamente à cimentação

Previamente à cimentação propriamente dita, os dentes foram limpos com pedra pomes extrafina (S.S. White Artigos Dentários Ltda., Rio de Janeiro, RJ, Brasil) e água, utilizando uma taça de borracha (Microdont Micro Usinagem de Precisão Ltda., São Paulo, SP, Brasil) montada em contra-ângulo em baixa rotação (Dabi Atlante, Ribeirão Preto, SP, Brasil). Já a pasta de prova foi removida manualmente dos discos cerâmicos com pincel de ponta chata nº 4 (Cosmedent Chicago, IL, Estados Unidos da América) e, em seguida, estes foram submetidos a banho com água destilada (ASFER Indústria Química, São Caetano do Sul, SP, Brasil) em cuba ultrassônica (Cristófoli, Campo Mourão, PR, Brasil) por 5 min.

4.8 Cimentação dos discos cerâmicos

Para a realização da cimentação adesiva dos discos cerâmicos aos dentes, foram seguidas as orientações dos fabricantes. Realizou-se condicionamento ácido na superfície preparada do dente com ácido fosfórico a 37% (Total Etch, Ivoclar Vivadent AG, Schaan, Leichtenstein) durante 30 s. Após vigorosa lavagem do gel condicionante com jato de ar-água por 60 s e secagem sem desidratar a superfície, o sistema adesivo Excite (Ivoclar Vivadent AG, Schaan, Liechtenstein) foi aplicado por 10 s, seguido de leve jato de ar à distância de 5 cm.

Em seguida, cada disco foi fixado em um dispositivo flexível com ponta adesiva (Kota Indústria e Comércio Ltda, São Paulo, SP, Brasil) para apreender, transportar e posicionar o disco no substrato. Em cada disco cerâmico foi realizado, na face não glazeada, um pré-tratamento da cerâmica com ácido fluorídrico a 10% (FGM Produtos Odontológicos Ltda, Joinvile, SC, Brasil) por 20 s. Depois, cada disco foi lavado com jato de ar-água pelo dobro do tempo e, em seguida, seco com jato de ar. A silanização da superfície não glazeada do disco foi realizada com líquido monocomponente Monobond-S (Ivoclar Vivadent AG, Schaan, Leichtenstein) por 60 s. Após secagem com jato de ar, foi aplicado o sistema adesivo Excite DSC (Ivoclar Vivadent AG, Schaan, Leichtenstein) sobre esta mesma face e os excessos foram removidos com leve jato de ar à distância de 5 cm.

A seguir, foi aplicada uma camada uniforme e padronizada do cimento resinoso Variolink Veneer (Ivoclar Vivadent AG, Schaan, Leichtenstein) da cor correspondente ao grupo do material de prova, conforme delineamento experimental apresentado na Figura 6, na superfície não glazeada do disco cerâmico e este foi posicionado e pressionado convencionalmente por meio da pressão de 200 g exercida por prensa especialmente confeccionada para este procedimento, como mostrado na Figura 7. Em seguida, foi realizada a pré-polimerização por 5 s para a remoção dos excessos de cimento. Após esse procedimento, Liquid Strip (Ivoclar Vivadent AG, Schaan, Leichtenstein) foi aplicado nas margens do disco e realizada a fotopolimerização com unidade fotopolimerizadora de luz LED (Radii Plus, SDI Limited, Bayswater, Victoria, Austrália), com potência de 1200 mW/cm^2, por 40 s, com a luz incidindo perpendicularmente na superfície externa glazeada do disco.

4.9 Mensuração da cor após a cimentação dos discos cerâmicos

As coordenadas L*, a* e b* foram obtidas pela mensuração de cor em espectrofotômetro Easyshade (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Alemanha), conforme procedimento descrito em 4.4. Essas coordenadas foram anotadas em tabela construída no programa Excel e denominadas L_2^*, a_2^* e b_2^* nesta leitura.

A mudança de cor (ΔE*) é comumente usada para representar uma diferença de cor. No presente estudo, foram obtidos três valores de ΔE*. O primeiro, denominado ΔE_0, foi obtido entre os valores das coordenadas da prova dos discos cerâmicos (L_1^*, a_1^* e b_1^*) e do substrato bovino (L_0^*, a_0^* e b_0^*); o segundo, denominado ΔE_1^*, foi obtido entre os valores das coordenadas da cimentação dos discos cerâmicos (L_2^*, a_2^* e b_2^*) e do substrato bovino (L_0^*, a_0^* e b_0^*); e o terceiro, denominado ΔE_2^*, foi obtido entre os valores das coordenadas da cimentação dos discos cerâmicos (L_2^*, a_2^* e b_2^*) e da prova (L_1^*, a_1^* e b_1^*).

ΔE_0^* foi calculado pela seguinte equação (CIE, 1986):

$$\Delta E_0^* = [(\Delta L_0^*)^2 + (\Delta a_0^*)^2 + (\Delta b_0^*)^2]^{0,5}$$

sendo:

$\Delta L_0^* = L_1^* - L_0^*$ (leitura da prova menos leitura do substrato bovino)

$\Delta a_0^* = a_1^* - a_0^*$ (leitura da prova menos leitura do substrato bovino)

$\Delta b_0^* = b_1^* - b_0^*$ (leitura da prova menos leitura do substrato bovino)

ΔE_1^* foi calculado pela seguinte equação:

$$\Delta E_1^* = [(\Delta L_1^*)^2 + (\Delta a_1^*)^2 + (\Delta b_1^*)^2]^{0,5}$$

sendo:

$\Delta L_1^* = L_2^* - L_0^*$ (leitura da cimentação menos leitura do substrato bovino)

$\Delta a_1^* = a_2^* - a_0^*$ (leitura da cimentação menos leitura do substrato bovino)

$\Delta b_1^* = b_2^* - b_0^*$ (leitura da cimentação menos leitura do substrato bovino)

ΔE_2^* foi calculado pela seguinte equação:

$$\Delta E_2^* = [(\Delta L_2^*)^2 + (\Delta a_2^*)^2 + (\Delta b_2^*)^2]^{0,5}$$

sendo:

$\Delta L_2^* = L_2^* - L_1^*$ (leitura da cimentação menos leitura da prova)

$\Delta a_2^* = a_2^* - a_1^*$ (leitura da cimentação menos leitura da prova)

$\Delta b_2^* = b_2^* - b_1^*$ (leitura da cimentação menos leitura da prova)

4.10 Análise estatística

A média, o desvio padrão e a mediana das medidas foram obtidos. A normalidade dos dados foi avaliada pelo teste de Kolmogorov-Smirnov. A diferença estatística entre as medidas obtidas no início, após a prova e após a cimentação foi avaliada pelo Teste-t para amostras pareadas ou pelo teste de Wilcoxon. A diferença entre as espessuras para cada grupo foi avaliada pelo Teste-t para amostras independentes ou pelo teste de Mann-Whitney. A diferença entre os grupos para cada espessura foi avaliada pelo teste de análise de variância (ANOVA) e *post hoc* Tukey ou pelo teste de Friedman. Foram considerados significativos valores de $p < 0,05$. A análise estatística dos dados foi realizada utilizando o software Statistical Package for the Social Sciences, versão 20 (SPSS, Chicago, IL, Estados Unidos da América).

5 PUBLICAÇÃO

Artigo – Resin cement: Correspondence with try-in paste and influence on the final color of veneers

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Resin Cement: Correspondence with Try-In Paste and Influence on the Final Color of Veneers

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Clinical Relevance

Try-in pastes that correspond to the same shades of resin cements can be considered an efficient method to choose the shade of the cementing agent. This study suggests that the thickness of the laminate veneer should also be taken into consideration.

SUMMARY

This study aimed to assess the correspondence of shades between try-in pastes and resin cements, as well as the influence on the final color of veneers, for two thicknesses of ceramic laminate veneer. The buccal surface of 140 bovine teeth were prepared. After that, 70 teeth were randomly distributed in seven groups (Groups 1a to 7a; n = 10 each) and received 0.35 mm thick ceramic veneers for trying in and final cementation, whereas the remaining 70

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teeth were also randomly distributed in seven groups (Groups 1b to 7b; n = 10 each) and received 0.70 mm thick ceramic veneers for trying in and final cementation. Variolink Veneer try-in pastes and resin cements were used as follows: Groups 1a and 1b (color –3); Groups 2a and 2b (color –2); Groups 3a and 3b (color –1); Groups 4a and 4b (color 0); Groups 5a and 5b (color +1); Groups 6a and 6b (color +2); Groups 7a and 7b (color +3). Color measurements were performed in a spectrophotometer Easyshade, the coordinates L*, a*, and b* of the CIE L*a*b* system were registered, and based on them, ΔE_0 (trial – substrate), ΔE_1 (cementation – substrate), and ΔE_2 (cementation – trial) were calculated. The data were analyzed using the Kolmogorov-Smirnov test, the Wilcoxon test, analysis of variance (ANOVA), post hoc Tukey's or the Friedman test, two-way ANOVA, and post hoc Tukey's ($p < 0.05$). The results indicated no statistically significant difference between the groups comparing ΔE_0 and ΔE_1 for 0.35 mm thick ceramic veneers, except for Groups 2a and 5a. For 0.70 mm thick ceramic veneers, no statistically significant differences were observed between the groups comparing ΔE_0 and ΔE_1. ΔE_2 values for 0.35 mm and 0.70 mm thick ceramic veneers ranged from 1.77 ± 0.81 to 4.99 ± 3.80 and from 1.01 ± 0.73 to 4.66 ± 2.96, respectively. Assessing the difference of the variables thickness and color, for ΔE_0 a significant interaction was observed between them ($p = 0.006$), and Group 1a presented values statistically lower than Groups 3b, 4b, 6b, and 7b. Group 4b presented values statistically higher than Groups 2a and 6a. For ΔE_1, a significant interaction was observed ($p = 0.001$), and Group 1a presented a statistically significant difference compared with Groups 4b and 6b, whereas Group 4b showed values statistically higher than Groups 2a, 6a, and 1b. Assessing the results of L* for 0.35 mm thick ceramic veneers, L_0^* values were similar to L_1^*, except for color +3, and to L_2^*, except for colors –3, –2, and +3; for 0.70 mm thick ceramic veneers, in most groups, the mean values increased significantly from L_0^* to L_1^* and L_2^*. Assessing a*, no statistically significant difference was found from a_1 to a_2 in the 14 groups, but comparing a_1 with a_0, statistically significant differences were observed in most groups, and the values were reduced using try-in pastes, except for Groups 1a, 1b, and 6a. Assessing b*, in all groups a significant decrease in values was found using try-in paste and resin cement. However, between b_1 and b_2, no statistically significant differences were found for any groups.

Therefore we conclude that: a correspondence occurred between the try-in pastes and their respective resin cements for most colors investigated in this study; the color of the resin cement may influence the final color of ceramic veneers; analyzing the variables thickness and color in the variation of the final color of ceramic veneers, the former was more relevant.

INTRODUCTION

Healthcare professionals have been dedicating increased attention to the social and psychological impact of facial appearance as a result of an increasing amount of evidence showing that physical attractiveness is an important factor in people's lives.[1] When it comes to attractiveness, facial appearance and, more specifically, the mouth region, receive special attention.[1] The features most commonly associated with facial attraction are the eyes, mouth, and smile.[2]

The following procedures are amog the most used ones to enhance dental appearance and, consequently, the smile: orthodontic treatments, periodontal surgeries, teeth whitening, direct composite resin veneers, and ceramic laminate veneers. Considering the individual indications of each technique, ceramic laminate veneers have become the main prosthetics type in esthetic dentistry due to the qualities of the material employed, which presents excellent optical properties and biocompatibility, and is also more durable and more similar to natural tooth appearance.[3,4]

Regarding indirect restorations, such as laminates, several steps should be followed in order to achieve clinical success and, consequently, patient satisfaction. These steps include planning, choice of ceramic system and technique to be employed, and moment of trying in and final cementation of restorations.

Laminate veneers should be bonded to the dental structure using a cementing agent, and for this purpose it is preferable to employ photo-activated cement.[5] A great advantage of this type of material is the longer working time compared with dual-cured or chemically activated cement. This makes it easier to remove excess cement before polymerization, reducing the time needed for finishing the restoration after cementation. Moreover, color stability is superior to dual-cured or chemically

activated systems.[5] Also, cementation using resin adhesive systems increases fracture resistance of both teeth and restoration and, simultaneously, minimizes fracture formation, a determinant of a successful outcome.[6]

Taking into consideration the importance of the phase involving cementation of indirect restorations, manufacturers offer numerous shades of resin cements, allowing the clinician to choose a color of cement for the veneer that achieves the desired esthetic result. Nonetheless, the impact of the color of the cement on the final esthetics of laminate veneers has been described as controversial in the literature.[7]

To obtain better previsibility of esthetic results, veneer try-in should be performed prior to cementation. Try-in can be carried out using water, hydrosoluble gel, or try-in pastes.[8] Try-in pastes that correspond to the same shades of resin cements allow both the dentist and the patient to evaluate the system tooth–veneer concerning the color and its nuances, ensuring that the esthetic expectation is achieved.[9] Thus knowing whether try-in pastes are reliable regarding final color of restoration is a factor of paramount importance in an esthetic treatment employing laminate veneers.

Therefore the present study aimed to assess the correspondence of shades between try-in pastes and resin cements, as well as the influence on the final color of veneers, for two thicknesses of ceramic laminate veneer. The hypotheses investigated were: 1) no correspondence of shades can be found between try-in pastes and the respective resin cements; 2) the presence of ceramic of different thicknesses and resin cement shades do not influence the final color of veneers.

METHODS AND MATERIALS

Selection and Preparation of Teeth

One hundred forty bovine teeth were used in this study. All of them were immersed in 0.05% thymol solution at room temperature [Farmácia Escola, Universidade Federal de Goiás (UFG), Goiânia, GO, Brazil]. After proper cleaning, the teeth were stored in deionized water (Quimidrol – Comércio, Indústria e Importação Ltda, Joinville, SC, Brazil) for 24 h in order to hydrate them and remove thymol solution. After that, color

measurements of the specimens were carried out using a spectrophotometer (Easyshade, VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Germany) and only teeth classified as A3, according to the Vita color scale, were selected for this research.

The roots were separated from the respective crowns, the buccal surface was flattened, preserving the enamel surface, and each tooth was bonded to a base made of autopolymerizing resin (Kota Indústria e Comércio Ltda, São Paulo, SP, Brazil), so that the prepared buccal surface remained parallel to the ground.

Fabrication of Ceramic Veneers

To represent the clinical use of laminate veneers, ceramic discs were produced according to the following specifications: IPS e.max HT B1, 0.35 mm (n = 70) and 0.70 mm (n = 70) thick (Ivoclar Vivadent AG, Schaan, Liechtenstein). Bleaching plates (Bio-Art Equipamentos Odontológicos Ltda., São Carlos, SP, Brazil) were laser-cut (Ghibli, Cutlite do Brasil, Blumenau, SC, Brazil) to produce discs 0.30 mm and 0.65 mm in thickness and 10 mm in diameter to be used as moulds for the ceramic discs. After that, pre-fabricated wax sprues (Kota Indústria e Comércio Ltda, São Paulo, SP, Brazil) were bonded to one of the surfaces of the moulds for the injection process and positioned inside the injection ring. The systems mould–sprue–ring were placed in an oven (Vulcan 3-550, Dentsply Ind. e Com. Ltda, Petrópolis, RJ, Brazil), heated to 850°C for total elimination of wax and, after 2 h, the moulds were ready to be injected. The ceramic press tablet was placed inside the ring and the piston was positioned over the tablet to be injected. This system was placed in an oven (IPS Empress, Ivoclar Vivadent AG, Schaan, Liechtenstein) to be pressed. After obtaining the discs, manual finishing was carried out using 1200-grit sandpaper (3M do Brasil, Sumaré, SP, Brazil). Next, one of the surfaces of the ceramic disc was glazed using IPS e.max Crystal Glaze (Ivoclar Vivadent AG, Schaan, Liechtenstein). Thickness control was performed using a 500-196-20 digital caliper, 0–150 mm precision (Mitutoyo America Corporation, Aurora, IL, United States).

Experimental Design

The teeth prepared as stated above were numbered from 1 to 140. Next, using Microsoft Office Excel 2010 (Microsoft Corp., Redmond, WA, United States), the specimens were randomly allocated into the experimental groups. The teeth were dividided according to the thickness of the ceramic discs into Groups 1a to 7a (n = 10 for each group), 0.35 mm thick, and Groups 1b to 7b (n = 10 for each group), 0.70 mm thick. After that, they were subdividided based on the color of the try-in paste and resin cement as follows: Groups 1a and 1b (color –3); Groups 2a and 2b (color –2); Groups 3a and 3b (color –1); Groups 4a and 4b (color 0); Groups 5a and 5b (color +1); Groups 6a and 6b (color +2); Groups 7a and 7b (color +3).

Measurement of Initial Color

To measure the initial color, i.e. the color of the substrate, L* (lightness, where 100 represents white and 0 represents black), a* (red–green chromatic coordinate), and b* (blue–yellow chromatic coordinate) coordinates were measured against a standard black background (opaque black cardboard, Griffe, São Paulo, SP, Brazil) with an Easyshade spectrophotometer (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Germany). These values were recorded in a table constructed using the Excel program and named L_0*, a_0*, and b_0*.

Ceramic Discs Try-in and Measurement of Color with the Try-in Paste

Ceramic discs try-in was performed prior to cementation by inserting the try-in paste between the discs and the teeth in a standardized amount. The system tooth–try-in paste–ceramic disc was pressed in a press device, especially designed for this procedure, coupled with a 200 g weight and excess paste was removed with a brush no. 1 (Cosmedent, Chicago, IL, United States). L*, a*, and b* coordinates were measured against a standard black background (opaque black cardboard, Griffe, São Paulo, SP, Brazil) with an Easyshade spectrophotometer (VITA Zahnfabrik H. Rauter

GmbH & Co. KG, Bad Säckingen, Germany). These values were recorded in a table constructed using the Excel program and named L_1*, a_1*, and b_1*.

Cleaning Teeth after Try-in and Prior to Cementation

The teeth were cleaned with extrafine pumice (S.S. White Artigos Dentários Ltda., Rio de Janeiro, RJ, Brazil) and water slurry using a rotating rubber cup (Microdont Micro Usinagem de Precisão Ltda., São Paulo, SP, Brazil) mounted in a slow-speed contra-angle handpiece (Dabi Atlante, Ribeirão Preto, SP, Brazil). The try-in was manually removed from the ceramic discs with a flat-angled brush no. 4 (Cosmedent Chicago, IL, United States) and the discs were placed in an ultrasonic bath (Cristófoli, Campo Mourão, PR, Brazil) with distilled water (ASFER Indústria Química, São Caetano do Sul, SP, Brazil) for 5 min.

Cementation of Ceramic Discs and Measurement of Color after Cementation

For the cementation phase, the manufacturer's instructions were followed. The surface of the prepared teeth was etched with 37% fosforic acid (Total Etch, Ivoclar Vivadent AG, Schaan, Leichtenstein) for 30 s. After thouroughly rinsing the conditioning gel away using water-air jet for 60 s and drying the teeth without dehydrating their surface, the adhesive system Excite (Ivoclar Vivadent AG, Schaan, Liechtenstein) was applied for 10 s, followed by a gentle air jet from a distance of 5 cm.

Next, each ceramic disc was fixed on a flexible rod with an adhesive tip (Kota Indústria e Comércio Ltda, São Paulo, SP, Brazil) to hold, transport, and position it on the substrate. The unglazed surface of each ceramic disc was etched with 10% hydrofluoric acid (FGM Produtos Odontológicos Ltda, Joinvile, SC, Brazil) for 20 s, washed using water-air jet for 40 s, dried with an air jet, and silanized with Monobond-S (Ivoclar Vivadent AG, Schaan, Leichtenstein) for 60 s. After drying with an air jet, the adhesive system Excite DSC (Ivoclar Vivadent AG, Schaan,

Leichtenstein) was applied to the same surface of the ceramic disc and excess was removed with a gentle air jet from a distance of 5 cm.

Next, a uniform and standardized layer of resin cement Variolink Veneer (Ivoclar Vivadent AG, Schaan, Leichtenstein), the color corresponding to the try-in paste used in each group, was applied on the surface of the ceramic disc treated as described above, then seated on the tooth and conventionally pressed in a press device, especially designed for this procedure, coupled with a 200 g weight. Next, pre-polymerization was performed for 5 s for excess cement removal. After this procedure, Liquid Strip (Ivoclar Vivadent AG, Schaan, Leichtenstein) was applied to the margins of the ceramic disc and photopolymerization was carried out using a LED curing light unit (Radii Plus, SDI Limited, Bayswater, Victoria, Australia), set at 1200 mW/cm^2, for 40 s, the axis of the light beam perpendicular to the external glazed surface of the ceramic disc. L*, a*, and b* coordinates were measured against a standard black background (opaque black cardboard, Griffe, São Paulo, SP, Brazil) with an Easyshade spectrophotometer (VITA Zahnfabrik H. Rauter GmbH & Co. KG, Bad Säckingen, Germany). These values were recorded in a table constructed using the Excel program and named L_2*, a_2*, and b_2*.

Color change (ΔE*) is commonly used to represent a difference in color. In the present study, three ΔE* values were obtained. The first, named ΔE_0, was calculated using the values obtained for the color coordinates of the ceramic discs with the try-in paste (L_1*, a_1*, and b_1*) and the bovine substrate (L_0*, a_0*, and b_0*); the second, named ΔE_1*, was calculated using the values obtained for the color coordinates of the ceramic discs after cementation with resin cement (L_2*, a_2*, and b_2*) and the bovine substrate (L_0*, a_0*, and b_0*); and the third, named ΔE_2*, was calculated using the values obtained for the color coordinates of the ceramic discs after cementation with resin cement (L_2*, a_2*, and b_2*) and the ceramic discs with the try-in paste (L_1*, a_1*, and b_1*).

Statistical Analysis

The assessment of the normality of data was performed using the Kolmogorov-Smirnov test. The statistical difference between color measurements obtained for the bovine substrate, after try-in paste application, and after cementation was evaluated

employing the *t*-test for paired samples or the Wilcoxon test. The statistical difference between groups for each thickness was assessed using analysis of variance (ANOVA) and post hoc Tukey's or the Friedman test. The evaluation of the statistical difference between thicknesses and colors was carried out using two-way ANOVA and post hoc Tukey's. Differences were considered statistically significant when the calculated p value was less than 0.05. The statistical analysis was performed employing the Statistical Package for the Social Sciences software, version 20 (SPSS, Chicago, IL, United States).

RESULTS

The results obtained after calculating ΔE_0 and ΔE_1, for the two thicknesses of ceramic discs tested, are presented in Tables 1 and 2. The assessment of the differences of the variables thickness and color are depicted in Figures 1 and 2. The results obtained for L*, at the different moments of color measurement, are shown in Tables 3 and 4.

The results indicated no statistically significant difference between the groups comparing ΔE_0 with ΔE_1 for the 0.35 mm thick ceramic discs, except for Groups 2a and 5a (Table 1), for which the respective ΔE_1 were higher than ΔE_0. Similarly, for the 0.70 mm thick ceramic discs, no statistically significant differences were observed between the groups comparing ΔE_0 with ΔE_1 (Table 2). The values found for ΔE_2 for the 0.35 mm thick ceramic discs ranged from 1.77 ± 0.81 to 4.99 ± 3.80, whereas for the 0.70 mm thick ceramic discs, they ranged from 1.01 ± 0.73 to 4.66 ± 2.96.

Assessing the difference of the variables thickness and color, for ΔE_0 a significant interaction was observed between them ($p = 0.006$), and Group 1a presented a statistically significant difference compared with Groups 3b, 4b, 6b, and 7b. Group 4b also presented statistically significant difference compared with Groups 2a and 6a (Figure 1).

In the evaluation of the variables described for ΔE_1, a significant interaction was observed ($p = 0.001$), and Group 1a presented a statistically significant difference compared with Groups 4b and 6b, whereas Group 4b showed a statistically significant difference compared with Groups 2a, 6a, and 1b (Figure 1).

Table 1: *Results of Mean ± Standard Deviation ($\overline{x}$ ± S) and Median (Md) of ΔE_0 and ΔE_1 Obtained for 0.35 mm Thick Ceramic Discs from Groups 1a to 7a, Using the *T-test for Paired Samples or the **Wilcoxon Test*

Experimental Group	ΔE_0		ΔE_1		*p*
	$\overline{x}$ ± S	Md	$\overline{x}$ ± S	Md	
Group 1a	11.97±3.17[a]	12.18	12.03±4.22[a]	11.12	0.948*
Group 2a	12.99±5.51[a]	14.11	14.98±5.11[b]	15.26	0.021*
Group 3a	17.77±3.73[a]	17.97	18.28±4.51[a]	19.77	0.493*
Group 4a	17.14±3.22[a]	16.81	18.58±3.73[a]	17.37	0.072*
Group 5a	17.96±3.32[a]	17.42	19.32±3.99[b]	19.12	0.018*
Group 6a	14.00±3.82[a]	15.02	14.02±3.76[a]	14.36	0.953*
Group 7a	21.28±5.71[a]	19.27	21.94± 4.67[a]	20.72	0.432**

Different letters in the same line indicate statistically significant difference ($p < 0.05$).
Same letters in the same line indicate no statistically significant difference ($p > 0.05$).

Table 2: *Results of Mean ± Standard Deviation ($\overline{x}$ ± S) and Median (Md) of ΔE_0 and ΔE_1 Obtained for 0.70 mm Thick Ceramic Discs from Groups 1b to 7b, Using the *T-test for Paired Samples or the **Wilcoxon Test*

Experimental Group	ΔE_0		ΔE_1		*p*
	$\overline{x}$ ± S	Md	$\overline{x}$ ± S	Md	
Group 1b	16.47±4.47[a]	16.07	15.04±4.65[a]	13.61	0.064**
Group 2b	21.95±6.21[a]	21.79	21.87±4.57[a]	21.20	0.933*
Group 3b	22.53±6.64[a]	22.88	22.32±6.37[a]	22.24	0.403*
Group 4b	26.59±16.73[a]	22.88	27.20±16.99[a]	23.52	0.105**
Group 5b	17.37±5.85[a]	18.74	17.28±6.13[a]	19.20	0.926*
Group 6b	23.32±6.91[a]	23.19	23.07±7.02[a]	22.29	0.725*
Group 7b	22.69±8.50[a]	21.85	21.93±8.82[a]	21.72	0.153*

Same letters in the same line indicate no statistically significant difference ($p > 0.05$).

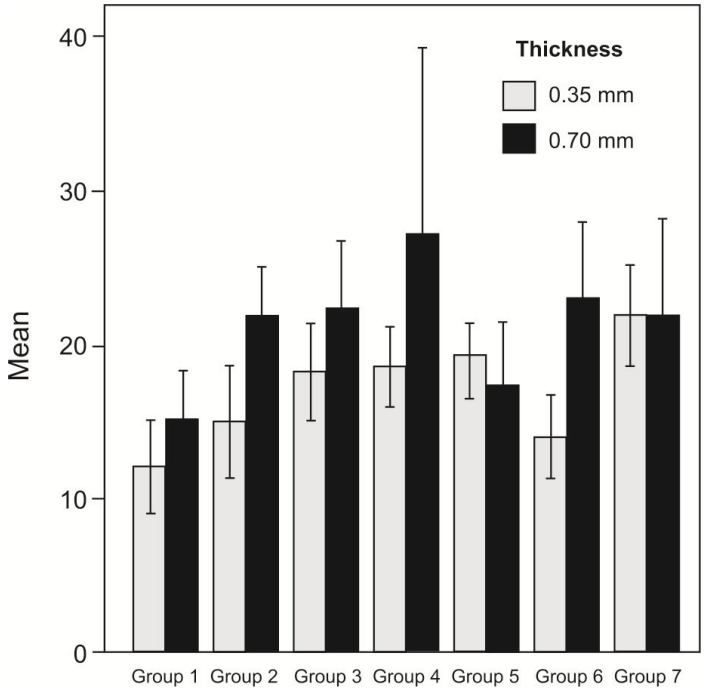

Figure 1. *Mean values of color change measurements obtained for ΔE_0 for each group of 0.35 mm and 0.70 mm thick ceramic discs.*

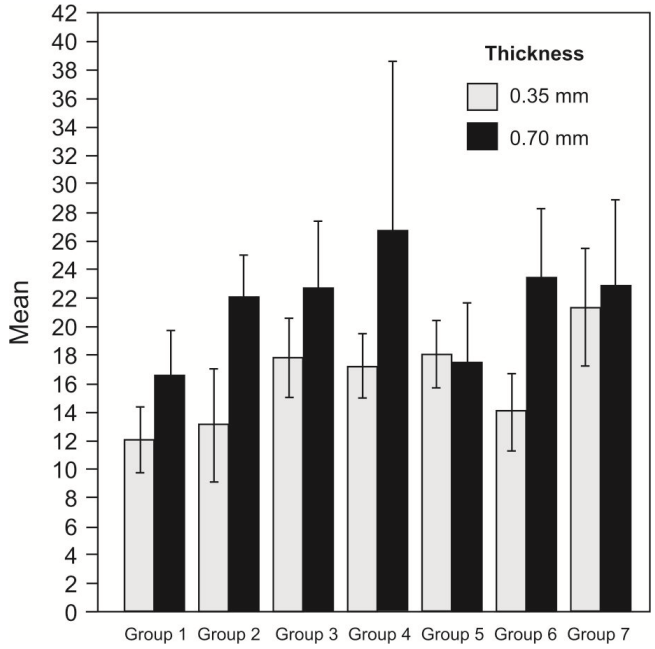

Figure 2. *Mean values of color change measurements obtained for ΔE_1 for each group of 0.35 mm and 0.70 mm thick ceramic discs.*

Table 3: *Results of Mean ± Standard Deviation ($\overline{x}$ ± S) and Median (Md) of the* comparison of L_0*, L_1*, and L_2* *for 0.35 mm Thick Ceramic Discs from Groups 1a to 7a, Using *ANOVA and Post Hoc Tukey's or the **Friedman Test*

Experimental Group	**L_0***		**L_1***		**L_2***		***p***
	$\overline{x}$ ± S	**Md**	**$\overline{x}$ ± S**	**Md**	**$\overline{x}$ ± S**	**Md**	
Group 1a	89.21±3.7^{a}	89.95	90.22±4.08^{ab}	90.30	94.01±4.33^{b}	94.00	0.032*
Group 2a	90.35±3.38^{a}	90.25	91.46±2.17^{ab}	90.80	92.54±2.16^{b}	92.60	0.025**
Group 3a	89.42±4.10^{a}	88.25	92.50±1.91^{a}	92.75	92.08±2.91^{a}	91.50	0.072*
Group 4a	90.80±2.71^{a}	91.15	92.35±2.09^{a}	92.55	92.84±2.84^{a}	93.80	0.198*
Group 5a	89.81±3.36^{a}	89.80	91.22±1.85^{a}	91.65	92.48±1.63^{a}	92.40	0.062*
Group 6a	92.72±3.01^{a}	91.75	93.24±2.35^{a}	93.35	94.05±1.69^{a}	94.20	0.472*
Group 7a	85.25±4.69^{a}	85.50	90.97±2.35^{b}	91.55	92.76±1.74^{b}	93.25	0.000*

Different letters in the same line indicate statistically significant difference ($p < 0.05$).
Same letters in the same line indicate no statistically significant difference ($p > 0.05$).

Table 4: *Results of Mean ± Standard Deviation ($\overline{x}$ ± S) and Median (Md) of the* comparison of L_0*, L_1*, and L_2* *for 0.70 mm Thick Ceramic Discs from Groups 1b to 7b, Using *ANOVA and Post Hoc Tukey's or the **Friedman Test*

Experimental Group	**L_0***		**L_1***		**L_2***		***p***
	$\overline{x}$ ± S	**Md**	**$\overline{x}$ ± S**	**Md**	**$\overline{x}$ ± S**	**Md**	
Group 1b	89.94±3.67^{ab}	91.00	89.25±1.28^{a}	89.40	92.83±3.18^{b}	92.40	0.004**
Group 2b	84.19±5.29^{a}	83.85	91.72±2.49^{b}	92.30	91.85±2.11^{b}	92.15	0.000*
Group 3b	84.28±6.02^{a}	85.15	91.46±1.49^{b}	91.60	91.70±1.46^{b}	91.75	0.000*
Group 4b	87.90±4.51^{a}	88.45	90.93±2.71^{ab}	91.00	91.78±1.75^{b}	91.85	0.029*
Group 5b	90.21±2.35^{a}	90.40	91.31±2.30^{a}	91.75	91.48±2.50^{a}	92.20	0.497**
Group 6b	84.99±6.64^{a}	84.30	92.16±1.51^{b}	92.15	89.87±3.03^{b}	90.20	0.003*
Group 7b	82.85±10.94^{a}	87.05	90.45±1.64^{b}	90.50	90.48±1.50^{b}	90.30	0.006**

Different letters in the same column indicate statistically significant difference ($p < 0.05$).
Same letters in the same column indicate no statistically significant difference ($p > 0.05$).

Assessing the results of L* for 0.35 mm thick ceramic discs, a discreet increase was observed in the mean values between the measurements for the substrate and the ceramic discs with the try-in paste, as well as between the measurements for the substrate and after cementation. Nevertheless, a statistically significant difference was observed only for the groups which represented the colors –3, –2, and +3, i.e. for the extremes of the system scale used in the present study (Table 3). Evaluating the results of L* for 0.70 mm thick ceramic discs, in most groups, the mean values increased significantly from L_0* to L_1* and to L_2* (Table 4).

Assessing a*, no statistically significant difference was found from a_1 to a_2 in the 14 groups. Nevertheless, comparing a_1 with a_0, statistically significant differences were observed in most groups, and the values were reduced using try-in pastes, except for Groups 1a, 1b, 2a, and 6a. Comparing a_0 with a_2, a statistically significant difference was also observed in most groups, except for Groups 1a, 1b, 6a, and 7b.

Assessing b*, in all groups a decrease in values was found using try-in paste and resin cement. A statistically significant difference was observed between b_1 and b_0 and between b_2 and b_0 in all groups. However, between b_1 and b_2, no statistically significant differences were found for any groups.

DISCUSSION

Obtaining the planned color using indirect bonded restorations is a fundamental step to achieve a successful outcome in esthetic rehabilitation treatments and, consequently, the satisfaction of both the dentist and the patient. Selection of the final color desired for a laminate veneer involves the evaluation of the dental substrate to be restored and the choice of the ceramic veneer, but other parameters should also be taken into consideration, such as the lips, the color of the gingival tissue, the adjacent teeth, and the position of the tooth in the dental arch.[10] The most commonly used method for color selection, in clinical practice, is the standardized scales, based on the visual perception of the observer. However, given the disadvantages of this method, it is not used in researches as a model for comparison.[11,12] Thus in the present study the CIE L*a*b* system was used to

measure the color, since spectrophotometry remains the most accurate method for this purpose.[13]

The results obtained for ΔE_0 and ΔE_1 were compared for the 14 groups and, in most groups, color correspondence was observed between try-in paste and resin cement polymerized under the ceramic veneers. This finding does not coincide with the results reported by other authors,[8,14–17] since they demonstrated that, in most cases, the color of the try-in paste did not correspond to the color of its respective cement. However, it should be emphasized that in these previous studies the variation in color did not reach four shades, different ceramic thicknesses were not tested, and in some of them the ceramic veneers were up to 1.0 mm thick. In contrast, the results found by Xing et al.[7] corroborate the present finding, given that, in general, no difference was observed between the color of the try-in pastes and their respective cements, although they used ceromer veneers instead of ceramic veneers.

It is also worth mentioning that, comparing the extreme colors evaluated herein, the mean values registered for the groups that represented color –3 (1a and 1b) were lower than those obtained for the groups that represented color +3 (7a and 7b) both for ΔE_0 and ΔE_1. Considering that in the present study only teeth classified as A3, according to the Vita color scale, were selected and that ceramic veneers were used in all the groups, it is possible to affirm that in addition to the effect of the ceramic laminate on the change of the initial color of the substrate, very perceptible in Groups 4a and 4b (color 0), some colors of try-in paste and cement, especially –3 and –2 for 0.35 mm thick ceramic laminates, influenced the final color of the system substrate–adhesive material–ceramic veneer, resulting in lower ΔE compared with the groups above color 0. For 0.70 mm thick ceramic laminates, this was perceptible in Group 1b compared with the remaining groups. Group 4b presented the highest values for color change both after try-in paste application and after cementation. These findings confirmed that, using thinner ceramic veneers, different colors of cement can change the final color of the laminate bonded to the tooth.

Therefore, considering that thickness is an important feature of laminate veneers, in the present study the ceramic discs were produced in two thicknesses: 0.35 mm, aiming to investigate the performance of a laminate thickness close to that described as “contact lens” in the literature (0.30 mm),[18]; and 0.70 mm, aiming to observe the

performance of a laminate used in conventional situations.[19] Analyzing the variables thickness and color (Figures 1 and 2), the most relevant factor in color change was thickness, since statistically significant differences were found for the different thicknesses, i.e. between groups a and b. These results are in agreement with the findings of Xing et al.[7], who reported that the effect of the color of the cement on the final color of ceramic veneers depends on the thickness of the material. By contrast, Kürklü et al.[20] also tested two thicknesses of ceramic veneers, 0.50 mm and 1.0 mm, but reported that no color change occurred comparing the two thicknesses using the cement color clear.

Regarding L* coordinate, in most groups no statistically significant difference was found between the measurements after try-in paste application and after cementation, except for Groups 2a and 1b. Consequently, it is possible to affirm that, in relation to the parameter luminosity, the try-in pastes correspond to their respective polymerized resin cements. Furthermore, in all groups L* values increased after cementation (from L_0 to L_2), therefore the final color of the ceramic laminates had an increased value, i.e. in the axis from black to white, it is nearer the latter. This result corroborates the findings of Salameh et al.[21], who affirmed that L* values increased after cementation.

In addition, a* and b* coordinates, related to chroma, did not present statistically significant difference between the measurements after try-in paste application and after cementation, for both thicknesses tested, showing the correspondence of color of these materiais. However, statistically significant differences were observed between the measurements of the substrate alone and the measurements in the moments when adhesive material (try-in paste or cement) plus the ceramic disc were placed over the substrate, for most groups and both coordinates. Analyzing the mean values obtained for Groups 4a and 4b (color 0), regardless of the color of the adhesive material placed between the substrate and the ceramic disc, the color of the system substrate–adhesive material–ceramic veneer changed, probably due to the presence of the ceramic veneer. The values obtained for a* and b* decreased in most groups, from the measurements of the substrate to the measurements after try-in paste application, as well as from the measurements of the substrate to the measurements after cementation. Thus the systems substrate–adhesive material–

ceramic veneer became less red and more green in the axis of a* coordinate, and less yellow and more blue in the axis of b* coordinate.

Determining a clinically acceptable value for ΔE* remains challenging. Balderamos et al.[8] adopted ΔE* ≤ 3.0 as the limit of perception; Xing et al.[7] determined that ΔE* ≥ 2.0 is perceptible; and Salameh et al.[21] considered that ΔE* ≥ 3.7 can determine perceptible changes in color. However, in an *in vivo* study, Douglas et al.[22] affirmed that the limit for clinical acceptability is ΔE* ≤ 5.5, and according to AlGhazali et al.[23], the limit for perception is ΔE* ≥ 1.0, whereas the limit for clinical acceptability is ΔE* ≤ 5.5. The findings of the present study were: for 0.35 mm thick ceramic veneers, ΔE_2 ranged from 1.77 to 4.99, and for 0.70 mm thick ceramic veneers, ΔE_2 ranged from 1.01 to 4.66. Therefore, in agreement with AlGhazali et al.,[23] although the color changes were perceptible in all groups, they are clinically acceptable within the aforementioned parameters, since for both thicknesses ΔE_2 ranged from 1.01 to 4.99.

CONCLUSION

Taking into consideration the limitations inherent to the present study, it is possible to conclude that:

1) Correspondence between the color of the try-in pastes and their respective resin cements was found for most colors investigated.

2) The color of the resin cement influenced the final color of the ceramic veneer.

3) The thickness of the ceramic veneer was the most relevant variable for color change.

Conflict of Interest

The authors of this manuscript certify that they have no proprietary, financial, or other personal interest of any nature or kind in any product, service, and/or company that is presentd in this article.

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6 CONCLUSÃO

Considerando as limitações do presente estudo, conclui-se que:

a) Houve correspondência de cor entre pasta de prova e cimento resinoso para a maioria das tonalidades investigadas.

b) A tonalidade do cimento resinoso influenciou a cor final do laminado cerâmico.

c) A espessura da cerâmica foi a variável mais relevante na alteração de cor.

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ANEXO A. TERMO DE APROVAÇÃO DA COMISSÃO DE ÉTICA NO USO DE ANIMAIS/CEUA DA UNIVERSIDADE FEDERAL DE GOIÁS

MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DE GOIÁS
PRÓ-REITORIA DE PESQUISA E INOVAÇÃO
COMISSÃO DE ÉTICA NO USO DE ANIMAIS/CEUA

Goiânia, 08 de setembro de 2014.

PARECER CONSUBSTANCIADO REFERENTE AO PROJETO DE PESQUISA/ENSINO, PROTOCOLADO NESTA COMISSÃO SOB O Nº 063/14

I - Finalidade do projeto:
(X) Pesquisa ( ) Ensino

II - Identificação:

- **Título do projeto:**
  Caracterização de cores de materiais de prova e de cimentos resinosos em laminados cerâmicos
- **Pesquisador Responsável/ Unidade:**
  Edenize Cristina Vaz/Faculdade de Odontologia –UFG
- **Pesquisadores Participantes:**

Nome	Instituição	Titulação	Função na Pesquisa
Lawrence Gonzaga Lopes http://lattes.cnpq.br/8698234314492960	UFG	Mestre e Doutor	Orientador
Erica Miranda de Torres http://lattes.cnpq.br/6356663266303896	UFG	Mestre e Doutora	Co-Orientador
Terezinha de Jesus Esteves Barata http://lattes.cnpq.br/6936507208310712	UFG	Mestre e Doutora	Pesquisador participante
João Batista de Souza http://lattes.cnpq.br/0642108682158061	UFG	Mestre e Doutor	Pesquisador participante

- **Unidade onde será realizado:** Faculdade de Odontologia –UFG
- **Data de apresentação a CEUA: 08/08/2014**

III - Objetivos e justificativa do projeto:
Comparar a cor dos laminados cerâmicos no momento da prova com a cor após a cimentação.

IV - Sumário do projeto:

- **Discussão sobre a possibilidade de métodos alternativos:**

Não foi descrito a possibilidade de métodos alternativos.

- **Descrição do animal utilizado (número, espécie, linhagem, sexo, peso, etc):**

Serão utilizados 140 dentes obtidos de 14 grupos, sendo que cada grupo contem 10 dentes de animais abatidos em frigorífico.

MINISTÉRIO DA EDUCAÇÃO
UNIVERSIDADE FEDERAL DE GOIÁS
PRÓ-REITORIA DE PESQUISA E INOVAÇÃO
COMISSÃO DE ÉTICA NO USO DE ANIMAIS/CEUA

UFG

❑ **Descrição das instalações utilizadas e número de animais/área/qualidade do ambiente (ar, temperatura, umidade), alimentação/hidratação:**

Não se aplica.

❑ **Utilização de agente infeccioso/severidade da infecção a ser observada:**

Não se aplica.

❑ **Adequação da metodologia e considerações sobre o sofrimento imposto aos animais:**

Não haverá adequações nem sofrimento de animais pela aplicação do projeto.

❑ **Método de eutanásia:**

Não haverá eutanásia de animais.

❑ **Destino do animal:**

Serão obtidos apenas material biológico em frigorífico, não é determinado o destino final deste material.

IV – Comentários do relator frente às orientações da SBCAL

❑ **Estrutura do protocolo:**

A estrutura do protocolo está adequada para a análise.

❑ **Necessidade do número de animais:**

Os materiais biológicos serão obtidos de frigorífico, porém não é citado o nome, localização do frigorífico nem se o mesmo possuí todas as licenças para a operação.

❑ **Análise de sofrimento imposto, métodos alternativos e benefícios:**

Não haverá sofrimento na aplicação do projeto.

❑ **Análise dos riscos aos pesquisadores/alunos:**

Não é discutido nenhum risco na execução do projeto, sendo esses minimizados pela utilização de EPIs.

V - Parecer do CEUA:

De acordo com a documentação apresentada a esta Comissão consideramos o projeto **APROVADO.**

Informação aos pesquisadores: Reiteramos a importância deste Parecer Consubstanciado, e lembramos que o(a) pesquisador(a) responsável deverá encaminhar à CEUA-PRPI-UFG o *Relatório Final* baseado na conclusão do estudo e na incidência de publicações decorrentes deste, de acordo com o disposto na Lei nº. 11.794 de 08/10/2008, e Resolução Normativa nº. 01, de 09/07/2010 do Conselho Nacional de Controle de Experimentação Animal-CONCEA. O prazo para entrega do Relatório é de até 30 dias após o encerramento da pesquisa, prevista para conclusão em **28/02/2015**.

VI - Data da reunião: 08 de setembro de 2014.

RENATA MAZARO:12343522812
2014.10.01 12:31:28 -03'00'

Dra. Renata Mazaro e Costa

Coordenadora da CEUA/PRPI/UFG

ANEXO B. NORMAS DE PUBLICAÇÃO DO PERIÓDICO OPERATIVE DENTRISTRY

INSTRUCTIONS TO AUTHORS

Updated 15 August, 2014

Dear Authors,

Operative Dentistry, Inc. adheres to the ethical considerations of the International Committee of Medical Journal Editors (hereafter “ICMJE”) also known as the Vancouver Guidelines. If any conflict arises with a submitted manuscript, the Editor will contact the Corresponding Author of the manuscript in accordance with the ICMJE guidelines.

Due to increased submission costs we need to pass a 25.00USD portion of those costs on to our submitting authors. The 25.00 USD is a one-time cost per manuscript. If you are asked to submit revisions of your paper, only the original submission will be charged. This fee will be required for a manuscript to be considered in any way. Please understand that this fee is non-refundable. Paying the submission fee will have no bearing on whether or not your manuscript will be accepted either for review, or for publication. Should you have any questions about this new policy, please contact our offices at editor@jopdent.org.

PayPal has been chosen to help with this fee collection. We understand that not all countries participate with PayPal. If you are unable to submit the fee via PayPal, contact our offices at editor@jopdent.org for other options. Should you have any questions about this policy, please contact our offices at editor@jopdent.org.

We operate with very strict guidelines regarding human subjects. In order for a manuscript to be considered for review in our journal, evidence that appropriate use of human or animal subjects or tissues must be provided. The journal editorial board cannot make that decision, just as an individual investigator should not make that decision. It is recognized that some jurisdictions have different expectations and requirements. If your manuscript uses animal or human subject derived data (including survey forms) or specimens of any kind (including teeth, saliva, tissues), evidence of IRB or local oversight committee approval that was obtained prior to beginning the study must be provided **WITH** the submission. In cases where your country does not ever require "permission" to use, for example, extracted teeth, there should be a written policy from the local human research ethics committee that states that no permission of any sort is required. A copy of that policy meets the journal's need to adhere to international publishing standards as described by theICMJE.

If the editorial staff determines that human or animal derived data was used to craft your manuscript, and no evidence of proper oversight is submitted, the journal will not accept the manuscript for review.
In addition, if the manuscript is a randomized, controlled clinical trial, registration of the trial with a public registry is required. A link to that registry must be provided **WITH** the submission.

All manuscripts are subject to plagiarism checks. Plagiarized article will be rejected without any option to resubmit. The decision of the Editor will be final in all cases – no appeals will be considered.

The Allentrack system will convert the files you submit into pdf files for the ease of electronic sharing. One of the steps of conversion is to merge all the files together, this step can take anywhere from 10 minutes to three hours depending upon the complexity of the paper. PLEASE allow the computer time to do this conversion before contacting our office reporting problems with the system; in almost all of the cases, patience will fix the problem.
All submitted manuscripts will be subject to the possibility of online only publication on our online journal site: www.jopdentonline.org. These e-pub articles will be paginated with an "e" prefix and will carry a fully citable DOI number. If you are not interested in the possibility of having your paper published online only, please do not submit your manuscript to us. Your authorization to allow us to e-publish will help us to publish manuscripts even faster than we have in the past. Our goal is to have a manuscript through the review process (submission to acceptance) in 2 months and from acceptance to publication within 6 months. Please feel free to send any questions about this policy to editor@jopdent.org.
We will need your text file (original word processing file in Word) in order to size your manuscript accurately. Our system will automatically merge the text file that you upload with the figure and table files, to make one article file PDF. This allows editors and reviewers to view and/or download your manuscript in one easy step. If any of your figures are illegible, or the figure sizes are too large or small (see below), your submission will be returned to you so that you can fix these problems. Your manuscript will only be considered officially submitted after it has been approved through our initial quality control check, and these problems (if any) 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 subject to removal from the server. You are still able to submit the

manuscript, but you must start from the beginning. Please be sure that you have all items listed below before you start the submission process.

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Before submitting a manuscript, please gather the following information:

- All Authors' First Names, Middle Names/Initials, Last Names
  - Author Degrees, and Current Institution information, Postal Addresses, Work Telephone Numbers
  - E-mail Addresses
- Title and Running Title (you can cut and paste this from your manuscript). Running title: This is simply a shorter version of the title used on following pages and in our database for reports, etc.
- Clinical Relevance Statement. This is required to submit and should appear in both the manuscript data field when entering initial info, as well as being part of the manuscript text document.
- Abstract (you can cut and paste this from your manuscript).
- Manuscript files and Tables in a .doc or .docx format. (Please include your abstract and figure captions in the text file.)

• References must be numbered (superscripted Arabic numerals...1, 2, 3 etc.) consecutively as they appear in the text and, where applicable, they should appear after punctuation. For examples, refer to the “Instructions to Authors” page at www.jopdent.org.

• For printing purposes, we require that your figure files be in TIFF, or JPG formats and be uploaded separately as source files, not PDF files. You may not embed the figures, graphs or tables in the manuscript.

The manuscript text must not contain any author identifying information, no names and addresses, no acknowledgements, no ethics board information, etc. These items are entered separately during the process, and will be merged into the final document by the computer. Any manuscripts with identifying information in the main manuscript file will be sent back to the author for correction. Remember, our peer review is double blind in order to provide our readers with the highest quality data possible.

A complete guide to manuscript requirements is available in our policy manual under "manuscript Submission" here, or by going to https://www.jopdent.com/journal/policies.pdf

Current as of: 3-Sep-14

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Mission:

Operative Dentistry, Inc. is committed to providing current, relevant, peer reviewed articles and other educational opportunities that advance the practice of restorative dentistry to practicing general and restorative dentists.

The scope of our offerings to the dental community is based on a scientific foundation and includes:
disease prevention;
conservation of tooth structure;
biomaterials and their application in the restoration of teeth;
interdisciplinary interactions;
dental education;
and the social, political, and economic aspects of dental practice.

Current as of: 3-Sep-14

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Issue two	15 Mar. – 15 Apr.	30 Mar. – 30 May
Issue three	15 May – 15 Jun.	30 May – 30 Jul.
Issue four	15 Jul. – 15 Aug.	30 Jul. – 30 Sep.
Issue five	15 Sep. – 15 Oct.	30 Sep. – 30 Nov.
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Operative Dentistry is the official journal for the following Dental Academies:

Academy of Operative Dentistry (AOD)
Academy of R V Tucker Study Clubs (ARVTSC)
& American Academy of Gold Foil Operators (AAGFO)

It is the position of Operative Dentistry, Inc. that each academy is unique and offers its members exclusive benefits, and, as such, each academy is served equally regardless of member numbers or length of time as parent academies to the journal.

Subscription monies paid by the academy to the journal are paid as a benefit to the Academy member by the Academy. The money that is collected by the academy then is, by definition, a part of the academy dues, and not an "add on", or selectable option of membership.

Members that belong to more than one of our parent academies are required to pay their full dues to each academy for which they desire membership. As a benefit to these individuals, although not stated in any by-laws or policies, money received from these individuals will be handled in the following manner and order:

- The additional credited money can go toward a gift subscription to an individual of the subscriber's choosing, or
- The additional funds can be donated to the general funds of the journal to help keep all member costs low, or
- If no direction is given, then the additional money will be returned to the member (upon receipt of the second set of funds).

Members of the listed academies receive their subscriptions for less than the cost of publication. A discount on various OpDent offerings may be offered during the AOD, ARVTSC or AAGFO Annual Meetings. These discounts are valid only at the meetings.

For purposes of subscription, OpDent considers the date that OpDent received the subscription monies from the academy as the date of subscription, and not the date when the dues were sent to the academy. This means that members who did not get their annual dues into their academy by the official date set by the individual academy run the risk of subscription monies being sent to the journal offices late, thereby missing the mailing date of a particular issue.

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As the Publication and Education arm of the Academies, we are willing and able to assist the academies and their official clubs with any endeavor pertaining to these areas. Fees, if any, will be negotiated with the requesting unit.

Continuing Dental Education

Goals

1. To recognize and encourage dental professionals who give of their time and talents to provide the dental community with current and relevant dental literature.
    a. Provide appropriate CE units to authors of peer-reviewed manuscripts accepted by the Editorial Staff of Operative Dentistry.
    b. Provide 2 units of CE Credit to the reviewers of manuscripts which are within the scope of, and are deemed to have relevance by the Editor of, Operative Dentistry.
    c. Provide feedback to both authors and reviewers of reviewed manuscripts
        i. Authors receive the comments of two different reviewers
        ii. Authors receive the comments (if any) of the Editor
        iii. Reviewers receive the comments of each other relating to the manuscript
        iv. Reviewers receive the comments and justifications from the authors regarding the review comments made, upon receipt of a revised manuscript (if revisions have been requested by the Editor)

2. To support the Parent Academies of Operative Dentistry in their pursuit of dental education by providing an administrative infrastructure that allows each Academy to focus on the practice of dentistry.
    a. Provide CDE administrative support by maintaining ADA CERP recognition.
        i. Offer Joint Sponsorship opportunities to the Academies for their annual meetings.
        ii. Offer Joint Sponsorship opportunities to the Study Clubs affiliated with the Academies for their monthly study/clinical meetings.
    b. Maintain high standards of planning and feedback to the Academies relating to their annual meetings.
        i. Provide a continuous dialog relating to the needs, requirements and guidelines of the ADA CERP recognition program as it relates to the planning, publicity and execution of each academy's annual meeting agenda.
        ii. Provide anonymous aggregated feedback to the Academy Executive Board, and to each presenter/instructor involved in the joint-sponsored meetings, of the responses of the participants in each activity for the purpose of gauging interest for future presentations/activities as well as for consideration by the presenters/instructors of the effectiveness of their presentation/activity.

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Operative Dentistry, Inc. we will always publish the number of CDE credit units that will be offered.

Concerns or complaints about OpDent as a CE provider may be directed to the OpDent Offices at editor@iopdent.org or to ADA CERP at ADA.org/cerp.

Joint Sponsorship Opportunities

OpDent is willing to act as joint sponsor to those organizations who would like to offer quality Continuing Dental Education, but do not have the means to become accredited themselves. The rules and regulations for this joint sponsorship, as well as any fees for the service can be found at www.iopdent.org/CDE. We especially welcome our parent academies to make use of this accreditation. We are willing to provide special assistance to the Academy Affiliated Study Clubs via an umbrella contract with the parent Academy.

Copyright

OpDent requires authors of submitted manuscripts to release their claim of copyright to Operative Dentistry, Inc. OpDent provides published authors with access to their final pdf format article. The acceptance letter sent to the author licenses the author to make unlimited prints of the article, but prohibits them from sharing the electronic file.

OpDent allows authors to place a copy of the electronic version of their article on their own professional website so long as copyright statement #2 is included prominently on the page. Posting to an institutional repository is also permitted if such posting is required by institutional policy or by funding contracts/stipulations. Repository posting requires that the author inform OpDent of the postings and provide a working URL to the article (see "author rights").

Manuscript submission

General Requirements

Operative Dentistry requires electronic submission of all manuscripts. All submissions must be sent to Operative Dentistry using the Allen Track upload site. A mandatory and nonrefundable $25.00 fee is required at submission. Your manuscript will only be considered officially submitted after it has been approved through our initial quality control check, and any quality problems have been resolved. 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 may 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 body MUST NOT include any:
  - Author identifying information such as:
    - Authors names or titles
    - Acknowledgements
    - Correspondence information
    - Response to reviewer files should also NOT include any author identifying information, such as a signature at the end, etc.
  - 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 and sizes.
- All other manuscript types use this template, with the appropriate changes as listed below.

Complete the online form (which includes complete author information, copyright release and conflict of interest), 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.

Important 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.
    - Manuscripts that are rejected before peer-review for English correction should be entered as a new manuscript upon resubmission. In the manuscript comments box the comment, "this is a resubmission of manuscript number XX-XXX" should be noted.
    - Manuscripts that are rejected after peer-review are not eligible for resubmission.
    - Manuscripts that have major revisions requested (i.e. For English correction) are entered as a resubmission of the original article.
- 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 upon acceptance through quality control. This may take up to 7 days. If you do not receive such an acknowledgement, please check your author homepage at http://iopdent.allentrack.net if the paper does not appear there please resend 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 and/or .doc(x) files.

Current as of: 3-Sep-14

Manuscript Type Requirements

All Manuscripts

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.

AUTHOR INFORMATION must include:

- full name of all authors
- complete mailing address for each author
- valid email address for each author
- degrees (e.g. DDS, DMD, PhD)
- affiliation (e.g. Department of Dental Materials, School of Dentistry, University of Michigan)

MENTION OF COMMERCIAL PRODUCTS/EQUIPMENT must include:

- full name of product
- full name of manufacturer
- city, state and country of manufacturer

MANUSCRIPTS must be provided as Word for Windows files. Files with the .doc and .docx extensions are accepted.

TABLES may be submitted as either Word (.doc and .docx) or Excel (.xls and .xlsx) files. All tables must be legible, with fonts being no smaller than 7 points. Tables have the following size limitations: In profile view a table must be no larger than 7 x 9 inches; landscape tables should be no wider than 7 inches. It is the Editor's preference that tables not need to be rotated in order to be printed, as it interrupts the reader's flow.

ILLUSTRATIONS, GRAPHS AND FIGURES must be provided as TIFF or high resolution JPEG files with the following parameters:

- line art (and tables that are submitted as a graphic) must be sized with the short edge being no shorter than 5 inches. It should have a minimum resolution of 600 dpi and a maximum resolution of

1200 dpi. This means the shortest side should be no smaller than 3000 pixels.

- **gray scale/black & white figures** must be sized with the short edge being no shorter than 5 inches. It should have a minimum resolution of 300 dpi and a maximum of 400 dpi. This means the shortest side should be no smaller than 1500 pixels.
- **color figures and photographs** must be sized with the short edge being no shorter than 3.5 inches. It should have a minimum resolution of 300 dpi and a maximum of 400 dpi. This means that the shortest side should be no smaller than 1050 pixels.

Other Manuscript Type – Additional Requirements

CLINICAL TECHNIQUE/CASE STUDY MANUSCRIPTS must include as part of the narrative:

- a running (short) title
- purpose
- description of technique
- list of materials used
- potential problems
- summary of advantages and disadvantages
- references (see below)

LITERATURE AND BOOK REVIEW MANUSCRIPTS must include as part of the narrative:

- 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 and will not be published
- references (see below)

References

Current as of: 3-Sep-14

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.
9. References that contain Crossref.org's DOIs (Digital Object Identifiers) should always be displayed at the end of the reference as permanent URLs. The prefix http://dx.doi.org/ can be appended to the listed DOI to create this URL. i.e. http://dx.doi.org/10.1006/jmbi.1995.0238

Reference Style Guide

- 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
- Journal Article with DOI: SA Feierabend, J Matt & B Klaiber (2011) A Comparison of Conventional and New Rubber Dam Systems in Dental Practice. *Operative Dentistry* 36(3) 243-250, http://dx.doi.org/10.2341/09-283-C

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Author acceptance letters give the right to the author to make unlimited prints of the manuscript. Authors may not share the electronic file. Those authors who are required to post a copy of their manuscript to a University, or Government repository due to professional or funding contract stipulations, may do so after receipt of the article as stated above; and after notifying Operative Dentistry, Inc. (at editor@jopdent.org) of their intent to post, and to what repository it will be posted, as well as the URL at which it will appear. Authors may post their articles to their own professional website as well. Any electronic postings should contain the appropriate copyright statements as listed in this manual (under "copyright").

Reviewers and the Reviewer Board

The list of current Reviewer Board Members will be printed in issue 6 of each volume in a manner that will allow the reviewer to remove the pages for use in professional folders.

Reviewer Board members serve as the primary source for peer review of submitted manuscripts, and are invaluable to us. In order to be as efficient as possible for everyone, Reviewers are required to update the online review system with current email address, areas of interest, and dates when unavailable for review. Every effort is made to limit review requests of new manuscripts. It will be assumed that members who repeatedly fail to respond with acceptance or regrets to requests for review will be removed from the Reviewer Board. Should a reviewer's circumstance change to where they are no longer able or willing to review, we request that a notice be sent to our offices at editor@jopdent.org.

Reviewer Board Members can expect to be asked to review to completion no more than 6 (original) manuscripts a year, and to participate in the annual Reviewer

Board Meeting, whether in person, or by proxy. The following items apply to all reviewers for Operative Dentistry:

- Jopdent must have a CV and current email address on file – the CV is due by the last day of September in the year in which the reviewer completed a review (in order to be recognized in issue 6). It should be updated by the reviewer upon any significant change.
- To be considered for the RB, a reviewer must have 3 or more published articles in internationally recognized journals in which the reviewer was either a corresponding author or 1st author on at least one article.
- A reviewer with "no response" for every request made in a calendar year will be dropped from the RB.
- A reviewer who completed 0 reviews in a calendar year citing, "time constraints" will be removed from the Reviewer Board. Inopportune requests can be prevented by having reviewer availability dates current.
- A reviewer who cites, "conflict of interest" to either decline or withdraw from a review will not be charged for a declined review.

Conflicts of Interest

OpDent believes in the free market and that it is in the best interest of the profession for the market to give back generously to those groups who promote continuing education of those professionals. There must be clear guidelines and expectations however, so that the goodwill and generosity of the Market do not taint the educational activities with bias, real or imagined. To this end we have adopted the following policies and guidelines.

Commercialism

To those who advertise in any medium at any activity where Operative Dentistry, Inc. is acting as the administrative authority for continuing education, whether as sole authority, or in joint sponsorship, the following guidelines must be observed:

1. Program topic selection will be based on perceived needs for professional information and not for the purpose of endorsing specific commercial drugs, materials, products, treatments, or services.
2. Funds received from commercial sources in support of any educational programs shall be unrestricted and the planning committee of said program shall retain exclusive rights regarding selection of presenters, instructional materials, program content and format, etc.
3. Promotional material or other sales activities are not allowed in the area of instruction, neither in the lecture hall/operatory nor in close proximity to the doors of said areas.

Commercial Support

To those who **provide monetary support** for any activity where Operative Dentistry, Inc. is acting as the administrative authority for continuing education, whether as sole authority, or in joint sponsorship, the following guidelines must be observed:

1. Program topic selection will be based on perceived needs for professional information and not for the purpose of endorsing specific commercial drugs, materials, products, treatments, or services.
2. Funds received from commercial sources in support of any educational programs shall be unrestricted and the planning committee of said program shall retain exclusive rights regarding selection of presenters, instructional materials, program content and format, etc.
3. Any and all commercial support received shall be acknowledged in program announcements, brochures, and in the on-site program book. This announcement may not be located on any page, or facing page, of the book announcing program speakers, or program evaluations.
4. Commercial support shall be limited to:
    a. The payment of reasonable honoraria;
    b. Reimbursement of presenters' out-of-pocket expenses; and

c. The payment of the cost of modest meals or social events held as part of an educational activity.

5. When the Provider supports presenters, support shall be limited to:
   a. The payment of reasonable honoraria; and
   b. Reimbursement of presenters' out-of-pocket expenses.

Full Disclosure

To those who present at any activity where Operative Dentistry, Inc. is acting as the administrative authority for continuing education, whether as sole authority, or in joint sponsorship, the following guidelines must be observed:

1. All presentations should promote improvements in oral healthcare and not specific drugs, devices, services, or techniques.
2. Any media shown to the participants should be free from advertising, trade names, or product messages (except as applies in guideline #3).
3. Presenters shall avoid recommending or mentioning any specific product by its trade name, using generic terms whenever possible. When reference is made to a specific product by its trade name, reference shall also be made to competitive products.

Conflict of Interest

A Conflict of interest may be considered to exist if a presenter, author or reviewer for an OpDent CDE activity is directly affiliated with or has a direct financial interest in any organization(s) that may be co-supporting a course/manuscript, or may have a direct interest in the subject matter of the presentation/manuscript.

The intent of this policy is not to prevent a speaker with an affiliation or financial interest from making a presentation, or submitting a manuscript. It is intended that any potential conflict be identified openly so that the participants in the CDE have the full disclosure of the facts so that they may form their own judgments about the presentation/manuscript.

Current as of: 3-Sep-14

To those who participate at any activity where Operative Dentistry, Inc. is acting as the administrative authority for continuing education, whether as sole authority, or in joint sponsorship, the following guidelines should be understood:

Presenter

Speakers/presenters at any CE activity will be required to disclose any potential bias towards commercial supporters, or any other commercial entity that will be mentioned in their presentation.

Author

Authors of every accepted manuscript will be required to disclose any potential bias towards commercial supporters, or any other commercial entity that will be mentioned in their manuscript.

Reviewer

Reviewers of manuscripts will be required to disclose any potential bias towards commercial supporters, or any other commercial entity that is mentioned in the manuscripts they are asked to review. Should a conflict arise, the reviewer is obligated to withdraw themselves as reviewers of the manuscript, and OpDent will select a new reviewer.

Faculty Posting:

Faculty postings are available from OpDent for a $175.00USD flat fee which covers up to 250 words and free logo placement if one is provided. Each additional 50 words is charged at $50.00USD per unit, and each additional issue for which you would like the posting to run is charged at $50.00USD as well.

OpDent reserves the right to refuse any posting.