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CAPACIDADE DE REMOÇÃO E SUSCEPTIBILIDADE AO REMANCHAMENTO DO ESMALTE APÓS CLAREAMENTO CASEIRO E ESCOVAÇÃO SIMULADA

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Dissertação apresentada ao Programa de Pós-graduação em Odontologia da Pontifícia Universidade Católica do Paraná, como parte dos requisitos para obtenção do título de Mestre em Odontologia, Área de Concentração Dentística.

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SUMÁRIO

1. ARTIGO EM PORTUGUES

1.1. PÁGINA TÍTULO

Titulo: Capacidade de remoção e susceptibilidade ao remanchamento do esmalte após clareamento caseiro e escovação simulada

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1.2. RESUMO

Objetivo: O objetivo deste estudo foi avaliar a capacidade de remoção de manchamento por clareamento dental e escovação dental simulada e a susceptibilidade ao remanchamento do esmalte bovino manchado com café e cigarro. Métodos: Quarenta superfícies vestibulares de esmalte bovino tiveram sua cor inicial analisada (baseline) e as coordenadas L* a* b* determinadas através do espectrofotômetro. Metade dos espécimes foram imersos em café por 72 h (CA) e a outra metade exposta à fumaça de cigarro (CI), por 4 ciclos de 10 minutos, em máquina de fumaça. Uma nova leitura de cor foi realizada e ΔE1 foi determinado para cada um dos grupos. As amostras foram divididas em dois subgrupos e submetidas ao clareamento dental caseiro (CL - 1h/dia, 21 dias) ou escovação simulada (ES - 120 ciclos/dia, 21 dias), seguido de nova leitura de cor (ΔE2). Ambos os procedimentos de manchamento foram repetidos, seguidos de uma nova leitura de cor (ΔE3). Os dados foram analisados por ANOVA e Teste Tukey (α=5%). Resultados: Ambos os pigmentos resultaram em ΔE1 similares. Os espécimes manchados com CA e CI apresentaram redução significante na alteração de cor após CL ($p<0,05$). Porém, a ES reduziu significantemente a alteração de cor apenas para CI ($p=0,0001$). Os espécimes submetidos ao manchamento com CA apresentaram maior remanchamento, independente do método de remoção ($p<0,05$). Conclusões: O clareamento dental caseiro (CL) foi capaz de remover tanto o manchamento por café quanto por cigarro. Independente do método de remoção, o café demonstrou maior poder de remanchamento que o cigarro.

Significância Clínica: O clareamento dental com peróxido de hidrogênio em baixa concentração foi capaz de remover o manchamento causado tanto por cigarro quanto café. Contudo, a manutenção do hábito de consumo frequente de café pode aumentar a susceptibilidade ao remanchamento do esmalte.

Palavras-chave: manchamento dental, café, fumaça de cigarro, clareamento dental, escovação dental.

1.3. INTRODUÇÃO

Nas últimas décadas, a aparência dos dentes tem sido de grande importância tanto para pacientes quanto para dentistas. O anseio para ter dentes brancos tem levado dentistas a atender as expectativas de seus pacientes na busca de um sorriso estético. Os manchamentos dentários têm sido classificados de acordo com a sua localização em intrínsecos ou extrínsecos.[1] Manchamentos intrínsecos resultam da incorporação de materiais pigmentantes no interior do tecido dentário, com causas localizadas ou generalizadas. O manchamento localizado pode ser causado por necrose e hemorragia pulpar, infecção periapical de dente decíduo, tratamento endodôntico inadequado, e manchamento por amálgama.[2] Os manchamentos intrínsecos generalizados são resultantes de fatores ambientais ou gerais como a fluorose dental, tetraciclina, doenças da infância, e doenças hereditárias que afetam as estruturas dentais, como amelogênese e dentinogênese imperfeita.[2,3]

Os manchamentos extrínsecos têm uma etiologia considerada multifatorial. Cromógenos derivados de hábitos alimentares como café, chá, vinho tinto, suco de laranja, alguns refrigerantes e corantes de alimentos são considerados agentes pigmentantes que levam ao manchamento extrínseco quando ingeridos com frequência.[4] Também, a exposição ocupacional a produtos químicos, o tabagismo e a mastigação de tabaco, além do uso frequente de enxaguatórios bucais e medicamentos, são relatados na literatura como fatores etiológicos de manchamentos dentários.[1,2,5]

Previamente ao tratamento, o histórico médico-dental do paciente deve ser investigado e um exame clínico deve ser realizado com o objetivo de identificar o fator etiológico do manchamento dentário. Adicionalmente, os

dentes devem ser examinados quanto à posição e distribuição da mancha, presença de defeitos no esmalte, cárie e restaurações, assim como o nível de higiene bucal do paciente.[3]

Algumas manchas extrínsecas podem ser parcialmente ou totalmente removidas por meio de escovação dentária com dentifrício, profilaxia profissional e polimento do esmalte.[2] Entretanto, quando esses tratamentos não são bem sucedidos, o clareamento dental é uma abordagem conservadora amplamente utilizada para a remoção de manchamentos persistentes.[6] O clareamento dental caseiro, introduzido por Haywood e Heymann,[7] é considerado um método seguro e eficiente e tem sido o tratamento clareador mais comumente utilizado nas últimas décadas.[8] A técnica original foi modificada e aperfeiçoada ao longo do tempo com o desenvolvimento de diferentes concentrações de peróxido de carbamida, com a introdução de agentes a base de peróxido de hidrogênio e a recomendação da redução do tempo de uso.

A literatura atual é escassa quanto à indicação e a eficácia das diferentes técnicas de remoção de manchas extrínsecas para os diferentes fatores etilógicos. Da mesma forma, a susceptibilidade ao remanchamento quando o hábito não é removido é um aspecto pouco investigado cientificamente.

As hipóteses investigadas neste estudo foram as de que (a) o clareamento dental e a escovação dentária seriam igualmente capazes de remover as manchas provocadas tanto por cigarro quanto por café, (b) ambos os tratamentos de remoção não influenciariam na susceptibilidade ao remanchamento do esmalte.

Desta forma, o objetivo deste estudo foi avaliar a capacidade de remoção de manchamento extrínseco provocado por café e cigarro por meio de um tratamento químico (clareamento caseiro) e tratamento mecânico (escovação dentária) e determinar a susceptibilidade ao remanchamento dos dentes após os tratamentos de remoção.

1.4. MATERIAIS E MÉTODOS

Preparo dos espécimes e medida da cor inicial (baseline)

Quarenta incisivos superiores bovinos foram extraídos e armazenados em solução de timol 0,2% a 4ºC antes da utilização. As coroas foram seccionadas para a separação das superfícies vestibulares e obtenção de blocos de esmalte com dimensão de 7 mm × 7 mm utilizando um disco diamantado de dupla face (# 7016, KG Sorensen, Cotia, SP, Brasil) em baixa-rotação sob refrigeração com água. A espessura dos espécimes foi igual à espessura total de esmalte e dentina a partir da superfície vestibular até a câmara pulpar para facilitar a retenção. Os espécimes foram embebidos em resina epóxi utilizando anéis de cloreto de polivinila (PVC) de 25 mm de diâmetro, de forma que pelo menos 2 mm de estrutura dentária ficasse exposta acima da superfície da resina. Os espécimes foram regularizados com lixas de SiC de granulação #600 e #800 e polidos com lixas de granulação #1200 sob água corrente em uma politriz rotatória (Labopol 21, Struers A/S, Ballerup, Dinamarca). Os espécimes foram limpos em banho de ultra-som com água destilada durante 10 minutos. A dentina subjacente ao esmalte exposto foi selada com resina composta (Filtek Supreme XT, 3M ESPE, St. Paul, MN, EUA) usada em associação ao condicionamento com ácido fosfórico 35% por 15 segundos e aplicação de sistema adesivo de dois passos (Adper Single Bond, 3M ESPE, St Paul, MN, EUA), a fim de evitar a difusão dos agentes pigmentantes através da dentina exposta.

A medida de cor inicial foi realizada empregando um espectrofotômetro portátil com uma ponteira de 6 mm de diâmetro (VITA Easyshade, VITA, Bad

Säckingen, Alemanha). As leituras de cor foram realizadas de acordo com o Sistema CIEL*a*b* contra um fundo branco. A ponta do colorímetro foi colocada perpendicularmente e em pleno contato com a superfície dos espécimes e as leituras foram realizadas em triplicata, na mesma sala, mesma iluminação e mesmo operador.

Procedimentos de manchamento

Os espécimes preparados foram divididos em dois grupos com 20 espécimes cada. O primeiro grupo foi submetido ao manchamento com café. Uma solução de café foi preparada com pó de café instantâneo (Nescafé Classico, Nestlé, Vevey, Suíça) de acordo com a concentração sugerida pelo fabricante, ou seja, 6 g do pó dissolvidos em 300 mL de água fervente. Os espécimes ficaram totalmente imersos em solução de café durante 72 horas a 37ºC, com trocas diárias da solução.

Os outros 20 espécimes foram submetidos ao processo de manchamento em uma máquina de fumaça de cigarro. Os espécimes foram posicionados na base de um pote de vidro com tampa perfurada para a entrada de dois tubos de silicone para dentro do pote. Um dos tubos ligava o pote a um compressor a vácuo e o outro a uma placa com entrada para cinco cigarros[9] (Fig 1). Com o dispositivo montado, uma pressão negativa (aproximadamente 20 mm Hg; 1 mm Hg = 133 Pa) foi aplicada e os cigarros foram queimados gerando fumaça automaticamente dentro do pote.[10] Todos os cigarros (Marlboro, Phillip Morris, Richmond, VA, EUA) foram queimados até uma medida de 10 mm aquém do filtro de papel. Os espécimes foram expostos a

fumaça de cigarro e o pote permaneceu saturado pela fumaça por 10 minutos.[6] Este ciclo foi repetido quatro vezes, seguindo os mesmos padrões.

As mudanças de cor (ΔE1) foram determinadas calculando a diferença dos valores de L*a*b* da medida inicial (*baseline*) e após os procedimentos de manchamento com café e fumaça de cigarro.

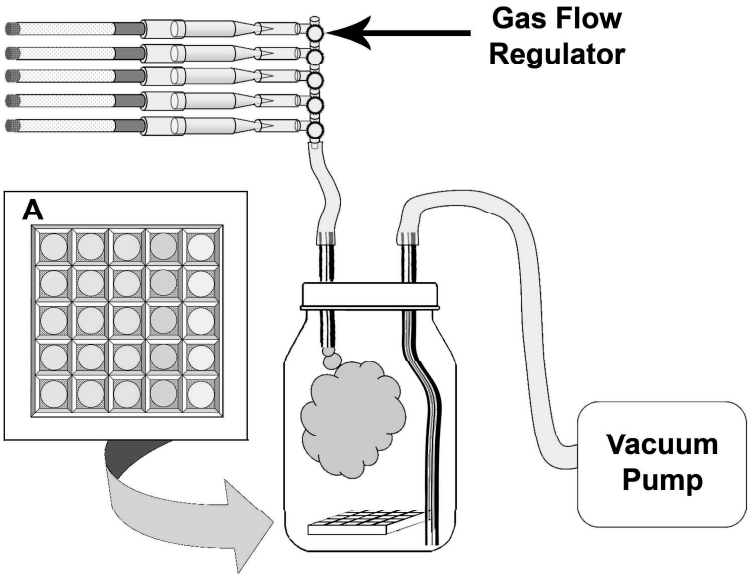

Figura 1: Desenho esquemático da máquina de exposição à fumaça de cigarro.[5]

Procedimentos de remoção de manchamento e medidas de cor

Os espécimes manchados com cada um dos métodos de manchamento (café e fumaça de cigarro) foram divididos em dois subgrupos. Metade dos espécimes foi submetida à escovação em uma máquina de escovação mecânica equipada com duas caixas de aço inoxidável com cinco porta-amostras cada. As cabeças das escovas de dente foram fixadas em dispositivos metálicos que mantinham seu longo eixo paralelo à superfície do espécime. O esmalte exposto foi submetido à ação de escovas dentais

compostas de cerdas de nylon macias (Sorriso Kolynos Original, Colgate-Palmolive Ind. Ltda., São Bernardo do Campo, SP, Brasil) associada a uma carga de 200 g.[11] Os ciclos de escovação foram realizados com uma pasta preparada imediatamente antes do teste na concentração de 2:1 de água potável e dentifrício fluoretado (MPF Colgate, Colgate-Palmolive Ind. Ltda.,São Bernardo do Campo, SP, Brasil). Cento e vinte ciclos foram realizados a cada dia, simulando 25 segundos de escovação[12], com uma freqüência de 278 ciclos/minuto, totalizando 2520 ciclos em 21 dias.

A outra metade dos espécimes foi submetida a um clareamento dental caseiro. Moldeiras de acetato foram fabricadas usando uma plastificadora à vácuo (Plastvac 7, Bioart, São Carlos, SP, Brasil), com placas de 1 mm de espessura (FGM Produtos Odontológicos, Joinville, SC, Brasil) e posicionadas sobre 10 espécimes simultaneamente. Um agente clareador composto de peróxido de hidrogênio 6% (WhiteClass 6%, FGM Produtos Odontológicos, Joinville, SC, Brasil) foi aplicado sobre a superfície do esmalte em uma camada de 1 mm de espessura. Os espécimes foram submetidos ao clareamento dental seguindo as instruções do fabricante durante 1 hora por dia, durante 21 dias, a 37℃. Após a conclusão do tratamento clarea dor, as moldeiras foram removidas e todos os espécimes foram lavados com água potável. O armazenamento foi realizado em recipiente escuro contendo saliva artificial a 37℃ ± 1℃ durante todos os intervalos do experimen to.

Novas medidas de cor (ΔE2) foram realizadas após o clareamento e escovação simulada, conforme descrito anteriormente.

Procedimentos de remanchamento e medidas de cor

Os espécimes submetidos aos procedimentos de clareamento e escovação simulada foram remanchados com o mesmo agente pigmentante (café e fumaça de cigarro) que gerou o manchamento previamente e da mesma forma já descrita anteriormente. Após os respectivos processos de manchamento, novas leituras de cor foram realizadas (ΔE3).

Análise das alterações de cor

Os valores médios de mudança de cor foram calculados para cada espécime de cada grupo em cada uma das etapas do estudo. A caracterização da diferença de cor foi obtida através do cálculo da diferença dos parâmetros individuais das coordenadas (ΔE*, Δa*, Δb*) no início (0) e após cada tratamento (1), conforme as seguintes fórmulas:

$\Delta L^* = L_1^* - L_0^*$

$\Delta a^* = a_1^* - a_0^*$

$\Delta b^* = b_1^* - b_0^*$

As diferenças de cor (ΔE*) foram calculadas através da fórmula:

$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$

Análise estatística

Os valores de alteração de cor foram submetidos a ANOVA a 2 critérios com medidas repetidas e teste de Tukey para comparações múltiplas. Em todos os casos, o nível de significância estatística foi de 5%. As análises foram realizadas utilizando os pacotes estatísticos SPSS 15.0 (SPSS Inc., Chicago, IL, EUA) e Statistica 9.0 (StatiSoft Inc., Tulsa, OK, EUA).

1.5. RESULTADOS

Foram encontradas diferenças significativas entre os agentes de manchamento e os métodos de remoção, bem como interação significante entre os fatores ($p<0,05$). A Tabela 1 mostra os valores médios e desvios-padrão dos grupos experimentais em todas os momentos de alteração de cor.

Tabela 1: Valores médios (D.P.) de alteração de cor (ΔE^*) dos grupos experimentais em todas as fases do estudo.

Agente de manchamento	*Método de remoção*	*ΔE1*	*ΔE2*	*ΔE3*
Cigarro	Clareamento	25,43 (3,36)^{A,a}	7,81 (2,63)^{A,B,b}	5,51 (2,01)^{B,b}
	Escovação	23,59 (1,95)^{A,a}	3,20 (1,85)^{B,b}	8,24 (3,49)^{B,b}
Café	Clareamento	18,88 (6,11)^{A,a}	4,31 (2,08)^{B,b}	14,51 (7,44)$^{A\,B,a}$
	Escovação	18,74 (6,37)^{A,b}	17,72 (7,11)^{A,b}	25,40 (10,90)^{A,a}

Grupos conectados pelas mesmas letras maiúsculas nas linhas e mesmas letras minúsculas nas colunas não são estatisticamente diferentes ($p>0,05$).

Os agentes pigmentantes café e fumaça de cigarro resultaram em manchamento semelhante na primeira medição de cor ($p>0,05$). Na segunda fase, a escovação mostrou redução significante no grau de manchamento apenas para os espécimes submetidos à fumaça de cigarro ($p= 0,0001$). Já o clareamento dental reduziu significantemente os valores de ΔE tanto para os espécimes manchados com cigarro quanto para os com café ($p<0,05$).

O remanchamento com cigarro não promoveu um aumento significante de alteração de cor tanto para o grupo submetido ao clareamento quanto para o submetido à escovação ($p> 0,05$). Porém, o remanchamento com café resultou em aumento da alteração de cor em ambos os grupos, independente do método de remoção ($p<0,05$). O grupo manchado com café e submetido à escovação demonstrou maiores valores de manchamento na etapa final ($\Delta E3$),

com diferenças estatisticamente significantes quando comparado aos manchados por cigarro ($p<0,05$).

1.6. DISCUSSÃO

Vários estudos têm reportado diferentes valores críticos de alteração de cor, acima dos quais esta mudança é considerada clinicamente perceptível.[13-19] O olho humano não consegue detectar valores de ΔE abaixo de 1,5, embora este valor seja mensurável por meio de um espectrofotômetro.[6] Uma pessoa treinada em reconhecimento de cor, com visão direta, pode ser capaz de detectar valores de ΔE de 1,5 a 2,5 unidades, enquanto uma pessoa com capacidade média de reconhecimento de cor pode reconhecer uma mudança de ΔE por entre 2,5 a 3,5 unidades.[14,18] Um estudo prévio[15], avaliando a alteração de cor observação visual e colorimetria, apontou que uma diferença média de cor considerada visualmente perceptível, assim como clinicamente inaceitável seria de 3,7. Valores de ΔE abaixo de 3,3 podem ser considerados clinicamente aceitáveis.[16] No presente estudo, os valores de ΔE se apresentam na faixa de 3,2 a 25,4. Assim, a mudança de cor observada no grupo submetido ao manchamento com cigarro com posterior escovação dental (ΔE 3,2) foi o único com valor considerado clinicamente aceitável.

O uso de dentes bovinos tem sido considerado uma alternativa comum em vários estudos laboratoriais sobre a avaliação da alteração de cor. [20-25] Além das questões éticas relacionadas aos dentes humanos, dentes bovinos proporcionam maior área plana, suficiente para o diâmetro da ponta de leitura do colorímetro e não difere significantemente do dente humano em termos de cor inicial.[24]

Sabe-se que fatores dietéticos podem levar ao manchamento dental extrínseco.[4] Entre outras bebidas, como chá e vinho tinto, o café tem sido relatado como um dos principais agentes de pigmentação.[6,25-27] O valor de pH

da solução desempenha um papel importante no grau de manchamento.[20] De acordo com Addy et al.[28], bebidas com baixos valores de pH são responsáveis por um aumento na pigmentação externa dos dentes. Além disso, a rugosidade inerente da superfície do esmalte, assim como a presença de fissuras e porosidades, podem contribuir para o aumento do manchamento dental por diferentes soluções.[25] Mesmo após procedimentos de polimento, que foram realizados no presente estudo a fim de garantir a padronização dos espécimes, a superfície do esmalte pode apresentar algumas irregularidades e pequenas rachaduras. Esta poderia ser uma possível razão para a maior dificuldade de remoção do manchamento promovido pelo café. Provavelmente, por estar em meio líquido, a solução de café poderia ter uma maior capacidade de difusão através desses pequenos defeitos quando comparada à fumaça de cigarro.

Um estudo prévio relatou que o tempo médio de consumo de uma xícara grande de café é de 15 minutos, e a quantidade de bebida é de 3,2 xícaras por dia. [26] No presente estudo, o tempo de 72 horas simulou o consumo da bebida por 3 meses. Este tempo se mostrou suficiente para produzir manchamento similar ao obtido pelos ciclos na máquina de fumaça de cigarro na primeira medida de alteração de cor.

O cigarro tem sido utilizado em estudos de laboratório como um agente de manchamento em materiais restauradores, utilizando uma máquina de cigarro. [5,29-31] No entanto, a susceptibilidade à pigmentação de dentes humanos ou bovinos submetidos à ação do cigarro nunca foi investigada antes. De acordo com Wasilewski et al.[5], a fumaça do cigarro é composta basicamente por ar, água, monóxido de carbono (CO) e dióxido de carbono (CO_2) e alcatrão. Durante a queima, os componentes do cigarro como alcatrão,

açúcares (sacarose, açúcar invertido e/ou xarope de milho rico em frutose), e cacau são transferidos à fumaça pelo aquecimento.[5] Provavelmente, estes componentes seriam os responsáveis pelo manchamento dos dentes devido a sua tonalidade escura e capacidade de se aderir à superfície. No entanto, o manchamento provocado pelo cigarro parece ser superficial e facilmente removido pela escovação e clareamento dental, como demonstrado pelos resultados apresentados neste estudo. Além disso, o cigarro não foi capaz de manchar mais após a escovação e o clareamento, ao contrário da imersão em café.

O peróxido de hidrogênio atua como um forte agente oxidante por meio da formação de radicais livres, moléculas de oxigênio reativas e de ânions de peróxido de hidrogênio.[32] Estas moléculas reativas atacam as cadeias longas e de cor escura, e divide-as em moléculas menores e mais claras, que se difundem para fora do dente.[33] Alterações na superfície do esmalte após procedimentos de clareamento, tais como erosões e porosidades, podem ser resultado de tempos prolongados de contato entre o agente clareador e a estrutura do esmalte.[8] Uma vez que o agente clareador utilizado neste estudo foi peróxido de hidrogênio 6%, aplicado 1h/dia, o efeito sobre a superfície do esmalte seria insignificante. Estes resultados estão de acordo com outros estudos que investigaram o gel clareador de peróxido de hidrogênio 6% e não encontraram nenhum efeito significativo sobre a microdureza e micromorfologia do esmalte.[34-36] Além disso, o efeito da saliva artificial durante o tratamento clareador durante 21 dias deve ser levado em consideração. Alguns estudos relataram o efeito remineralizante da saliva durante os protocolos de clareamento, o que pode ter reduzido significantemente as porosidades do

esmalte e, consequentemente, reduziu a sua susceptibilidade ao manchamento. [8,25,37]

Embora alguns estudos prévios tenham investigado a susceptibilidade à pigmentação do esmalte após o clareamento[21,24,25], a comparação entre clareamento e escovação como procedimentos de remoção de manchamento dental nunca foi investigado antes. Ghavamnasiri et al.[21] examinaram a susceptibilidade ao manchamento do esmalte após o clareamento com peróxido de carbamida 16% e encontraram maiores alterações de cor para os dentes que foram submetidos ao clareamento e, em seguida, submersos em solução de café por 30 minutos. No entanto, Liporoni et al.[25] relataram que o café não foi capaz de manchar a superfície do esmalte após a terapia de clareamento com peróxido de hidrogênio 35%, ao contrário da imersão em vinho tinto. No presente estudo, o clareamento dental com peróxido de hidrogênio 6% foi efetivo na redução do manchamento do esmalte para ambos os corantes. Entretanto, a susceptibilidade ao remanchamento foi mais evidente para os espécimes manchados com café do que os manchados com fumaça de cigarro.

A escovação dental demonstrou redução significante na mudança de cor apenas para os espécimes manchados com cigarro. Este resultado pode ser atribuído ao manchamento mais superficial obtido pela fumaça de cigarro. A ação do dentifrício pode ter desempenhado um papel importante na remoção de manchas extrínsecas devido à capacidade de limpeza do abrasivo carbonato de cálcio presente na composição do dentifrício utilizado. Além do tipo de abrasivo, a quantidade deste componente tem uma relação direta com a abrasividade do dentifrício e, conseqüentemente, a capacidade de remoção de

manchas.[22] No presente estudo, a seleção de um dentifrício fluoretado comum, ao invés de creme dental clareador, foi baseada na necessidade de avaliar apenas a capacidade de remoção de manchas da escovação como um hábito de higiene diária, sem qualquer efeito clareador adicional.

O manchamento com cigarro, inicialmente considerado elevado, foi removido tanto pela escovação quanto pelo clareamento caseiro e manteve esta condição mesmo após o remanchamento. Entretanto, o manchamento com café foi resistente à remoção somente com o procedimento de escovação, resultando em um efeito cumulativo após o remanchamento. Já o clareamento foi capaz de remover manchamento por café de maneira eficaz, porém os índices retornaram aos valores iniciais, demonstrando que se houver a manutenção do hábito de ingestão frequente de café, após o procedimento de clareamento, pode haver um comprometimento do resultado do tratamento.

Com base nos resultados obtidos, a primeira hipótese apresentada como premissa deste estudo foi rejeitada, pois a escovação foi menos capaz de remover as manchas de café do que o clareamento dental. Da mesma forma, a segunda hipótese foi rejeitada, pois o café influenciou mais a susceptibilidade ao remanchamento do que a fumaça de cigarro, independente do método de remoção.

1.6. CONCLUSÕES

A partir dos resultados obtidos e dentro das limitações deste estudo, foi possível concluir que:

• o clareamento caseiro foi capaz de reduzir as alterações de cor tanto após o manchamento com cigarro quanto com café. Porém, a escovação teve o mesmo efeito de remoção apenas para o esmalte manchado com cigarro;

• independentemente do método de remoção, o café resultou em maior suscetibilidade ao manchamento que o cigarro;

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2. ARTIGO EM INGLÊS

2.1. TITLE PAGE

Journal's Department: Research: Full Articles; Advances in Dental Products

Title: Effect of home bleaching and toothbrushing on coffee and cigarette smoke stain removal and color stability of enamel

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2.2. ABSTRACT

Background: The aim of the study was to evaluate the staining removal ability of dental bleaching and simulated toothbrushing and the susceptibility to restaining of bovine enamel stained with coffee and cigarette smoke. *Methods:* Forty labial bovine enamel surfaces had their initial color analyzed (baseline) and coordinates L*a*b* were determined by a spectrophotometer. Half of the specimens were immersed in coffee (CO) for 72h and other half exposed to cigarette smoke (CS) for 4 cycles, 10 minutes each, in a smoking machine. Another color measurement was carried out and ΔE1 was determinated for each group. The samples were divided in 2 subgroups and submitted to at-home dental bleaching (BL-1h/day, 21 days) or simulated toothbrushing (ST-120 cycles/day, 21 days), followed by a new color change measurement (ΔE2). Both staining procedures were repeated followed by a third color measurement (ΔE3). Data were subjected to two-way ANOVA and Tukey test (α=5%). *Results:* Both pigments resulted similar ΔE1. The specimens stained with CO and CS presented significant reduction in color change after BL ($p<0.05$). However, ST reduced significantly the color change only for CI-stained specimens ($p=0.0001$). The discoloration of the coffee-stained specimens increased despite the removal method ($p<0.05$). *Conclusion*s: At-home dental bleaching was able to remove both coffee and cigarette smoke staining. Despite the removal method, coffee staining showed more restaining potential than cigarette smoke.

Clinical Significance: 6% hydrogen peroxide at-home bleaching was effective in removal staining caused by either coffee or cigarette smoke. However, keeping the highly frequency of coffee consumption can increase the staining susceptibility of enamel.

Keywords: enamel staining, coffee, cigarette smoke, dental bleaching, toothbrushing.

2.3. INTRODUCTION

In the last decades the appearance of teeth has been of great importance for both patients and dentists. The longing for white teeth has driven dentist to meet their patients' expectations of dental esthetics. Tooth discoloration has been classified according to the location of the staining, which may be either intrinsic or extrinsic.[1] Intrinsic stains result from the incorporation of pigmented materials into the dental tissues caused by localized or generalized factors. Localized discoloration can be caused by pulpal necrosis and bleeding, infection of primary teeth, inadequate endodontic treatment and amalgam staining.[2] Generalized intrinsic discolorations are the result of environmental or generic factors, such as dental fluorosis, tetracycline, diseases of childhood, and hereditary disorders that affect the dental structures (amelogenesis and dentinogenesis imperfecta).[2,3]

Extrinsic stains have a multi-factorial etiology with chromogens derived from dietary sources or habitually placed in the mouth. Coffee, tea, red wine, orange juice, some soft drinks and food colorants are considered staining agents that lead to extrinsic tooth discoloration when consumed frequently.[4] Also, occupational exposure to chemicals, tobacco smoking and chewing, frequently use of mouth rinses and other medicaments are reported in the literature as etiologic factors of tooth discoloration.[1,2,5]

Before an immediate treatment, the dental and medical histories of the patient must be investigated and a through dental examination should be carried out in order to identify the etiology of the discoloration. Additionally, the teeth should be examined for position and distribution of the stain, presence of enamel defects, caries and restorations, and oral hygiene status.[3]

Some extrinsic stains can be partially or totally removed by toothbrushing with dentifrice, professional prophylaxis and enamel polishing.[2] However, when these treatments are not successful, dental bleaching is a conservative approach widely used for the removal of persistent tooth discolorations.[6] Nightguard vital bleaching introduced by Haywood and Heymann[7] is considered an efficient and safe method that has been the most commonly used bleaching treatment in the last decades.[8] The original technique was modified and improved over the time with the development of varying concentrations of carbamide peroxide, the introduction of hydrogen peroxide agents and the recommendation of reduced usage time.

The current literature is scarce regarding the selection and efficacy of stain removal techniques. Similarly, the susceptibility of discolored teeth when the habit that causes external staining is not removed is poorly investigated.

The hypotheses to be answered in this study are that (a) dental bleaching and toothbrushing would be equally able to remove cigarette and coffee staining, (b) both staining removal treatments would not influence the susceptibility of teeth to re-staining.

Thus, the aim of this study was to evaluate the removal ability of chemical (dental bleaching) and mechanical (toothbrushing) treatments after coffee and cigarette smoke staining and determine the restaining susceptibility after both removal techniques.

2.4. MATERIALS AND METHODS

Preparation of the specimens and baseline color measurements

Forty bovine maxillary incisors were extracted and stored in 0.2% thymol solution at 4ºC before use. The roots were sectioned using a double-faced diamond disc (#7016, KG Sorensen, Cotia, SP, Brazil) at low-speed under water cooling. The crowns were sectioned longitudinally to separate the labial surfaces of the crowns and to obtain blocks 7 mm × 7 mm in dimensions. The specimens' thickness was equal to the whole thickness of enamel and dentin from the labial surface to the pulpal chamber. The teeth were embedded in epoxy resin using polyvinyl chloride (PVC) rings 25 mm in diameter in a way that 2 mm of tooth structure were exposed above the resin surface. The specimens were flattened using #600 and #800 grit and polished using #1200 grit silicon carbide sandpaper under running water in a rotary machine (Labopol 5, Struers A/S, Ballerup, Denmark). The specimens were cleaned under ultrasound bath with distilled water during 10 min. The dentin adjacent to the exposed enamel was sealed with a composite resin (Filtek Supreme XT, 3M ESPE, St. Paul, MN, USA) used in association with 35% phosphoric acid conditioning for 15 sec and the application of a etch-and-rinse 2-step bonding system (Adper Single Bond, 3M ESPE, St. Paul, MN, USA) in order to avoid the diffusion of the staining agents into the exposed dentin.

The baseline color measurement was carried out using a portable spectrophotometer with a handpiece tip 6 mm in diameter (VITA Easyshade, VITA Zahnfabrik, Bad Säckingen, Germany). The color readings were performed according to the CIE L*a*b* System against a white background. The

tip of the colorimeter was placed perpendicularly to and in full contact with the specimen surface and the readings were carried out in triplicate, inside a room with controlled temperature and carried out by the same operator.

Staining procedures

The prepared specimens were divided in two groups of 20 specimens each. The first group was subjected to coffee staining. A coffee solution was prepared with instant coffee (Nescafe Classic, Nestle, Vevey, Switzerland) according to the manufacturer's suggested concentration, dissolving 6 g of powder coffee into 300 mL of boiling water. The specimens were totally immersed in coffee for 72 h at 37ºC with daily changes of the solution.

The other twenty specimens were subjected to a discoloration process in a cigarette smoking machine. The specimens were positioned at the bottom of a glass jar with two silicone tubes penetrating into the jar through holes in the lid. One tube was connected to a vacuum machine and the other to a linear 5-port cigarette holder[9] (Fig 1). Once the device was assembled, a negative pressure (approximately 20 mm Hg; 1 mm Hg = 133 Pa) was applied and the cigarettes were smoked generating smoke into the jar.[10] All cigarettes (Marlboro, Phillip Morris, Richmond, VA, USA) were smoked to a butt length of 10 mm before the filter tipping paper. The specimens were exposed to the main stream cigarette smoke and the jar was kept saturated with the smoke for 10 minutes. This cycle was repeated four times, following the same standards.

Color changes ($\Delta E1$) were assessed by determining the color differences between L* a* b* coordinates at baseline and after the staining procedures.

Staining removal procedures and color measurements

The stained specimens (coffee and cigarette smoke) were divided into two subgroups. One group of specimens was submitted to toothbrushing in a 1mechanical toothbrushing machine equipped with two stainless steel boxes with five sample holders each. The toothbrush heads were fixed into metallic devices that maintained their long axis parallel to the enamel surfaces. Once the specimens were positioned inside the holders the enamel surfaces were subjected to the action of toothbrushes composed by soft nylon bristles (Sorriso Kolynos Original, Colgate-Palmolive Ind. Ltda., São Bernardo do Campo, SP, Brazil) and used under load of 200g.[11] The toothbrushing cycles were carried out with a slurry prepared immediately before testing by mixing 2:1 ratio of tapped water and a fluoridated dentifrice (Colgate MFP, Colgate-Palmolive Ind. Ltda., São Bernardo do Campo, SP, Brazil). One-hundred twenty strokes were performed each day, simulating 25 sec of toothbrushing [12], at a frequency of approximately 278 strokes/min, totalizing 2520 cycles in 21 days.

The other half of specimens were submitted to simulated dental home bleaching. Thin plastic trays (1 mm) were fabricated using a vacuum-forming machine (Plastvac 7, Bio-Art, São Carlos, SP, Brazil) and seated on 10 specimens simultaneously. A bleaching agent composed by 6% hydrogen peroxide gel (WhiteClass 6%, FGM Dental Products, Joinville, SC, Brazil) was placed on the enamel surfaces in a 1mm thick layer. The specimens were subjected to dental bleaching following the manufacturer's instructions for 1h per day, during 21 days, at 37℃. After the bleachi ng treatment was completed, the night guard was removed and all the specimens were rinsed under tapped

water. The specimens were stored in dark recipients containing artificial saliva at 37℃ ± 1℃ during all the experimental intervals .

Color measurements (∆E2) were carried out after bleaching and simulated toothbrushing procedures as described previously.

Re-staining procedures and color measurements

All the specimens subjected to each removal staining method were re-stained by the same agent (coffee and cigarette smoke) in the same way previously described. After the respective staining procedures, new color readings were carried out (∆E3).

Color change analysis

Characterization of color difference was achieved by comparison of differences in individual coordinate parameters (∆L*, ∆a*, ∆b*) at baseline (0) and after each treatment (1) as follows:

$\Delta L^* = L_1^* - L_0^*$

$\Delta a^* = a_1^* - a_0^*$

$\Delta b^* = b_1^* - b_0^*$

Color differences were calculated using the formula:

$\Delta E^* = [(\Delta L^*)^2 + (\Delta a^*)^2 + (\Delta b^*)^2]^{1/2}$

Statistical analysis

The ∆E* data were submitted to repeated measures two-way ANOVA and Tukey Test for multiple comparisons. In all cases, the level of statistically significant differences was set at 0.05 (α=5%). Statistical analysis was

performed using SPSS 15.0 (SPSS Inc., Chicago, IL, USA) and Statistica 9.0 (StatiSoft Inc., Tulsa, OK, USA).

2.5. RESULTS

There were found significant differences between staining agents and removal methods, as well as significant interaction between both factors ($p<0.05$). Table 1 show the mean values and standard deviations of the experimental groups in all the color change measurements.

Cigarette smoke and coffee staining resulted in similar discoloration at the first color measurement ($p>0.05$). At the second stage, toothbrushing showed a significant reduction in color change only for the specimens stained with cigarette smoke ($p=0.0001$). Dental bleaching reduced significantly the ΔE values for both cigarette smoke and coffee stained specimens ($p<0.05$).

Re-staining with cigarette smoke did not increase significantly the color change for both bleached and brushed specimens ($p>0.05$). However, re-staining with coffee resulted in significantly more discoloration for both groups despite the removal method ($p<0.05$). The coffee-stained group subjected to toothbrushing demonstrated the highest mean of discoloration at the final stage of the experiment ($\Delta E3$), with statistically significant differences when compared to cigarette-stained groups ($p<0.05$).

2.6. DISCUSSION

Various studies have reported different thresholds of color change values above which the color change is clinically perceptible.[13-19] The human eye can usually not detect ΔE values lower than 1.5, although this value is measurable using a spectrophotometer.[6] A person trained in color recognition, under direct viewing, may be able to detect a ΔE value of 1.5 to 2.5 units, whereas a person with average color matching ability can recognize a shift in ΔE of 2.5 to 3.5 units.[14,18]. A previous study [15], evaluating color match by visual observation and colorimetry, stated that the average color difference considered visually perceptible as well as clinically unacceptable was 3.7. ΔE values below 3.3 are also considered clinically acceptable.[16] In the present study, ΔE values were in the range of 3.2 to 25.4. Thus, the color change observed in the cigarette smoke/toothbrushing group was the only discoloration that could be considered clinically acceptable.

The use of bovine teeth has been considered a common alternative in various laboratory studies on the evaluation of color changes.[20-25] Besides the ethical issues related to human teeth, bovine teeth provide higher flat areas, enough for the large diameter tip of the colorimeter handpiece, and do not differ significantly from human teeth in terms of baseline color.[24]

It is known that dietary factors lead to extrinsic tooth discoloration.[4] Among other drinks, like tea, red wine, coffee has been reported as one of the major staining agents.[6,25-27] The pH-value of the solution plays an important role in the degree of discoloration.[20] According to Addy et al.[28], low-pH beverages are responsible for an increase in dental staining. Additionally, the inherent roughness, fissures and porosities of the tooth surface may contribute to

increase staining by different solutions.[25] Even after the polishing procedures that were carried out in the present study in order to assure the standardization of the samples, the enamel surface could present some irregularities and cracks. This could be a possible reason for the unsuccessful coffee staining removal. Probably, due to its liquid form, the coffee solution would diffuse easily though these structural defects when compared to the cigarette smoke.

A previous study reported that the average time for consumption of one cup of coffee is 15 minutes, and the amount of drink is 3.2 cups per day.[26] Therefore, in the present study, 72 hours of storage time simulated consumption of the drink over 3 months. This storage time was considered sufficient to produce similar discoloration to the cigarette smoke cycling during the first color measurement.

Cigarette smoke has been used in laboratory studies as a staining agent for restorative materials using a smoking machine.[5,29-31] However, the staining susceptibility of teeth subjected to the action of cigarette smoke was never investigated before. According to Wasilewski et al.[5], cigarette smoke is composed by air, water, carbon monoxide (CO) and dioxide (CO_2) and tar. During burning, cigarette components like tar, sugars (sucrose, invert sugar and/or high fructose corn syrup) and cocoa are transferred to the smoke by heating. Probably, these components would be responsible for the discoloration of teeth due their dark shade and the ability to stick to the surface. However, this type of staining appears to be superficial and easily removed by toothbrushing and dental bleaching, as demonstrated by the results of the present study. Additionally, cigarette smoke was not able to stain more after toothbrushing and bleaching, contrarily to the coffee immersion.

Hydrogen peroxide acts as a strong oxidizing agent through the formation of free radicals, reactive oxygen molecules and hydrogen peroxide anions.[32] These reactive molecules attack long-chained, dark-colored molecules and split them into smaller, less colored molecules that diffuse out of the tooth.[33] Changes in enamel surface after bleaching procedures, such as erosions and porosities, could be a result of the extended contact time between bleaching agent and the dental structure.[8] Since the bleaching agent used in the present study was a 6% hydrogen peroxide applied for 1h/day, the effect on the enamel surface was supposed to be insignificant. These results are in agreement with other studies that investigated 6% hydrogen peroxide bleaching gel and found no significant effects on enamel microhardness and morphology.[34-36] Also, the effect of artificial saliva during the 21-days bleaching treatment has to be taken into consideration. Some studies have reported the remineralizing effect of saliva during bleaching protocols, which could reduce significantly the amount of enamel surface porosities and the susceptibility to enamel discoloration. [8,25,37]

Although some previous studies have investigated the staining susceptibility of enamel after dental bleaching[21,24,25], the comparison between dental bleaching and toothbrushing as staining removal procedures for discolorated teeth was never investigated before. Ghavamnasiri et al.[21] examined the staining susceptibility of enamel after bleaching with 16% carbamide peroxide and found greater color changes for teeth that had undergone bleaching and then immersed in coffee for 30 min. However, Liporoni et al.[25] reported that coffee was unable to stain enamel surfaces after the bleaching therapy with 35% hydrogen peroxide, contrarily to red wine immersion. In the present study, dental bleaching with 6% hydrogen peroxide

was effective in reducing enamel staining for both staining agents. However, the susceptibility of re-staining was more evident for the coffee-stained specimens than for cigarette smoke.

Toothbrushing showed a significant reduction in color change only for the specimens stained with cigarette smoke. This result might be attributable to the superficial features of this type of staining. In fact, the action of dentifrices may have played a major role in the removal of extrinsic stain due to the cleaning ability of calcium carbonate present in the dentifrice. Besides the type of abrasive, the amount of this component has a direct relation to the dentifrice abrasiveness and, consequently, to its stain removal ability.[22] In the present study, the selection for a regular fluoridated dentifrice, instead of a whitening toothpaste, was based on the need to evaluate only the stain removal ability of toothbrushing as a hygiene daily habit without any additional bleaching effect.

The cigarette smoke staining, considered initially high, was removed by both toothbrushing and home dental bleaching and kept stable even after re-staining. However, coffee staining was resistant to stain removal only by toothbrushing, resulting in a cumulative effect after re-staining. Contrarily, dental bleaching was able to remove coffee staining effectively, but the color rates returned to the initial values, demonstrating that if the frequent ingestion is maintained after dental bleaching the treatment outcome can be compromised.

On the basis of the present data, the first hypothesis set as premise of this study was rejected, because toothbrushing was less able to remove coffee staining than dental bleaching. Similarly, The second hypothesis was also rejected, since the effect of coffee in enamel staining was stronger than that of cigarette smoke, despite of the removal treatment.

2.7. CONCLUSIONS

Based on the obtained results and within the limitations of the present study, it was possible to conclude that:

- at-home dental bleaching was able to reduce color changes after both cigarette smoke and coffee staining. However, toothbrushing had the same removal effect only for cigarette-stained enamel;
- despite the removal method, coffee-stained enamel demonstrated more susceptibility to discoloration than cigarette-stained enamel.

2.8. REFERENCES

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2.9. TABLES/FIGURES

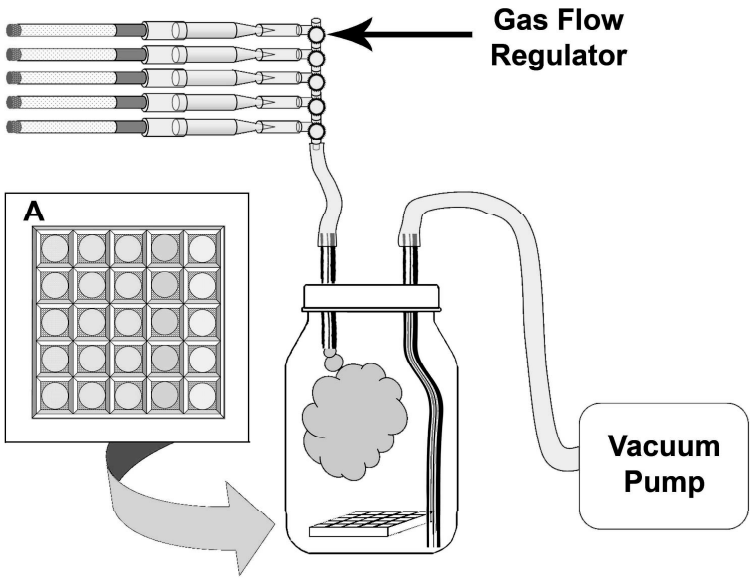


Figure 1: Schematic drawing machine smoke exposure cigarro.[5]

Table 1: Mean values (SD) of color changes (ΔE*) of the experimental groups in the three stages of the study.

Staining Agent	*Removal Method*	*ΔE1*	*ΔE2*	*ΔE3*
Cigarette	Bleaching	25.43 (3.36) ^{A,a}	7.81 (2.63) ^{AB,b}	5.51 (2.01) ^{B,b}
	Toothbrushing	23.59 (1.95) ^{A,a}	3.20 (1.85) ^{B,b}	8.24 (3.49) ^{B,b}
Coffee	Bleaching	18.88 (6.11) ^{A,a}	4.31 (2.08) ^{B,b}	14.51 (7.44) $^{A\,B,a}$
	Toothbrushing	18.74 (6.37) ^{A,b}	17.72 (7.11) ^{A,b}	25.40 (10.90) ^{A,a}

Groups connected by the same lower-case letters in lines and the same upper-case letters in columns are not statistically different (p>0.05).

3. ANEXOS

3.1. ILUSTRAÇÕES ADICIONAIS PARA MATERIAIS E MÉTODOS

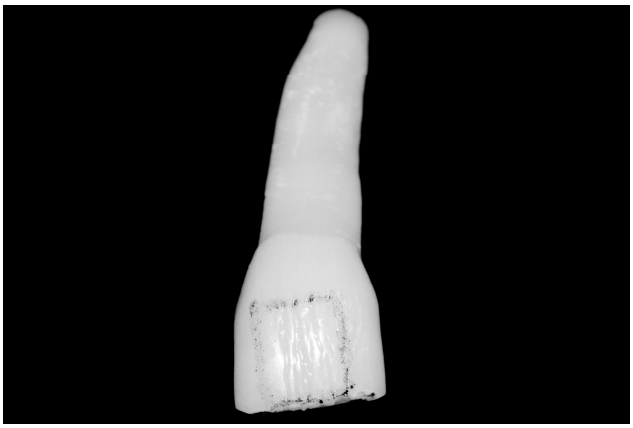


Fig. 1- Incisivo central superior bovino

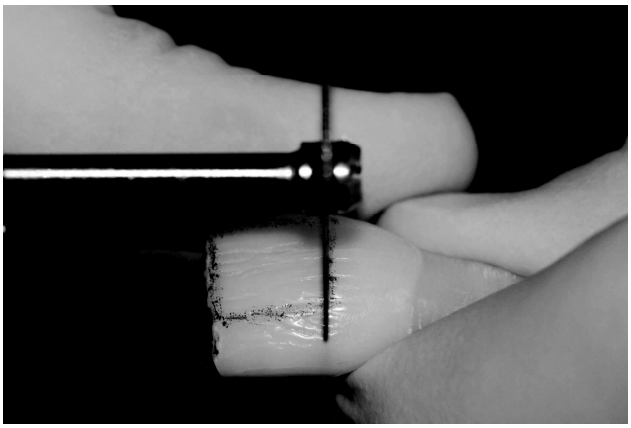


Fig.2- Secção da coroa com disco diamantado de dupla face (# 7016, KG Sorensen, Cotia, SP, Brasil)

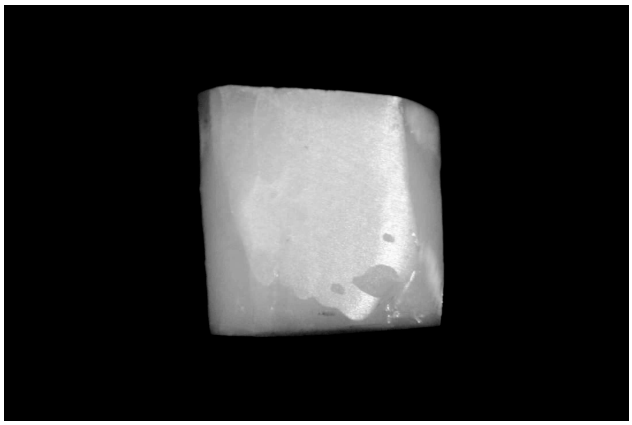


Fig.3 – Fragmento de esmalte com dimensão de 7×7mm

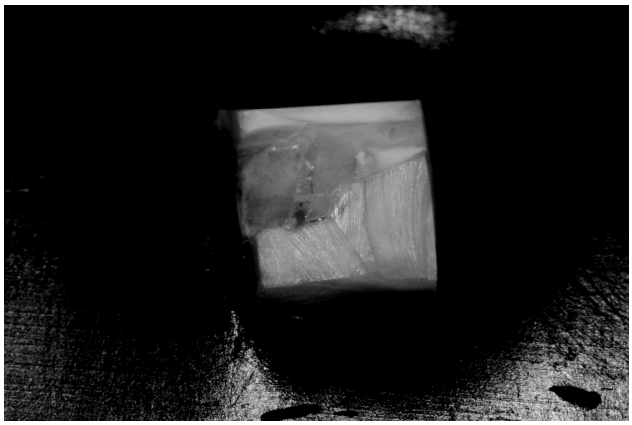


Fig.4 – Inserção do fragmento em cera utilidade nº 7

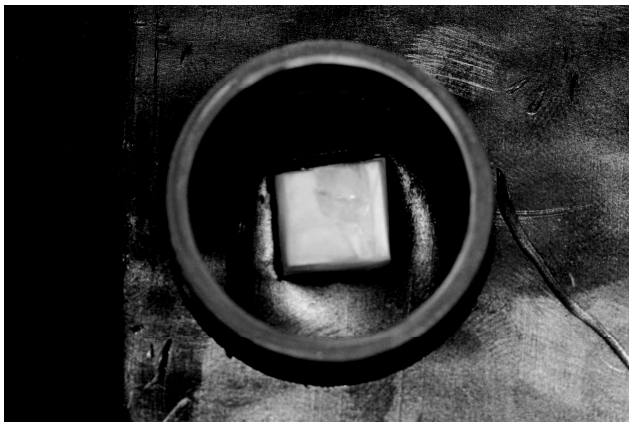


Fig.5- Posicionamento do cano de PVC com 25mm de diâmetro

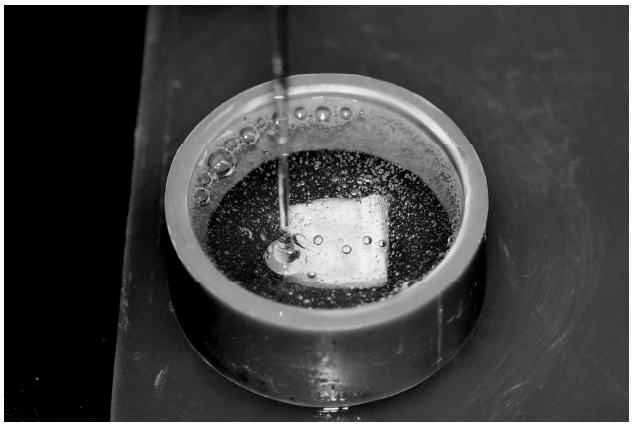


Fig.6 – Inserção de resina epóxi

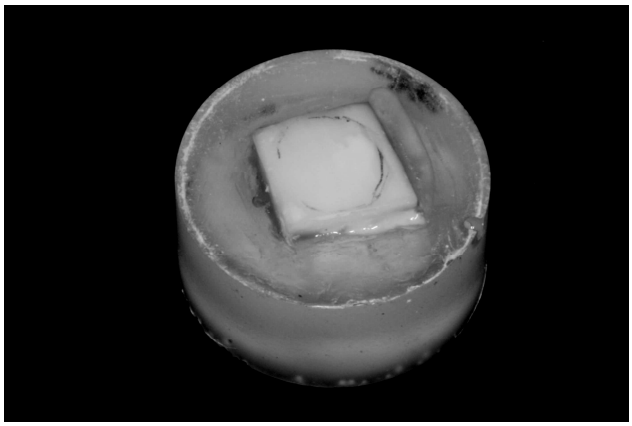


Fig.7 – Fragmento de esmalte incluído e polido com lixas d`água # 600, # 800 e #1200

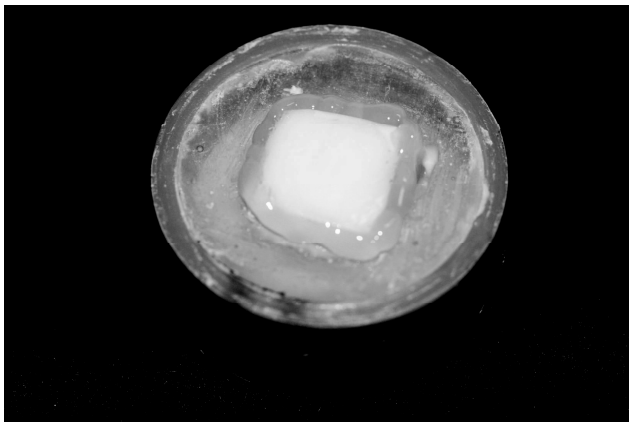


Fig. 8 – Aplicação de ácido fosfórico 37 % por 40 segundos

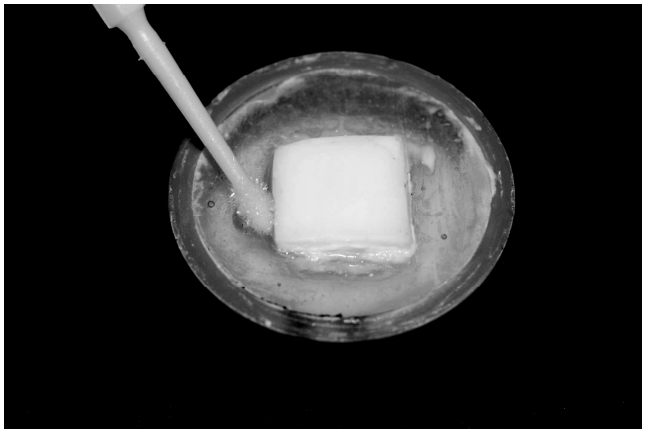


Fig. 9 – Aplicação do sistema adesivo (Adper Single Bond, 3M ESPE, St Paul, MN, EUA)

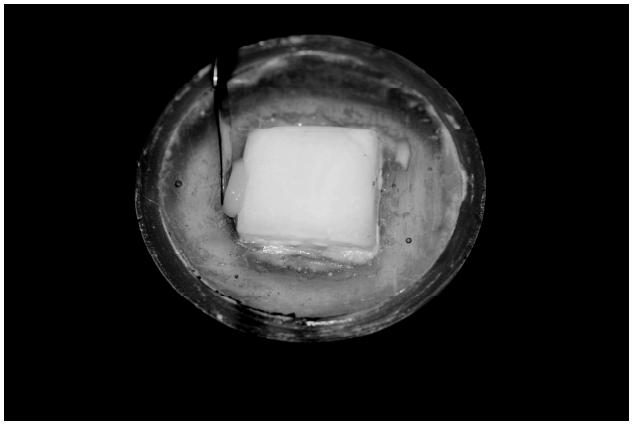


Fig.10 – Inserção de resina composta (Filtek Supreme XT, 3M ESPE, St. Paul, MN, EUA)

Fig.11 – Fotopolimerização

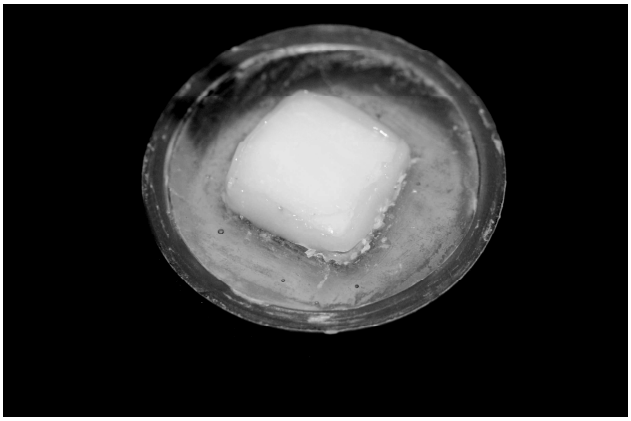


Fig.12 – Espécime selado com resina composta

Fig.13 – Tomada de cor com colorímetro (VITA Easyshade, VITA, Bad Säckingen, Alemanha).

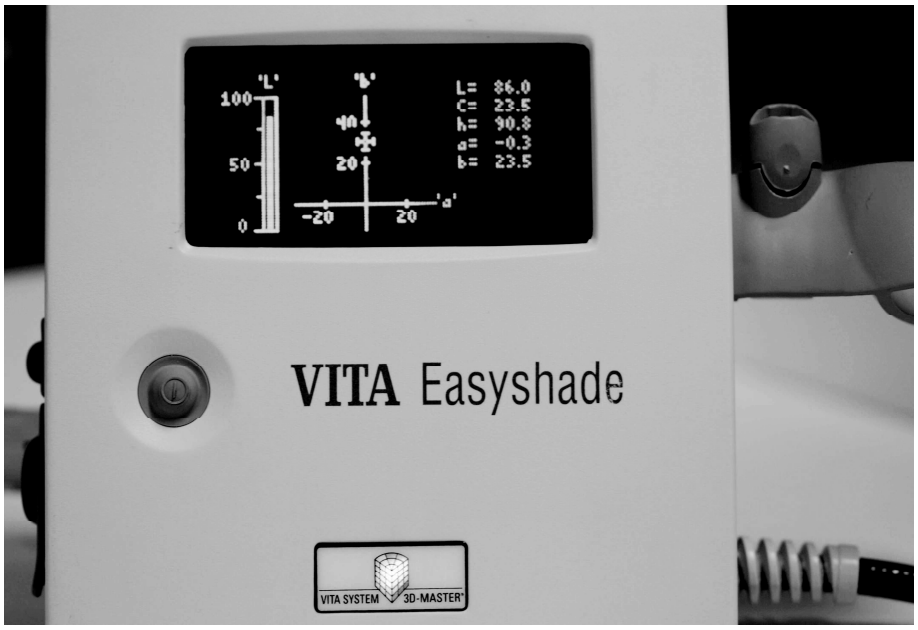


Fig.14 – Obtenção das coordenadas de cor através do sistema CIE L* a* b*

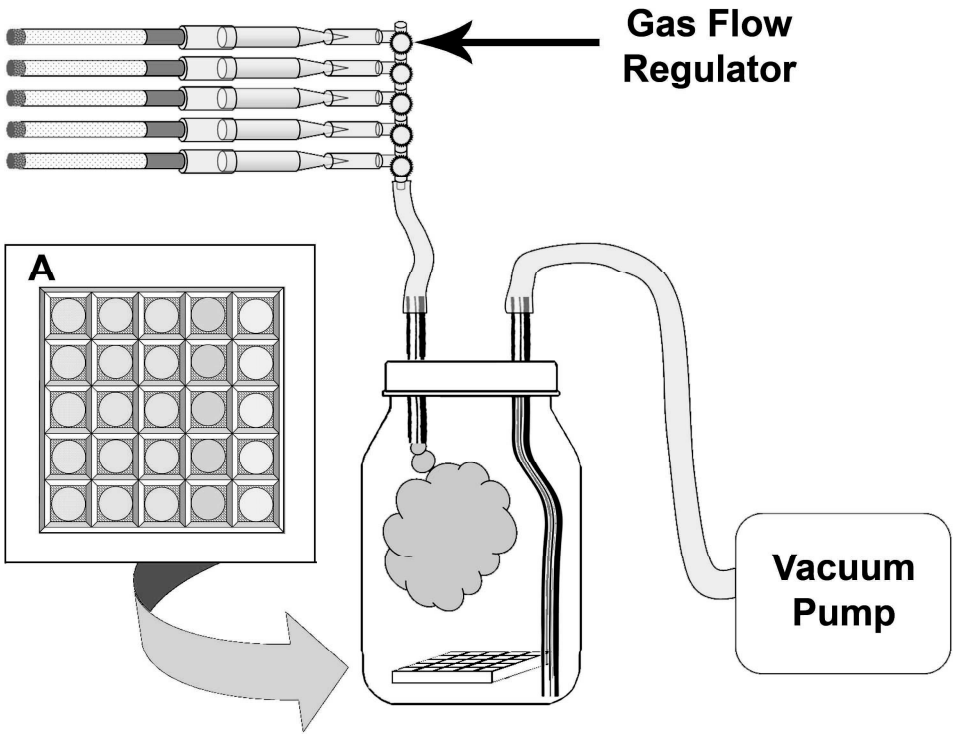


Fig 15– Desenho esquemático da máquina de fumaça.

Fig. 16– Espécimes submersos em solução de café solúvel
(Nescafé Classico, Nestlé, Vevey, Suíça)

Fig.17 – Tratamento clareador com peróxido de hidrogênio 6 % (WhiteClass 6%, FGM Produtos Odontológicos, Joinville, SC, Brasil)

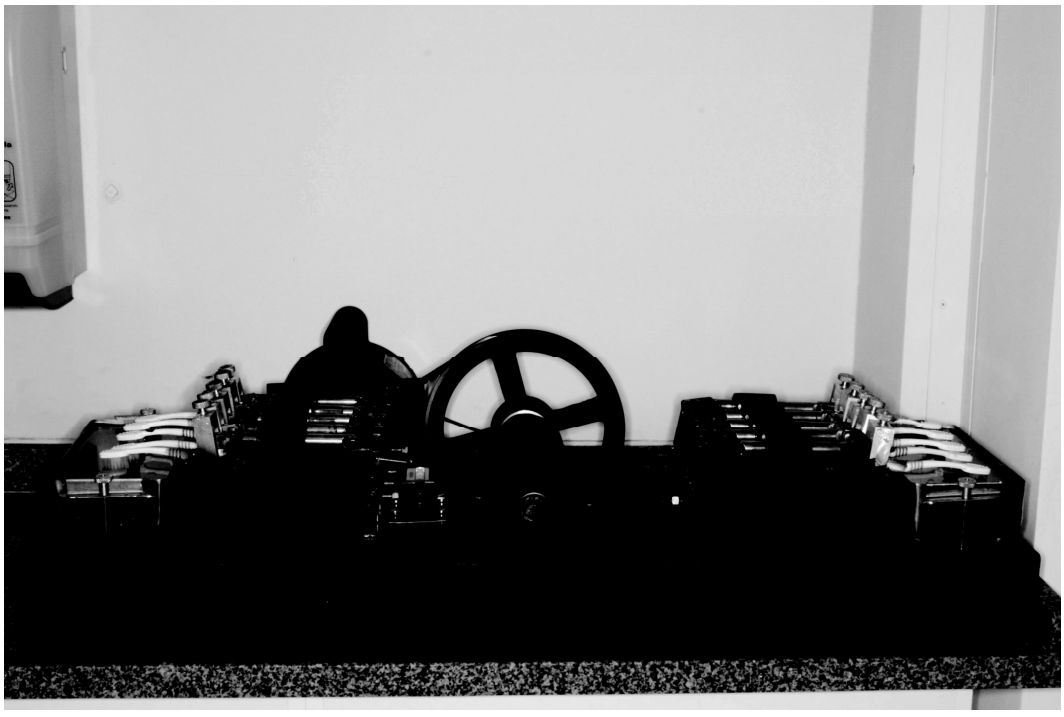


Fig.18 – Máquina de escovação simulada

Fig.19 - Aspecto da ação das escovas dentais sobre os espécimes na máquina de escovação.

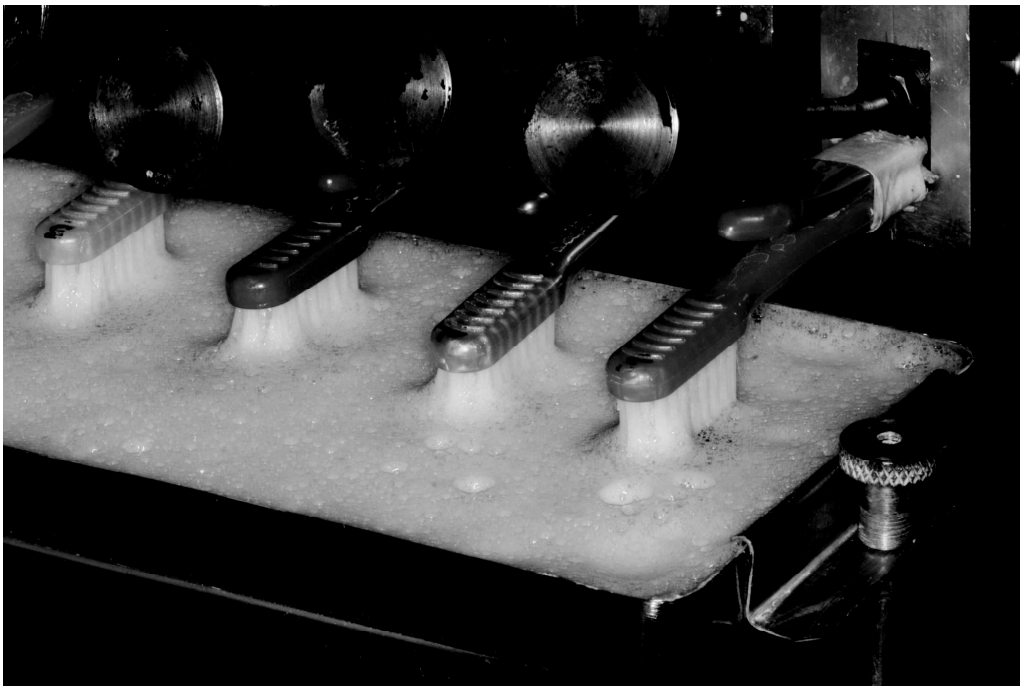


Fig.20 - Aspecto da ação das escovas e da pasta dental diluída em água.

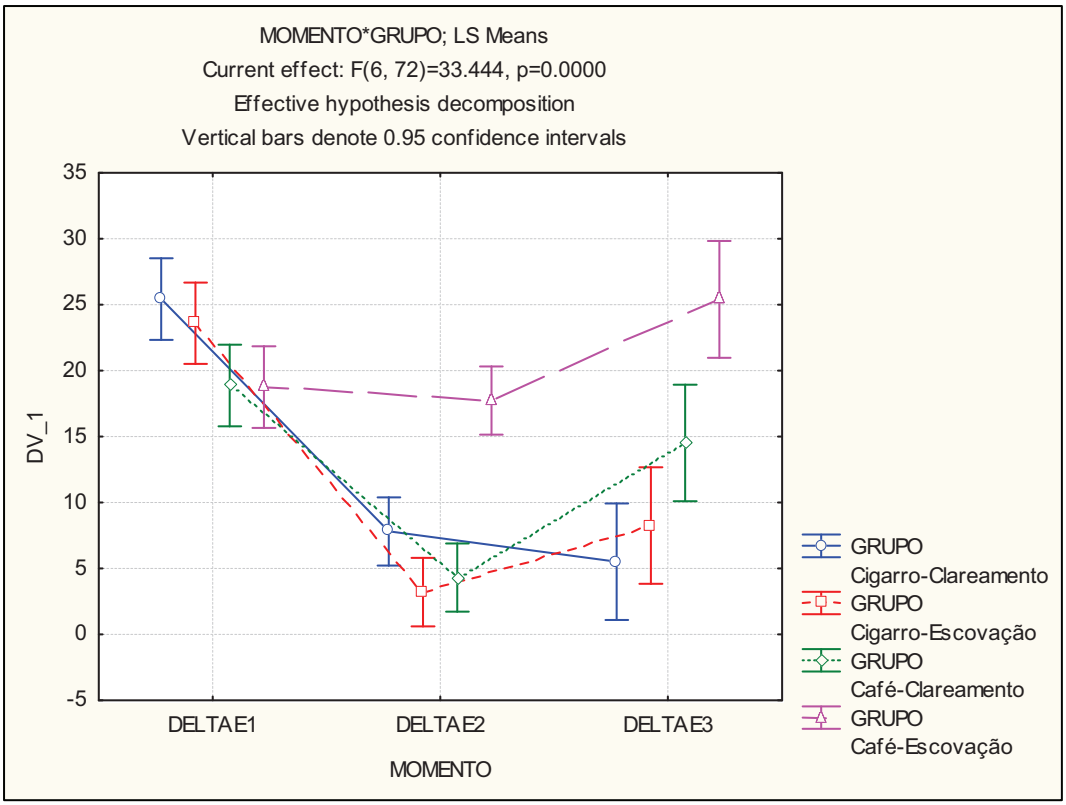
3.2. TABELAS DA ANÁLISE ESTATÍSTICA

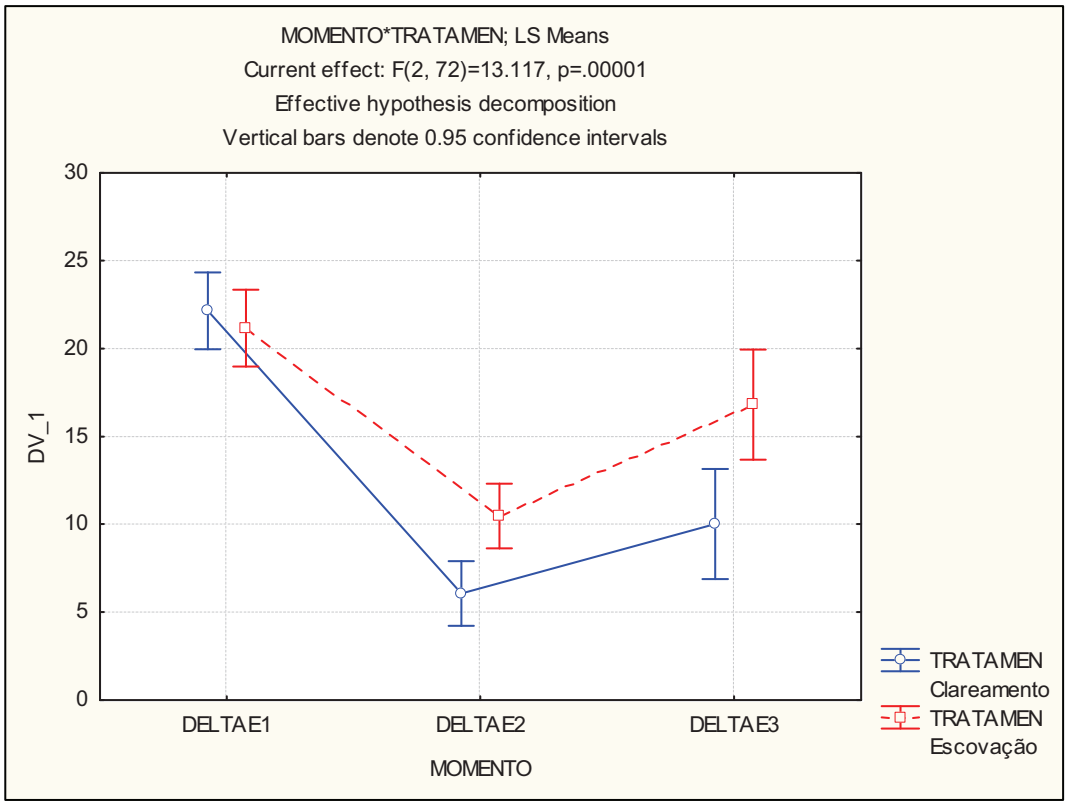
Análise descritiva dos dados do estudo.

Grupos	ΔE1		ΔE2		ΔE3	
	Média	S.D.	Média	S.D.	Média	S.D.
Cigarro-Clareamento	25,433	3,357407	7,805	2,627577	5,507	2,013389
Cigarro-Escovação	23,589	1,953205	3,204	1,850497	8,244	3,486036
Café-Clareamento	18,877	6,105691	4,314	2,079408	14,51	7,437301
Café-Escovação	18,741	6,373629	17,723	7,113705	25,399	10,89644

Tabela de ANOVA para os fatores “Tipo de manchamento” e “Tratamento de remoção” considerando α=5%.

	Soma dos Quadrados	gl	Quadrado Médio	F	p
Intercept	25040,70	1	25040,70	398,8391	0,000000
MANCHAMENTO	553,93	1	553,93	8,8227	0,005270
TRATAMENTO	348,64	1	348,64	5,5530	0,024011
MANCHAM*TRATAM	647,28	1	647,28	10,3097	0,002785
Erro	2260,22	36	62,78		
ΔE	3654,11	2	1827,06	150,1228	0,000000
ΔE*MANCHAMENTO	1785,85	2	892,92	73,3684	0,000000
ΔE*TRATAMENTO	319,28	2	159,64	13,1172	0,000014
ΔE*MANCHM*TRATAM	337,05	2	168,53	13,8471	0,000008
Erro Total	876,27	72	12,17		




MOMENTO*TRATAMEN; LS Means
Current effect: F(2, 72)=13.117, p=.00001
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals
DV_1
30
25
20
15
10
5
0
DELTAE1
DELTAE2
DELTAE3
MOMENTO
TRATAMEN
Clareamento
TRATAMEN
Escovação

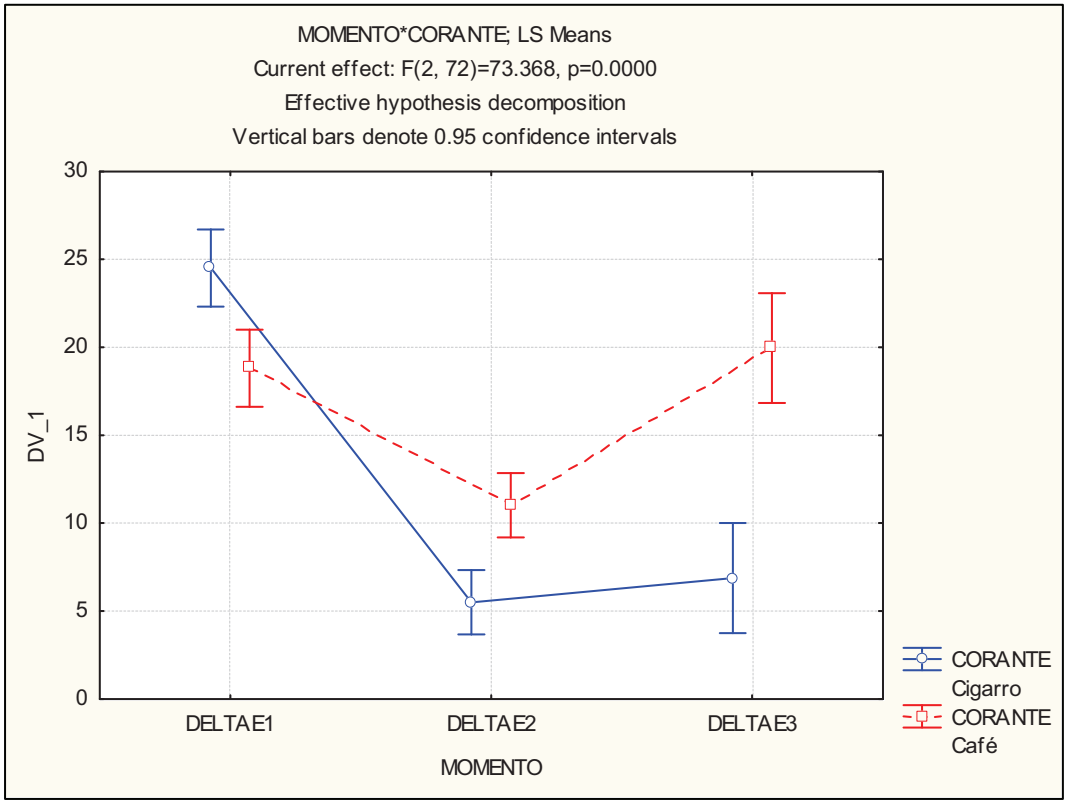

MOMENTO*CORANTE; LS Means
Current effect: F(2, 72)=73.368, p=0.0000
Effective hypothesis decomposition
Vertical bars denote 0.95 confidence intervals
DV_1
30
25
20
15
10
5
0
DELTAE1
DELTAE2
DELTAE3
MOMENTO
CORANTE
Cigarro
CORANTE
Café

Tabela do teste de Tukey para os resultados de alteração de cor dos grupos experimentais (p<0,05).

		CI-CL	CI-CL	CI-CL	CI-ES	CI-ES	CI-ES	CA-CL	CA-CL	CA-CL	CA-ES	CA-ES	CA-ES
		ΔE1	ΔE2	ΔE3	ΔE1	ΔE2	ΔE3	ΔE1	ΔE2	ΔE3	ΔE1	ΔE2	ΔE3
CI-CL	ΔE1		0,000118	0,000118	0,999994	0,000121	0,000121	0,780233	0,000121	0,001572	0,758314	0,082240	1,000000
CI-CL	ΔE2	0,000118		0,943171	0,000121	0,974084	1,000000	0,001260	0,997164	0,212385	0,001546	0,222952	0,000121
CI-CL	ΔE3	0,000118	0,943171		0,000121	0,998171	0,999694	0,000148	0,999997	0,348824	0,000156	0,000318	0,000235
CI-ES	ΔE1	0,999994	0,000121	0,000121		0,000118	0,000118	0,969260	0,000121	0,017257	0,962485	0,399437	0,999810
CI-ES	ΔE2	0,000121	0,974084	0,998171	0,000118		0,073943	0,000121	1,000000	0,000929	0,000121	0,010579	0,000121
CI-ES	ΔE3	0,000121	1,000000	0,999694	0,000118	0,073943		0,002302	0,891133	0,823870	0,002760	0,010444	0,001376
CA-CL	ΔE1	0,780233	0,001260	0,000148	0,969260	0,000121	0,002302		0,000118	0,202665	1,000000	0,999998	0,247101
CA-CL	ΔE2	0,000121	0,997164	0,999997	0,000121	1,000000	0,891133	0,000118		0,000118	0,000125	0,024088	0,000121
CA-CL	ΔE3	0,001572	0,212385	0,348824	0,017257	0,000929	0,823870	0,202665	0,000118		0,835047	0,971428	0,129105
CA-ES	ΔE1	0,758314	0,001546	0,000156	0,962485	0,000121	0,002760	1,000000	0,000125	0,835047		0,999954	0,003336
CA-ES	ΔE2	0,082240	0,222952	0,000318	0,399437	0,010579	0,010444	0,999998	0,024088	0,971428	0,999954		0,000425
CA-ES	ΔE3	1,000000	0,000121	0,000235	0,999810	0,000121	0,001376	0,247101	0,000121	0,129105	0,003336	0,000425	

3.3. NORMAS DA REVISTA JADA

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All new manuscripts must be submitted via JADA's online submission and review Web site, JADA Manuscript Central (Authors who do not yet have an account on the Web site should click the "Create Account" link on the upper right-hand corner of the JADA Manuscript Central welcome page and follow the step-by-step process to open an account.). On the dashboard page, authors should select the Corresponding Author Center. In the Corresponding Author Center, they should click the "Click here to submit a new manuscript" link.

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Peer-Reviewed:Articles

Clinical Practice. Articles with a clinical and practical focus. Potential topic areas include esthetic and restorative care, oral-systemic health, pharmacology, specialty dental practice, and informatics and technology.

Brief Reports. Short articles focusing on specific topics that do not lend themselves to longer, more in-depth treatments (6 double-spaced pages). The articles formerly included in the “Clinical Directions” department are included in the Brief Reports category. Pilot studies also would be appropriate for this section.

Case Reports. Short articles describing the presentation, diagnosis and management of clinical cases (6 double-spaced pages).

Critical Review. Review articles using a systematic approach to describe what is known from the literature about a clinical dental topic and evaluating the strength of the evidence (10 double-spaced pages).

Full Article. Full-length articles with a clinical and practical focus.

Practical Science. Articles providing scientific information on critical issues of practical interest to general dentists, helping to bridge the gap between dental research and patient care (10 double-spaced pages).

Practice Management. Practical information about the day-to-day aspects of running a dental practice, as well as about broader management concepts and techniques. Articles on informatics and technology could appear here if the technology being discussed has a management rather than a clinical focus (10 double-spaced pages).

Research. Articles describing the results of clinical, laboratory and population-based research pertinent to dentistry and providing foundation knowledge for future application.

Full Article. Full-length articles describing potential clinical applications of research findings (10 double-spaced pages).

Brief Reports. Short articles focusing on specific topics that do not lend themselves to longer, more in-depth treatments (6 double-spaced pages).

Advances in Dental Products. Articles describing research on new products useful to the clinician. Research sponsored or substantially funded by manufacturers appears here (10 double-spaced pages).

Trends

Full Article. Articles describing trends in dentistry and health care, such as access to care; patient and practitioner demographics; economic, ethical and

societal issues; state and federal law, policy and regulations that affect dentistry; and surveys of dentists on topics of interest (10 double-spaced pages).

Brief Reports. Short articles focusing tightly on specific topics that do not lend themselves to longer, more in-depth treatments (6 double-spaced pages).

Non-Peer–Reviewed:Material

Letters to the Editor. Brief comments on issues raised and articles published in JADA. A letter about a particular article will be forwarded to the article's author for comment, if the letter is selected for publication. The JADA Editor reserves the right to edit the letters into a publishable format (550 words, maximum of five references, no illustrations). A letter concerning a recent JADA article will have the best chance of acceptance if it is received within two months of the article's publication. By sending a letter to the editor, the author acknowledges and agrees that the letter and all rights of the author in the letter become the property of The Journal. Letters may be submitted via e-mail to jadaletters@ada.org; by fax to 1-312-440-3538; or by mail to 211 E. Chicago Ave., Chicago, Ill. 60611-2678.

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prepared in PowerPoint, please copy it into a Microsoft Word document or submit it as a PDF, a JPEG, a TIFF or an EPS file.

Length. Unless otherwise noted above, manuscripts must be no longer than 10 double-spaced pages (roughly 3,000 words), exclusive of title page, abstract, acknowledgments, references and illustrations.

Page setup. Pages should have 1-inch margins and must be numbered consecutively throughout the document.

Title page. Each manuscript should have a title page bearing the complete title of the manuscript and complete information on all authors. It should be the first page of the manuscript.

Each author's degrees must be listed on the title page. JADA generally does not publish U.S. fellowships and honorary degrees and designations. Degrees below the master's level generally are not listed, unless they are the highest degree attained.

The title page should designate the corresponding author and list that author's complete mailing address for the purposes of directing reprint requests after publication.

Abstract. A separate section describes how to format structured abstracts.

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(Exception. For only articles on esthetic care, authors are invited to provide sufficient numbers of high-quality photographs to present their material comprehensively, provided that there is an appropriate ratio of text to photographs: the length of the manuscript must be sufficient to support placement of photographs within the text. As a rule of thumb, assume an outside limit of three photographs per manuscript page.)

Any patient who is clearly identified in the article (either in text or in photographs) must sign a form indicating his or her consent to be thus depicted in the article. This consent form (PDF) must be submitted with the manuscript.

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Basic style/writing requirements. The foundation of JADA style is the most recent edition of the American Medical Association Manual of Style. The purpose of any piece of writing is to deliver information. This requires the author to define his or her message and to present it in a way that is readily understood by and engaging to the reader. Manuscripts should be written in active voice and declarative sentences for a clear, concise style. The overall tone of these reports should be factual and professional, and thus suitable for a scholarly journal. Authors are allowed to express a personal opinion as long as the basis for that opinion is stated plainly. For example, an author may express an opinion "based on long experience and intensive observation." Other statements of opinion and all statements of fact require references from the appropriate published literature (dental, medical, epidemiologic, practice management, etc.). Authors are invited to write headlines for their articles. Headlines should be as brief as possible while clearly conveying the main point or purpose of the article. Short subheads also should be used throughout the article to highlight key points. All submissions, including headlines and subheads, are subject to change during the editing process.

References. All published references should be cited in the text and numbered consecutively. No references should be cited in the abstract. Each reference should be cited only once; on subsequent citations, the original number should be used. Personal communications and unpublished data should not be numbered, but should be cited in the text as follows:

(G Edmunds, DDS, oral communication, November 2004)

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Citations in the reference list should follow this basic style:

Periodical

1. Lauterbach M, Martins IP, Castro-Caldas A, et al. Neurological outcomes in children with and without amalgam-related mercury exposure: seven years of longitudinal observations in a randomized trial. JADA 2008;139(2):138-145.

Book

2. Cohen S, Burns RC. Pathways of the pulp. 8th ed. St. Louis: Mosby; 2002:196.

Book chapter

3. Byrne BE, Tibbetts LS. Conscious sedation and agents for the control of anxiety. In: Ciancio SG, ed. ADA Guide to Dental Therapeutics. 3rd ed. Chicago: American Dental Association; 2003:17-53.

Government publication

4. Medicine for the public: Women's health research. Bethesda, Md.: U.S. Department of Health and Human Services, Public Health Service, National Institutes of Health; 2001. DHHS publication 02-4971.

World Wide Web site

5. Hoffman ED, Klees BS, Curtis CA. Brief summaries of Medicare & Medicaid: Title XVIII and Title XIX of the Social Security Act as of November 1, 2007. Baltimore, Md.: U.S. Department of Health and Human Services, Center for Medicare & Medicaid Services, Office of the Actuary; 2007. "http://www.cms.hhs.gov/ MedicareProgramRatesStats/downloads/MedicareMedicaidSummaries2007.pdf ". Accessed Aug. 28, 2008.

Publication in press

6. McCoy J. Alteration in periodontal status as an indicator of general health. JADA (in press). NOTE: Authors should double-check the status of any in-press work cited in their reference lists before submitting the final manuscript to JADA.

Presentation

7. Eichenstadt L, Brenner T. Caries levels among low-income children: report of a three-year study. Paper presented at: 146th Annual Session of the American Dental Association; Oct. 7, 2005; Philadelphia.

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All references should be checked for accuracy, correct format and completeness.

If applicable, acknowledgments should be included in the manuscript on a separate page.

Complete information—name, degrees, position or title, address, phone and fax numbers, e-mail address—should be included for the corresponding author.

JADA Structured Abstracts

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No abstract may exceed 200 words. If an abstract goes over that word count, JADA Manuscript Central will flag it and direct the author to shorten the abstract. The word counts given in parentheses after each subhead are not requirements, merely suggestions to help keep authors within the 200-word limit. As long as an abstract in total does not exceed 200 words regardless of the length of the individual sections, it will be acceptable.

Clinical Practice: Full Articles

Clinical Practice: Brief Reports

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Clinical Practice: Case Reports

Practice Management

Research: Full Articles; Advances in Dental Products

Research: Brief Reports

Trends: Full Articles

Trends: Brief Reports

Research: Full Articles; Advances in Dental Products

Background (30 words). A summary of the general topic and the purpose or hypotheses of the study.

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