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DESEMPENHO DE DOIS ESPECTROFOTÔMETROS NA AVALIAÇÃO DAS ALTERAÇÕES DE COR DE LESÕES CARIOSAS NÃO CAVITADAS EM ESMALTE

DISSERTAÇÃO DE MESTRADO

Flávia Isaia Vieira

Santa Maria, RS, Brasil
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DESEMPENHO DE DOIS ESPECTROFOTÔMETROS NA AVALIAÇÃO DAS ALTERAÇÕES DE COR DE LESÕES CARIOSAS NÃO CAVITADAS EM ESMALTE

Flávia Isaia Vieira

Dissertação apresentada ao Curso de Mestrado do Programa de Pós-Graduação em Ciências Odontológicas, Área de Concentração em Odontologia, ênfase em Odontopediatria, da Universidade Federal de Santa Maria (UFSM, RS), como requisito parcial para obtenção do grau de
Mestre em Ciências Odontológicas

Orientadora: Profª. Dra. Rachel de Oliveira Rocha

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elaborada por
Flávia Isaia Vieira

como requisito parcial para obtenção do grau de
Mestre em Ciências Odontológicas

COMISSÃO EXAMINADORA

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Santa Maria, 10 de agosto de 2015.

DEDICATÓRIA

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É preciso relativizar tudo e não dramatizar nada.

É mais conforme a natureza

Rir da vida do que chorá-la.

Sêneca.

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Brindo a casa,

Brindo a vida,

Meus amores, minha família.

O Rappa.

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Quando eu for, um dia desses,

Poeira ou folha levada

No vento da madrugada,
Serei um pouco do nada,
Invisível delicioso.
Que faz com que o teu ar
Pareça mais um olhar,
Suave mistério amoroso,
Cidade de meu andar
(Desde já tão longo andar!)
E talvez de meu repouso...
Mário Quintana.

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George Eliot.

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Marrashiri.

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(...) Viver é melhor que sonhar,
Eu sei que o amor
É uma coisa boa,
Mas também sei
Que qualquer canto
É menor do que a vida
De qualquer pessoa...
Elis Regina.

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O importante é não parar de questionar.

Albert Einstein.

RESUMO

Dissertação de Mestrado
Programa de Pós – Graduação em Ciências Odontológicas
Universidade Federal de Santa Maria

DESEMPENHO DE DOIS ESPECTROFOTÔMETROS NA AVALIAÇÃO DAS ALTERAÇÕES DE COR DE LESÕES CARIOSAS NÃO CAVITADAS EM ESMALTE

AUTORA: FLÁVIA ISAIA VIEIRA
ORIENTADORA: RACHEL DE OLIVEIRA ROCHA
Data e Local da Defesa: Santa Maria, 10 de agosto de 2015.

O objetivo do trabalho foi avaliar o desempenho de dois espectrofotômetros, na mensuração das alterações do esmalte dentário submetido a desmineralização e tratamento com fluoretos. Os espectrofotômetros Easyshade (VITA, Alemanha) SP60 (Ex- Rite, EUA) foram utilizados para mensurar as alterações ópticas de 30 blocos de esmalte bovino (n=10) nos momentos de avaliação inicial (esmalte hígido) (T0), esmalte desmineralizado (T1 – após ciclagem de pH) e durante o tratamento das lesões de mancha branca com agentes fluoretados – 5 aplicações tópicas de gel fluoretado (fluoreto de sódio a 2% - grupo NaF e flúor fosfato acidulado 1,23% - grupo FFA) (T2 à T6). Os espécimes pertencentes ao grupo controle foram mantidos em água deionizada durante o período experimental e não receberam tratamento com fluoretos. Os dados obtidos referentes à alteração de cor (ΔE) bem como das dimensões CIE L*a*b* foram submetidos a analise de variância e teste de contraste de Tukey (α=0,05). O coeficiente de correlação de Pearson foi utilizado para medir a possível correlação entre os dois aparelhos do estudo. Os resultados do trabalho apontaram que o aparelho SP60 foi capaz de identificar e monitorar as diferenças de alteração de cor (ΔE) do esmalte nos diferentes momentos de avaliação (p= 0.000), assim como, foi capaz de informar variações em cada um dos parâmetros CIE L*a*b* (p=0.000). Por outro lado, o aparelho Easyshade, não apontou diferenças significantes entre os momentos de avaliação (p=0.713) e entre os grupos experimentais (p=0.684). Baixa correlação entre os dois dispositivos foi observada (r=0,25; p= 0,001). Com base nos resultados obtidos, foi concluído que o espectrofotômetro SP60 foi capaz de identificar essas alterações nos diferentes tempos de avaliação. No entanto, o aparelho Easyshade não foi capaz de avaliar alterações ópticas no esmalte, decorrentes da perda de minerais e do tratamento com agentes fluoretados.

Palavras – chave: Cárie. Esmalte Dentário. Espectrofotometria. Fluoretos Tópicos.

ABSTRACT

Master Course Dissertation
Dental Science Post Graduation Program
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PERFORMANCE OF TWO SPECTROPHOTOMETERS ON COLOR CHANGES EVALUATION OF NON-CAVITATED ENAMEL CARIES LESIONS

AUTHOR: FLÁVIA ISAIA VIEIRA
ADVISOR: RACHEL DE OLIVEIRA ROCHA
Defense Place and Date: Santa Maria, August 10th, 2015.

The aim of this study was evaluate the performance of two spectrophotometer devices in assessing color changes of dental enamel after artificial caries induction (demineralization) and treatment with fluorides. The Easyshade spectrophotometer (VITA, Germany) and SP60 (Ex-Rite, USA) were used to measure the color changes of 30 bovine enamel blocks (n=10) in evaluation times: initial (sound enamel) (T0), demineralized enamel (T1 after pH cycling) and after treatment with fluoride agents – 5 applications of fluoride gel (2% sodium fluoride – group NaF and 1.23% acidulated phosphate fluoride – APF group) (T2 to T6). The specimes in control group were kept in deionized water during the experimental time and received no treatment with fluoride. Obtained color change values (ΔE) as well as the values of each CIE L*a*b* dimensions were subjected to ANOVA and Tukey's *post hoc* test (α=0,05). The Pearson's correlation coefficient was used to measure a correlation study between the two devices. Results showed tha SP60 device was able on identifying and monitoring enamel color changes (p=0.000) and CIE L*a*b* dimension on evaluation times (p=0.000). On other hand, Easyshade showed no significant differences in main factors 'evaluation time' (p=0.713) and 'treatment' (p=0.684). Low correlation between the two devices was observed (r=0.25; p= 0. 001). Based on the obtained results, one can conclude that spectrophotometer SP60 was able to identify enamel color changes during enamel de-remineralization. Color changes in enamel were not assessed by Easyshade device.

Key-words: Caries. Dental Enamel. Fluoride Topics. Spectrophotometry.

SUMÁRIO

INTRODUÇÃO GERAL

Nos últimos tempos houve um aumento das pesquisas direcionadas aos métodos de detecção e acompanhamento de lesões de mancha branca (lesões não - cavitadas) em esmalte (PRETTY, 2006; BRAGA et al., 2010; MENDES et al., 2013). A busca por métodos para detectar com segurança áreas desmineralizadas no esmalte ainda se faz presente (BRAGA et al., 2010), dada a importância da detecção de lesões de mancha branca e a avaliação de sua atividade, para que adequadas condutas terapêuticas sejam adotadas e em momento oportuno (BRAGA et al., 2010).

O método de inspeção visual é o método de diagnóstico mais comumente empregado na pratica clínica (BRAGA et al., 2010; PRETTY, 2006) para a identificação e classificação das lesões de mancha branca. O método visual fornece informações sobre a gravidade da doença, no entanto fica aquém da verdadeira quantificação. Sua capacidade em detectar precocemente lesões de mancha branca restritas ao esmalte é baixa (PRETTY, 2006), pois possui uma alta especificidade em identificar corretamente sítios sadios, mas baixa sensibilidade, bem como, pouca reprodutibilidade em identificar corretamente sítios de carie, devido a sua natureza subjetiva (NAKAGAWA et al., 2013).

Métodos quantitativos fundamentados no emprego de dispositivos eletrônicos capazes de mensurar diferentes características dos tecidos dentários têm sido sugeridos e avaliados a fim de verificar sua aplicabilidade, não apenas na identificação, mas também no monitoramento das lesões ao longo do tempo (YUAN et al., 2014; GOMEZ et al., 2014; ZANDONÁ et al., 2010; PAUL et al., 2002). Métodos quantitativos permitem identificar de forma precisa e confiável as alterações no conteúdo mineral de lesões de cárie, além de avaliar a eficácia do tratamento proposto (MENDES et al., 2005). No entanto, até o presente momento, os estudos que empregam dispositivos como QLF (*Quantitative Light Fluorescence*) e fluorescência por laser (DIAGNOdent), são capazes de aumentar a acurácia e sensibilidade da inspeção visual, porém ainda são inconclusivos em acompanhar a

progressão ou regressão das lesões de mancha branca (DINIZ et al., 2009). Deste modo, ainda são válidas as tentativas de identificar outros possíveis métodos quantitativos capazes de informar as alterações no esmalte dentário, assim como monitorar a atividade dessas lesões de cárie.

O espectrofotômetro é um aparelho eletrônico capaz de avaliar de maneira quantitativa e não invasiva a cor e densidade de um dente, bem como de outros materiais odontológicos (POLO et al., 2013; PAUL et al., 2002), por meio de medições precisas, reprodutíveis e confiáveis (LI et al., 2010).

As coordenadas L* a* b* propostas pela CIE (*Comission Internationall' Eclairage*), onde L* refere-se à coordenada de luminosidade e as variáveis a* e b* se referem à cor nas axiais vermelho-verde e azul-amarelo respectivamente, são capazes de aferir diferenças objetivas das propriedades ópticas entre duas medições, quando se avalia a cor de um dente ou material restaurador (KAIZER et al., 2012). Além disso, em alguns aparelhos de espectrofotometria é possível mensurar a translucidez de um material, assim como, o seu percentual de opacidade (MAYORAL et al., 2013; KAIZER et al., 2012).

Desse modo, pode-se presumir que aspectos clínicos de uma lesão de mancha branca em esmalte, como perda de translucidez e opacidade, possam também ser avaliados quantitativamente pelo uso da espectrofotometria (LI et al., 2010). Diante disso, justifica-se o desenvolvimento deste trabalho, pois embora existam métodos quantitativos capazes de identificar e detectar a desmineralização do esmalte em superfícies lisas, esses métodos empregados ainda não são eficazes em monitorar a progressão ou regressão das lesões de mancha branca.

Assim o objetivo do presente trabalho foi analisar, por meio de dois espectrofotômetros, as características ópticas do esmalte dentário, durante a desmineralização e tratamento remineralizador das lesões de mancha branca, tratadas com agentes fluoretados.

1 ARTIGO

IS IT POSSIBLE TO MEASURE THE COLOR CHANGE IN ARTIFICIAL WHITE SPOT LESIONS USING SPECTROPHOTOMETERS?

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IS IT POSSIBLE TO MEASURE THE COLOR CHANGES IN ARTIFICIAL WHITE SPOT LESIONS USING SPECTROPHOTOMETERS?

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Enamel color changes assessed by two spectrophotometers

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Key - words: Caries; Enamel; Fluoride treatment; Optical properties.

IS IT POSSIBLE TO MEASURE THE COLOR CHANGES IN ARTIFICIAL WHITE SPOT LESIONS USING SPECTROPHOTOMETERS?

ABSTRACT

Objective: This in vitro study aimed to evaluate the performance of two spectrophotometer devices on assessing the dental enamel color changes after demineralization and treatment with fluorides.

Methods: Thirty enamel blocks obtained from 10 bovine teeth were subjected to one of the following treatments (n=10): (Control) no treatment, (NaF) 2% sodium fluoride gel application, (APF) 1.23% acidulated phosphate fluoride gel application. All blocks were submitted previously to a 14-day pH cycling model (8 hours on demineralization solution, pH=4.5 and 16 hours in remineralization solution, pH=7.0). Then, specimens were treated with fluoride gels to a 5 week with an interval of 7-days. Specimens from control group received no treatment and all specimens remained stored in deionized water during experimental time. Color changes (ΔE and ΔE_{00}) were determined in baseline (T0), after demineralization (T1) and after each fluoride gel application (T2 to T6), using two spectrophotometer devices (Easyshade and SP60). ΔE, ΔE_{00}, and individual CIE L*a*b* dimensions were analyzed using ANOVA and Tukey's post-hoc test ($p<0.05$). ΔE values obtained with two devices were also submitted to Pearson's correlation coefficient.

Results: The spectrophotometer SP60 was able to measure enamel color changes during des-remineralization process. No significant differences were found to both fluoride gel treatment at T6 ($p>0.05$). It was not possible to verify the enamel color changes using the clinical device (Easyshade). Poor correlation were found between ΔE values of SP60 and Easyshade.

Conclusions: This study highlighted that only laboratorial spectrophotometer (SP60) can be used to quantitatively measure enamel color changes during the de-remineralization process.

Key-words: Caries; Enamel; Fluoride treatments; Optical properties.

Clinical significance: It is possible to assess the enamel color changes during in vitro de-remineralization process using a spectrophotomer, consequently, new devices could be developed and evaluated to allow this use also in a clinical situation.

INTRODUCTION

The diagnosis and treatment of white spot carious lesions has been incorporated to clinical routine since studies pointed that the prevalence of non-cavitated lesions is higher that cavitated ones.[1-4] Monitoring the behavior of these lesions over time and the results of non-invasive approaches, as topical fluoride application[4-7] , requires an additional effort as it is not so easy to perceive the optical changes in enamel by visual inspection.[8]

White spot lesions are consequences of increased porosity within enamel that affect the light scattering and gives to enamel a whitish and opaque appearance. Similarly, fluoride therapy seems to influence the enamel surface properties.[9] The effect of fluoridated regimens on remineralization of enamel caries lesions is ubiquitous in increasing hardness and fluoride content[6], whatever changes in surface brightness could not be perceived visually.[6] Quantitative methods have been used to detect mineral loss in enamel and as an attempt to monitoring lesions over remineralizing approaches.[5, 8, 10] Therefore, color alterations on enamel have been investigate using color measurement system CIE L*a*b* (Comission Internationall' Eclairage)[11,12] by spectrophotometers although few studies[9,11] have included color measurements by spectrophotometer in detecting or monitoring white spot caries lesions.

The relationship between the enamel color changes and tissues density was clearly pointed in previous in vitro studies[9-11], including in assessing dentinal caries activity[13], but spectrophotometer is still uncommon to validate the loss or gain of minerals in caries lesions. Spectrophotometer is a non-destructive method and do not require specifically preparing and added to these advantages there are

spectrophotometer devices specifically to clinical use.[14] The clinical devices could be a reliable way of monitoring non-cavitated caries lesions over time reducing the subjectivity of visual inspection. To the best knowledge, no information is available regarding the use of one compact spectrophotometer on detecting the enamel color changes during demineralization and remineralization process.

Therefore, this in vitro study aimed to evaluate two spectrophotometer devices to assess the enamel color changes after demineralization and treatment with fluorides. The null hypothesis tested was that the two devices are able to assess color changes in demineralized and remineralized enamel.

MATERIAL AND METHODS

The study design is shown in Figure 1.

Specimen preparation

The study protocol was previously approved by the local Ethics Committee. Ten bovine teeth were cleaned and disinfected in 0.5% chloramine-T two days and stored in distilled water at 4ºC until used. Teeth were sectioned in 3 enamel blocks (4 x 4 x 3-mm). The surface of each enamel section was polished using 600-grit SiC paper and 3-µm alumina oxide paste (Diamond Gloss, KG Sorensen, Cotia, São Paulo Brazil). The specimens were then covered with 2 layers of acid resistant varnish, leaving an exposed enamel area of approximately 3 x 3-mm.

Artificial caries induction

Specimens were submitted to pH cycling to induce artificial caries lesions. To it each specimens was immersed individually in 5 ml of demineralizing solution (2.2 mM $CaCl_2$, 2.2 mM NaH_2PO_4, and 0.05 M acetic acid, adjusted to pH 4.8) for 8 h, followed by remineralizing solution (1.5 mM $CaCl_2$, 0.9 mM NaH_2PO_4, and 0.15 mM KCl, adjusted to pH 7.0) for 16 h for 10 days.[15] Fresh solutions were used daily and maintained at room temperature.

Topical fluoride treatment

After artificial caries induction, specimens were randomly assigned to three groups according treatment: (1) no treatment (control group), (2) 2% sodium fluoride gel application (NaF), (3) 1.23% acidulated phosphate fluoride gel application (APF). Fluoridated gels (1 ml) were applied on air-dried enamel surfaces and maintained for 1 min [4]. After specimens were washed and stored in deionized water. Specimens from control group were just stored in deionized water, with no treatment.

Color measurements

Enamel color measurements were performed using a clinical spectrophotometer device Easyshade Compact (VITA Zahnfabrik, Bad Säckingen, Germany) and a laboratorial device SP60 (Ex - Rite/ Grand Rapid, MI,USA), in analyze mode, using CIE L*a*b* system (Commission International L'Eclairage). A single trained operator used the two devices according to the manufacturers' instructions.

All enamel specimens were evaluated with the two spectrophotometer devices at the moments: (T0) baseline (sound enamel), (T1) after artificial caries induction

(demineralized enamel), (T2 to T6) after the first to fifth fluoride application. All specimens were air-dried for 5 seconds, three measurements with each device were carried out at each evaluation time and before of each one, the devices were calibrated according instructions.

Enamel color changes (ΔE and ΔE_{00}) were calculated according to the equations[16,17], respectively:

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

where $\Delta L= L_{final} – L_{initial}$; $\Delta a=a_{final} – a_{initial}$ and $\Delta b= b_{final} – b_{initial}$, and

$$\Delta E_{00}=[(\Delta L'/k_L S_L)^2 + (\Delta C'/k_C S_C)^2 + (\Delta H'/k_H S_H)^2 R_T(\Delta C'/k_C S_C) (\Delta H'/k_H S_H)]^{1/2},$$

where $\Delta L'$, $\Delta C'$, and $\Delta H'$ are lightness, chroma and hues differences respectively between the standard and sample in a pair and R_T is an interactive term between the hue and chroma differences

Statistical analysis

The normal distribution of the data was confirmed using the Kolmogorov-Smirnov test.

The mean values of the color changes (ΔE and ΔE_{00}) for experimental groups were analyzed individually for each device using ANOVA and Tukey's post hoc multiple comparisons to evaluate the effects of evaluation time and treatment group. Mean values of each CIE L*a*b* dimensions were also submitted to two-way ANOVA and Tukey's test.

The Pearson correlation coefficient was used to quantify the degree of enamel changes (ΔE) between two devices.

All the levels of significance were stablished at $\alpha = 5\%$.

RESULTS

Color changes (ΔE and ΔE_{00}) values obtained with SP60 are presented in Table 1 and 2 (respectively). The device was able to measure enamel alterations (ΔE) among evaluation time (F=37.77; p=0.000) and treatment group (F=17.37; p=0.000) as well as to interaction between these factors (F=4.00; p=0.000). Similar results were obtained to ΔE_{00} to evaluation time (F=30.26; p=0.000), treatment group (F=17.81; p=0.000) and the cross interaction (F=3.65; p=0.000). Considering that, ΔE and ΔE_{00} presented similar results, from now only data relating to ΔE will be presented. Tukey's post hoc analysis among experimental groups are also presented in Table 1. The device SP60 was able to indicate significant differences in ΔE between sound and demineralized enamel (T0 and T1) as well as between demineralized and final enamel condition (after the fifth topical fluoride application). Moreover, color changes in enamel was similar between the first and final evaluation. This finding is obviously not valid to control group, in which specimens received no treatment.

For ΔE and ΔE_{00} values obtained with Easyshade, no statistically significant differences in ANOVA were found to factor 'evaluation time (F=0.58; p=0.713 and F=0.62; P=0.684) nor to interaction between factor (F=0.74; p=0.689 and F=0.74; p=P.687). In light of these results, no post hoc comparisons were done. Figure 2 shows the behavior of ΔE values considering evaluation time and treatment group and it is possible to perceive that the color alteration values did not follow any pattern.

Figure 3 shows the behavior of dimensions of CIE L*a*b* separately, on line charts, considering the devices SP60 and Easyshade. All line charts represent the statistically significant factor 'evaluation time' since the interaction between two factors was just significant to dimension L* SP60. The two devices were able to indicate statistically significant differences between T0 and T1 (sound and demineralized enamel), except to dimension a* with Easyshade. Moreover, when enamel evaluation was performed with SP60 device, changes in dimensions CIE L*a*b* were also found between T1 (demineralized enamel) and T6 (final evaluation). The same findings were not found when Easyshade device were used.

The correlation between two devices was only weak (r=0.25; p=0.001).

DISCUSSION

The use of spectrophotometer to assess the color of the natural teeth seems to be successful.[18-20] It is a common way to evaluate color changes in dental substrates or restorative materials submitted to staining solutions[21] or to assess the effect of dental bleaching.[18-21] In vitro studies have also included spectrophotometer to evaluate the physical properties of teeth during the de-remineralization phenomena.[10] That is possible since in white spot caries lesions the mineral loss occur mainly in subsurface and the increase porosity inner enamel provide optical changes despite intact surface layer.[22]

In this study, an in vitro demineralization model and fluoride remineralization regimens were used to evaluate two spectrophotometer device in determining enamel color changes during de-remineralization process. Intraoral dental spectrophotometer (Easyshade) was not able in detecting enamel color changes

during artificial caries-like lesions development and treatment with fluorides. At the present, there is no published data available demonstrating this application; however, studies have shown that device is useful in match the shade of natural[23] or artificial teeth.[24]

As opposed Easyshade results, SP60 spectrophotometer shown to be a sensitive method in detecting color changes in enamel as consequence to de-remineralization process. Obtained ΔE, ΔE_{00} and individual CIE L*a*b* dimensions values to all evaluation times were as expected to mineral changes after in vitro caries-like lesions development as after treatment with fluorides. It is important to consider that previous study[6] , it was not possible to detect any change in enamel surface brightness during in vitro demineralization or in situ remineralization besides increasing in surface microhardness and enamel fluoride content.

This observation makes the results of the present study potentially relevant for next laboratorial studies once it is difficult to identify easily the effects of optical enamel properties resulting of de-remineralization process by visual inspection, regardless the color measurements are uncommon method to monitor enamel caries. Spectrophotometer is an advantageous non- destructive technique to measure accurately the color of the teeth and possibly, to evaluate the color changes associated with gain or loss minerals[10] as possible substitute to commonly methods employed in studies on enamel de-remineralization.[10] In a previous study, the enamel mineral loss associated with bleaching was assessed and authors found a significant correlation between ΔL and changes in teeth mineral content.[10] The whiteness in enamel is a consequence of demineralization and it was perceived using a spectroradiometer either according CIE L*a*b* system.[11] Iwami et al., also correlated dimensions CIE L*a*b* with caries activity and bacterial presence but considering just

dentinal caries lesions.[13] These previous results are able to withstand the aim of the present study that was to compare a clinical spectrophotometer to a laboratorial device, using no other validation methodology.

The behavior of CIE L*a*b* dimensions individually also followed the expected after artificial caries-like promotion (demineralization) with significant increase in L* (lightness) and recovering similar values to sound enamel (T0) after remineralization (T6). This results is just valid measurements obtained with SP60 since that obtained with Easyshade did not show the same trend. This probably could explain the weak correlation between two devices, confirming that Easyshade was not suitable to monitoring white spot caries lesions even favorable results in assessment of teeth[20,23] or restorations shade.[14,24]

Although topical fluoride treatment did not always result in reversal of white spot lesions color[9,25] ,the obtained results showed that after fifth fluoride application, dimensions L* and a* returned to similar initial values. It is clear that the in vitro demineralization model used in this study could result in more superficial lesions than natural ones[1] though this model is commonly employed in several laboratorial studies.[1,25] The obtained ΔE, ΔE_{00} and individual CIE L*a*b* dimensions values were also similar to two fluoride regimens (APF and NaF) after fifth application, corroborating to Bonow et al. (2013) in which better results enamel lesions remineralization were obtained with longer treatment periods. It is not possible to stating that it would be possible to obtain similar results with fluoride treatment protocol used in present study in clinical situations, with other factors are involved like dental hygiene, diet and saliva. Furthermore, de-remineralization process were developed in bovine enamel, commonly used in laboratorial studies[6,9,26] , although

not identical to human enamel. A flat surface consequent of specimens polishing can also affect the results making the color assessment easier.

CONCLUSION

In conclusion, this in vitro study shows that the SP60 spectrophotometer was able to assess enamel color changes arising from demineralization and treatment with fluoride gels. The clinical spectrophotometer device was not appropriate to it.

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Table 1. Means (SD) of color alteration (∆E) obtained with SP 60 device and results of Tukey's post hoc analysis*.

	Treatment group		
Evaluation time	**Control**	**NaF**	**APF**
T1–T0	8.05 (1.95)^{A}	6.60 (2.03)^{A}	8.70 (2.91)^{A}
T2-T1	1.86 (0.92)^{B}	2.47 (1.46)^{B,C}	2.74 (2.65)^{B,C}
T3-T1	1.86 (1.37)^{B}	3,36 (1.70) ^{B,C}	2.90 (1.56) ^{B,C}
T4-T1	1.82 (1.25)^{B}	2.62 (2.18) ^{B,C}	3.80 (1.65)^{B,C}
T5-T1	2.76 (1.67)^{B,C}	5.17 (3.21)^{A,B,C}	6.23 (3.12)^{A,B,C}
T6-T1	3.86 (1.74)^{B,C}	10.24 (3.68)^{A}	11.03 (4.66)^{A}

*Different superscript letters: significant difference ($p<0.05$).

Table 2. Means (SD) of color alteration (ΔE_{00}) obtained with SP 60 device.

	Treatment group		
Evaluation time	**Control**	**NaF**	**APF**
T1–T0	5.69 (1.46)	4.82 (1.47)	6.22 (2.24)
T2-T1	1.48 (0.77)	2.09 (1.45)	2.03 (1.93)
T3-T1	1.41 (0.98)	2.85 (1.65)	2.24 (1.15)
T4-T1	1.42 (0.96)	2.27 (2.14)	3,04 (1.23)
T5-T1	2.10 (1.15)	4.32 (2.77)	4.94 (2.40)
T6-T1	2.86 (1.24)	7.75 (2.97)	8.26 (3.41)

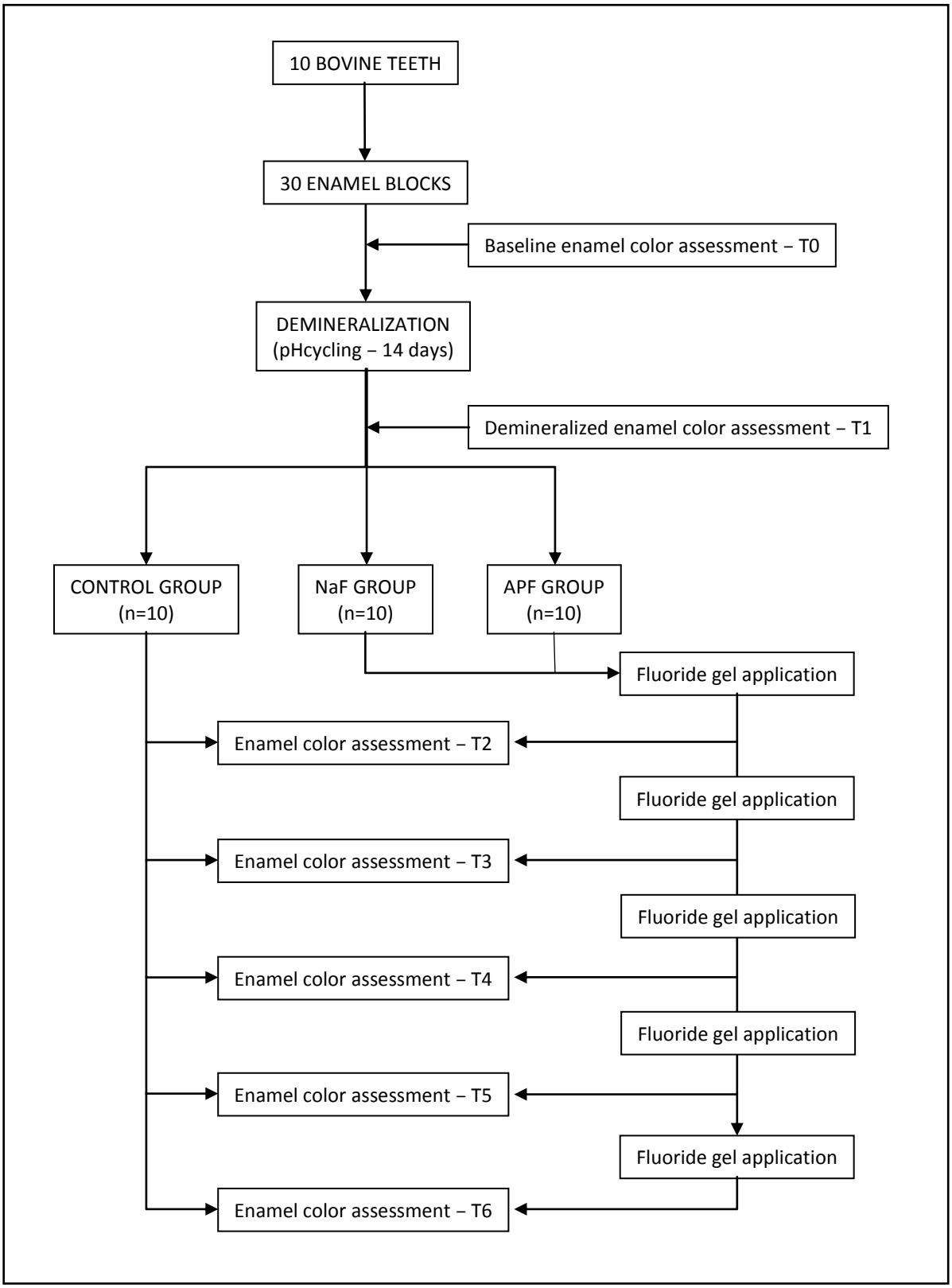

Figure 1. Experimental design

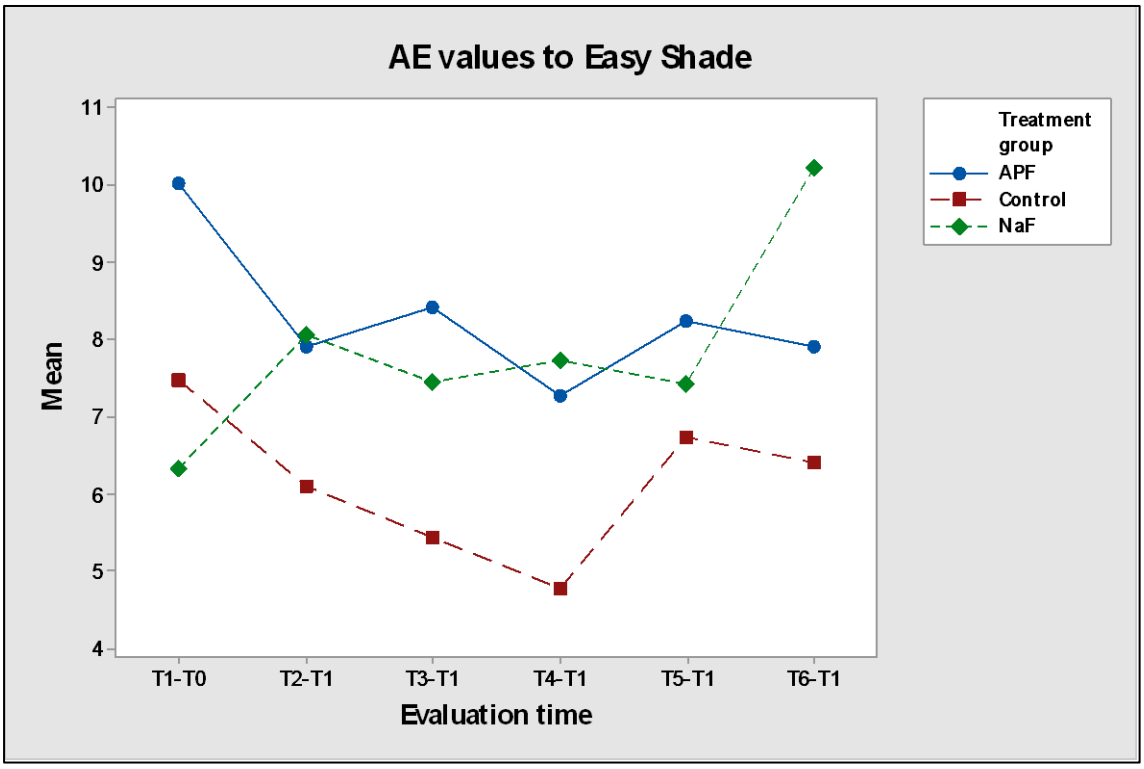

Figure 2. ΔE values obtained with Easyshade device considering the interaction between evaluation time and treatment group.

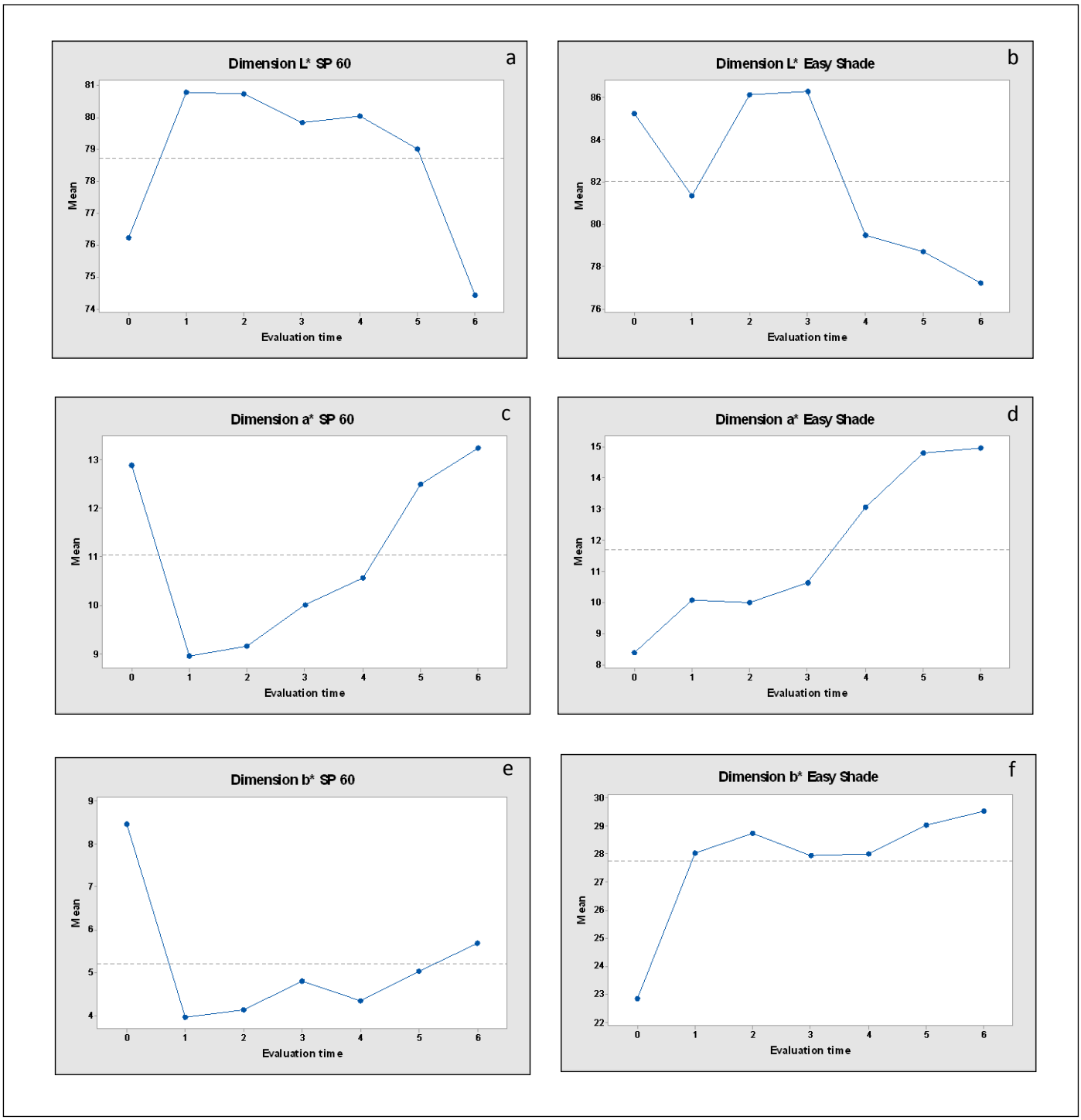

Figure 3. Behavior of dimensions CIE L* a* b* individually for devices SP60 (a, c, e) and Easyshade (b, d, e) to factor 'evaluation time'.

2 CONSIDERAÇÕES FINAIS

As alterações ópticas decorrentes da perda de minerais e tratamento remineralizador, ocorridas no esmalte dentário, foram capazes de ser identificadas com o aparelho SP60, nos diferentes momentos de avaliação. Verificou-se a empregabilidade deste dispositivo eletrônico, para a identificação e monitoramento de lesões de mancha branca, tratadas com fluoretos tópicos. Por outro lado, o aparelho de espectrofotometria Easyshade, não foi capaz de detectar as alterações de cor do esmalte durante a des-remineralização. Além disso, a baixa concordância entre os dois aparelhos impossibilitou a comparação direta do desempenho dos dispositivos, na avaliação das características ópticas do esmalte dentário submetido à des-remineralização.

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ANEXO

Anexo A – Normas para publicação no periódico Journal of Dentistry

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AUTHOR INFORMATION PACK

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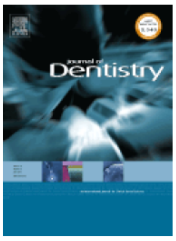

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