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FABIO AUGUSTO DE SANTI ALVARENGA

**CONTROLE DE QUALIDADE EM
MICROINFILTRAÇÃO MARGINAL**

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Controle de Qualidade em Microinfiltração Marginal

Tese apresentada ao Programa de Pós-Graduação em Ciências Odontológicas - Área de Dentística Restauradora, da Faculdade de Odontologia de Araraquara-Universidade Estadual Paulista, para obtenção do título de Doutor em Ciências Odontológicas.

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FABIO AUGUSTO DE SANTI ALVARENGA

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Dedico esse trabalho ...

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Alvarenga FAS. Controle de qualidade em microinfiltração marginal (Tese de Doutorado). Araraquara – Faculdade de Odontologia da UNESP; 2011.

RESUMO

Objetivo: O objetivo principal deste estudo foi verificar a reprodutibilidade e validade do diagnóstico de microinfiltração marginal visual e digital, estabelecendo, *a priori*, a resolução e magnificação mais indicadas para a modalidade digital.

Métodos: Para o diagnóstico da microinfiltração marginal, os métodos utilizados foram o visual (estereomicroscópio) e o digital (*Image Tool Software-ITS3.0*), sendo as leituras realizadas por dois examinadores previamente calibrados. Foi estimada a concordância intra/interexaminador e foi estudada a validade da imagem digital para diagnóstico, tomando-se o estereomicroscópio como critério de validação. Para o uso da imagem digital, foram comparadas diferentes resoluções e magnificações.

Resultados: A detecção da microinfiltração por meio digital (ITS3.0) deve ser feita na resolução 600 dpi, com diferença estatisticamente significativa entre as magnificações de 100%, 200%, 300% e 400% ($H=13,34$; $p<0,05$), sendo que as de 200% e de 300% apresentaram comportamento semelhante. Ambos os métodos visual e digital ofereceram altos níveis de reprodutibilidade intraobservador (visual: $\kappa_1=0,87$ e $\kappa_2=0,76$; digital: $\rho_1=0,99$ e $\rho_2=0,99$) e interobservador (visual: $\kappa=0,84$; $\rho=0,99$). Tomando-se o estereomicroscópio como critério de validação, a acurácia do ITS3.0 foi verificada, com sensibilidade de 0,95 e especificidade de 0,92.

Conclusões: Em relação à microinfiltração marginal: Ao se empregar o sistema digital ITS3.0, deve-se adotar as magnificações de 200% ou de 300% na resolução de 600 dpi. Os métodos de diagnóstico da microinfiltração marginal visual e digital mostraram-se

reprodutíveis. Considerando o estereomicroscópio como critério de validação, o método digital ITS3.0 se mostrou sensível e específico.

Palavras-chave: Infiltração dentária; Diagnóstico, Restauração dentária permanente; Reprodutibilidade dos testes; Validade dos testes.

Alvarenga FAS. Quality control in marginal microleakage (Tese de Doutorado). Araraquara – Faculdade de Odontologia da UNESP; 2011.

ABSTRACT

Objective: The main objective of this study was to evaluate the reproducibility and the accuracy of the marginal microleakage diagnosis, by means of visual and digital methods, establishing the ideal resolution and magnification for digital images.

Methods: In relation to the marginal microleakage diagnosis, by means of visual (stereomicroscope) and digital (Image Tool Software-ITS3.0) methods, two observers previously calibrated did the diagnosis, independently. It was estimated the intra/interobserver agreement and it was studied the validity of the digital image (using the stereomicroscope as the validation criterion). Also, it was verified the ideal resolution and magnification for digital image diagnosis.

Results: Using the Image Tool Software (ITS3.0), the magnification levels of 100%, 200%, 300%, and 400% showed to be different ($H=13.34$; $p<0.05$), and 200% and 300% were similar and are indicated to detect microleakage at 600 dpi. The visual method was reliable, with high levels of intraobserver agreement ($\kappa_1=0.87$, and $\kappa_2=0.76$) as the interobserver agreement ($\kappa=0.84$); for ITS3.0, the intraobserver was almost perfect for both examiners ($\rho_1=\rho_2=0.99$) and so was the interobserver agreement value ($\rho=0.99$). The accuracy of the ITS3.0 was verified, using the stereomicroscope as the validation criterion, with sensitivity of 0.95 and specificity of 0.92

Conclusions: In relation to microleakage, its detection by means of digital image (ITS3.0) showed that 200% and 300% magnification levels are indicated in the 600dpi resolution. The diagnosis of marginal microleakage using visual and digital methods presented high levels of intra- and interobserver agreement. Using the stereomicroscope as the validation criterion, digital diagnosis by ITS3.0 was sensitive and specific.

Keywords: Dental leakage; Diagnosis; Dental Restoration, Permanent; Reproducibility of results; Validity of tests.

1 Introdução

Em odontologia, uma das preocupações do clínico está voltada para o uso de materiais odontológicos de qualidade, aliada a um atendimento profissional que traga satisfação ao cliente.

Desta forma, procura-se obter sucesso no procedimento realizado, entendendo que seja importante estar atento ao material empregado, bem como à prestação de serviço, levando satisfação ao paciente.

Pelo exposto, dois aspectos de naturezas diversas chamam a atenção e merecem destaque. O primeiro deles se refere ao material odontológico empregado, pois, aliado a fatores como tipo da restauração, técnica empregada e características do paciente (idade, higiene e retorno ao consultório em atendimento de rotina), poderão afetar a longevidade da restauração⁵. A troca das restaurações é realizada quando a qualidade estética e funcional está comprometida, de acordo com sua forma anatômica, integridade marginal, descoloração e textura superficial. Considerando a integridade marginal, se o selamento da cavidade na interface dente-restauração for inadequado, resultará a microinfiltração, sendo importante saber realizar o diagnóstico dessa ocorrência. Assim, as restaurações são avaliadas quanto à existência de microinfiltração por diversos métodos, porém, poderão ocorrer erros, sejam casuais ou sistemáticos. O material odontológico empregado em restaurações deve ser avaliado continuamente, tanto *in vitro* como *in vivo*, colaborando para a longevidade das restaurações.

Deve-se considerar o surgimento de novas tecnologias, como a nanotecnologia, a utilização do laser em odontologia e o aparecimento de tratamento das superfícies, onde se torna necessário a avaliação da microinfiltração. Estes estudos abrangem desde a avaliação da influência das nanopartículas no comportamento dos materiais restauradores^{11, 1}, o tratamento do material restaurador¹ ou da superfície das cavidades antes de receberem uma restauração direta ou indireta^{10, 2}, podendo levar, inclusive, ao desenvolvimento de novos materiais⁸. Desse modo a avaliação da microinfiltração marginal é de fundamental importância para que novas técnicas e novos materiais possam ser desenvolvidos e aplicados com sucesso no tratamento restaurador.

Assim, existe a preocupação de que as informações sejam fidedignas, objetivas e pertinentes. Assim, alguns conceitos são fundamentais em controle de qualidade das informações em diagnóstico clínico^{9,3,6}. Tais conceitos dizem respeito:

- à reprodutibilidade (ou confiabilidade ou precisão), entendida como a “consistência dos resultados quando a medição ou o exame se repete”⁹. Assim, se um mesmo examinador procede à aferição, em dois momentos distintos, se houver concordância entre os resultados, tem-se a reprodutibilidade intra-examinador; porém, se dois examinadores procederem à aferição, num mesmo momento, de forma independente, e houver concordância, tem-se a reprodutibilidade inter-examinador⁵ e,

- à validade (ou acurácia ou exatidão) entendida como a “capacidade de os dados medirem o que pretendem realmente medir, ou seja, os resultados de uma aferição que correspondem ao estado verdadeiro dos fenômenos que estão sendo medidos”⁶. Ao serem realizados testes diagnósticos, os seguintes tipos possíveis de resultados poderão ocorrer:

- resultado correto, quando for positivo na presença da doença (verdadeiro-positivo) ou negativo na ausência da doença (verdadeiro-negativo) e

- resultado incorreto, quando for positivo e a doença é ausente (falso-positivo) ou quando for negativo e a doença é presente (falso-negativo).

Para se estudar a validade de um teste, é importante uma indicação mais sólida de outro exame que pode ser tomado como “verdade”, referido como “padrão-ouro”, “gold standard”, “critério de validação” ou “padrão de referência”. Às vezes, recorre-se a testes mais simples ao invés dos mais sofisticados para “critério de validação”, pela segurança e conveniência de serem aplicados. As relações entre um teste diagnóstico e a real presença da doença se expressam em termos de sensibilidade (proporção de pessoas com a doença que têm um teste positivo) e de especificidade (proporção de pessoas sem a doença que têm um teste negativo).

Considerando que o diagnóstico clínico é uma etapa importante da prática odontológica, deve-se ter em mente que esse processo poderá apresentar algum grau de imprecisão. Para contornar o problema, o cirurgião-dentista deve lançar mão de uma ferramenta importante, chamada de “teste diagnóstico”, que se torna mais informativa com a incorporação de estimativas de “reprodutibilidade” e de “validade”. Embora

encerrem conceitos distintos, sabe-se que um teste de baixa reprodutibilidade poderá acarretar baixa validade, portanto, de pouca utilidade. Porém, um teste de alta reprodutibilidade poderá (ou não) apresentar alta validade; isto se explica pelo fato de que determinado diagnóstico poderá se repetir, mas não ter capacidade de discriminar corretamente a situação que se apresente.

Pela importância que o tema desperta, procurou-se analisar o diagnóstico clínico da microinfiltração marginal, quanto à reprodutibilidade e à validade, realizando estudos de metodologia *in vitro*.

2 Proposição

O objetivo principal deste estudo foi verificar qualidade de testes diagnósticos em microinfiltração marginal.

Foram objetivos específicos:

1. Investigar a resolução e magnificação ideais para imagens digitais na detecção de microinfiltração marginal *in vitro*,
2. Avaliar o grau de reprodutibilidade dos métodos digital e visual para diagnosticar microinfiltração marginal,
3. Verificar a validade do método digital na obtenção do nível de microinfiltração marginal, adotando-se o estereomicroscópio como critério de validação,

3.1 Capítulo 1

THE USE OF DIGITAL IMAGE IN THE DIAGNOSIS OF MICROLEAKAGE

ALVARENGA F.A.deS., PINELLI C., LOFFREDO L.C.M. The use of digital image in the diagnosis of microleakage. STOMA 2008; 86:24-27. (ANEXO 1)

ABSTRACT

Digital images can provide quantitative measures of marginal microleakage, and they have been applied as an effort to reduce the subjectiveness of the qualitative measurements, based on scores. However, no previously study verified the performance of different zooming procedures in the evaluation of microleakage. **Objective:** The aim was to investigate the ideal resolution and magnification for digital images to detect marginal microleakage *in vitro*. **Methods:** Sixty one class V cavities were prepared in bovine teeth at the enamel/cement junction, and restored with a composite resin (Single Bond and Z100). The restorations were polished (Sof-lex discs) and thermo cycled 500 times with baths of 30s at 5°C and 55°C. Teeth fragments were obtained and digitalized. Three resolutions (200, 400 and 600 dpi) and four magnifications (100%, 200%, 300% and 400%) were applied, by using Image Tool software. Two calibrated examiners evaluated marginal microleakage on each resolution, and magnification, by consensus. It was applied Kruskal Wallis test (H) at 5% of significance. **Results:** The 600 dpi resolution provided the best quality of the images. Different magnifications at 600dpi resolution produced significant effects on the microleakage classification (H= 13,34; p<0.05). The statistical contrasts showed that the levels of magnification were similar for microleakage diagnosis, related to: 100%-400%, 200%-300%, 200%-400%, 300%-400%. The 200% and 300% magnifications showed the highest frequencies of well defined diagnosis (dp or da), with 74% and 72 % respectively. The magnification of

200% and 300% showed the best diagnostic performance and they were statistically similar. **Conclusion:** The 200% and 300% magnification are indicated and can be chosen to detect microleakage by means of digital image produced by the Image Tool Software.

INTRODUCTION

Traditionally, the diagnosis of microleakage *in vitro* has been performed under qualitative measurements in scores, previously defined by the examiner. Such analysis is obtained by sectioning the teeth, where the tooth-restoration junction can be observed with a stereomicroscope, giving the diagnosis and classifications of marginal microleakage^{1,2,3,4,5}.

Digital imaging can be used^{6,7,8,9} in microleakage diagnosis, with the advantage of manipulating the images. The use of softwares has been recommended for detection of bone lesions, small endodontic fillers, and initial caries lesions, and it is of interest to evaluate the use of the digital tool to detect marginal microleakage⁶. The “Image Tool”^{10,11,12,13} software has been used in the evaluation of the marginal microleakage restorations, although no previous study showed/indicated which resolution or magnification should be chosen in the moment the images are obtained.

PROPOSITION

The aim of this study was to investigate the ideal resolution and magnification by using the Image Tool software, in which digital imaging can be performed to produce the best definition for microleakage diagnosis *in vitro*.

METHODOLOGY

Sixty-one bovine incisor teeth were selected to avoid cracks or fractures in enamel, cleaned and stored in distilled water for 7 days. On each tooth one standardized class V cavity (4mm wide, 3mm high, and 1.5mm deep) was prepared in the buccal surface by means of cylindrical diamond bur. All the class V cavities were restored at the enamel/cement junction with Single Bond and Z100 composite. The restorations were polished with Sof-lex discs and thermocycled 500 times with baths of 30s at 5°C and 55°C. Teeth were cut with a rotating diamond disc and the fragments were digitalized under 200dpi, 400dpi, and 600dpi of resolution, and under magnification of 100%, 200%, 300%, and 400% by the Image Tool software. In total, 732 images were evaluated.

Two previously calibrated examiners classified the images according to the level of microleakage, in scores, by consensus. During microleakage analysis with the Image Tool software, it was possible to observe the importance of the definition of the image quality to detect the initial and the final points of the microleakage.

It was adopted a 5-point confidence scale, to assess the marginal microleakage, as follows: da= definitely absent; pa= probably absent; u= uncertain; pp= probably present; dp= definitely present.

It was applied Kruskal Wallis test (H) at 5% of significance. Stata 8.0 software was used to statistical analysis (Stata Corp. 2003. Stata Statistical Software: Release 8.0. College Station, TX: Stata Corporation. Texas, USA).

RESULTS

Taking into account that the resolution of 600dpi was the best, because of the quality of the provided image, Table 1 shows the results in relation to different levels of magnification at 600 dpi:

Table 1. Rank sum and mean rank according to level of magnification under 600dpi resolution.

Magnification	Obs	Rank sum	Mean Rank
100%	61	6075.00	99.59
200%	61	8363.00	137.10
300%	61	8325.00	136.48
400%	61	7127.00	116.84

It was found $H= 13.338$, showing that different levels of magnification lead to different marginal microleakage diagnosis.

The magnification levels (100%, 200%, 300% and 400%) were compared, according to Table 2:

Table 2. Comparison between the magnification levels.

Comparison	Difference	Critical value
100% and 200%	37.50*	32.83
100% and 300%	36.88*	
100% and 400%	17.25 ^{ns}	
200% and 300%	0.62 ^{ns}	
200% and 400%	20.25 ^{ns}	
300% and 400%	19.63 ^{ns}	

*Significant; ^{ns} non-significant

According to Table 2, there was no statistical significant difference between the magnifications: 100% - 400%, 200% - 300%, 200% - 400%, 300% - 400%.

Otherwise, it was observed that the 200% and 300% promoted the highest frequencies of well defined diagnosis (definitely present or definitely absent), with 74% and 72% respectively.

Therefore it's recommended to evaluate digital images of microleakage under 200% or 300% magnification.

DISCUSSION

Previous studies tested the Image Tool software to detect marginal microleakage^{4,6,8}, although none of them reported the ideal magnification and resolution for this kind of diagnosis. The present study was aimed at evaluating the best resolution and magnification for marginal microleakage diagnosis when this software was applied.

Such knowledge could help researchers to standardize image scanning in order to assure well defined limits of microleakage evaluation.

According to the present findings image quality had a direct relation with the scope to have a correct diagnosis of microleakage.

Two factors are essential in the acquirement of a high image quality: the resolution and the magnification, which are respectively related to the definition and the ampliation of the marginal limits of the restoration.

The results showed that a higher resolution at the same magnification is able too produce a better definition of the images. This can be explained by the increase of the dots per inch (dpi) making the definition even better. In this way when an image is scanned with a high resolution, there is a rise in the points observed by the scanner, consequently, the image definition has a better quality. The present study found that the ideal resolution to diagnosis the microleakage was 600 dpi.

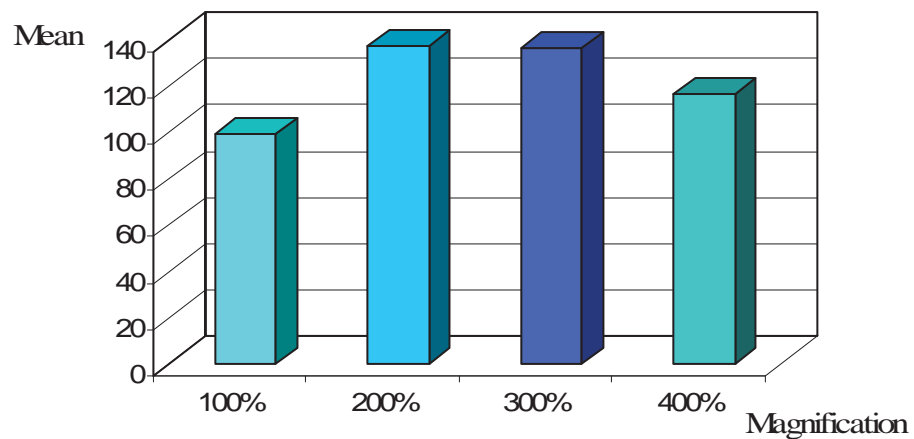
When the magnification was considered, it was observed that a low magnification gave a short image, in which the determination of the initial and final points of the microleakage were too difficult, making evaluation process more difficult to do.

The increase of the magnification value to 200% and 300%, corresponds to three or four times the original dimension, and as result an image with suitable size was obtained, which facilitated the microleakage evaluation.

The magnification of 400% (five times the original dimension), made the image definition to decrease, and the image to become unfocused. A higher magnification made it difficult to evaluate the initial and final points of microleakage.

It can be concluded that as higher the resolution, the best is the definition of the images. The better magnifications to detect the microleakage *in vitro*, under Image Tool software were 200% and 300%, as it can be seen at graph below:

Graph 1: Mean rank according to level of magnification



CONCLUSION

The ideal resolution was 600 dpi, and the levels of magnification of 200% and 300% showed similar results to evaluate microleakage diagnosis.

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3.2 CAPÍTULO 2

REPRODUCIBILITY OF THE MARGINAL MICROLEAKAGE DIAGNOSIS: VISUAL AND DIGITAL METHODS.*

Fábio Augusto de Santi Alvarenga; Marcelo F Andrade; Camila Pinelli; Leonor de Castro M Loffredo

Abstract

Objective: The aim of this study was to investigate the reproducibility of visual and digital methods to evaluate marginal microleakage *in vitro*. Methods: Class V cavities were prepared in 53 bovine teeth in the cementenamel junction, and were restored with composite resin. After dye penetration (0.5% basic fucsin), teeth were cut and only half was used to evaluate marginal microleakage. Two previously calibrated examiners (A and B) evaluated dye penetration in scores, by means of a stereomicroscope, and in millimeters, by the Image Tool software. The intra- and inter-examiner agreement was estimated according to Kappa statistics (κ), and intraclass correlation coefficient (ρ). Results: In relation to the visual method (stereomicroscope), the intra-examiner agreement was obtained for A ($\kappa=0.87$) and B ($\kappa=0.76$). The inter-examiner agreement showed an almost perfect reliability ($\kappa=0.84$). For the digital method (Image Tool software), the intra-examiner agreement was almost perfect for both examiners and equal to $\rho=0.99$, and so was the inter-examiner agreement value. Conclusion: The diagnosis of marginal microleakage using visual and digital methods showed high level of intra- and inter-examiner reproducibility.

Key Words: Reproducibility of Results, Dental leakage, Diagnosis, Software Validation, Composite resins

***Submetido para publicação no periódico Dental Materials (Anexo 2)**

Introduction

Microleakage is characterized by the passage of fluids, molecules, ions, and mainly bacteria, between the cavity wall and the filling material [1, 2, 3]. The study of microleakage has been a constant issue for dental care professionals, because its presence may result in tooth sensitivity, caries recurrence and pulpal injuries [4, 5]. Several techniques have been used to measure the level of marginal microleakage, such as the application of compressed air, bacteria, chemical, and radioactive markers, as well as electrochemical investigations, scanning electron microscopy, and dye penetration [3].

With regard to the dye penetration technique, the marginal microleakage classification can be measured by means of qualitative assessment, in scores [6, 7, 8] or by means of quantitative assessment, in numerical measurements [9, 10]. Despite the use of semi-quantitative assessment, some authors have investigated the application of specific softwares to evaluate digital images [7, 11, 12, 13, 14] in millimeters, micrometers or percentage. Digital imaging has been recommended for the detection of small endodontic filling defects, initial caries lesions, periodontal bone defect [15], and marginal microleakage [16, 17, 18].

In order to attribute a score or to establish the specific marks to perform a microleakage measurement, it is important to mention that there is considerable subjectivity in the classification process. Regardless the methods to assess marginal microleakage, the study of reproducibility is recommended. Another important issue is that a lack of standardization may lead to variability among researchers.

If it is admitted that there may be discrepancy between classifications and measurements taken by the same examiner in two distinct occasions, or by different examiners at the same moment, in an independent way of classification, so, it is necessary to be aware of the limitation with which a microleakage result is interpreted, whichever the method chosen for assessment. Thus, it is extremely relevant to provide the level of reproducibility of the microleakage diagnosis so that the research can be considered reliable [19, 20].

Thus, a fundamental concept is of reproducibility, defined as the consistence of the results when the measurement or examination is repeated under identical conditions. A test or measurement is reproducible if the results are identical or closely similar each time it is conducted[21].

This study aimed to contribute to the understanding of the reliability of marginal microleakage assessment. Therefore, it was investigated the intra-examiner agreement of results, that means the level in which a same examiner obtains the same results when assesses the diagnosis in two different occasions, and the inter-examiner agreement of results, that is related to different examiners making their own diagnosis independently in two distinct occasions. For such evaluation it was used, the visual examination under stereomicroscope, and the digital examination, using the Image Tool software.

Materials and Methods

Sample preparation

Sixty-one bovine incisor teeth were selected from a pool of 110 teeth in order to avoid cracks or fractures in enamel, and they were cleaned and stored in distilled water for 7 days. One standardized class V cavity (4mm wide, 3mm high, and 1.5mm deep) was manually prepared in the buccal surface on each tooth by using a high speed cylindrical diamond bur (#1092, KG Sorensen, São Paulo, SP, Brazil). One examiner prepared and checked the dimensions of each cavity with a periodontal explorer. Half of the cavity had the gingival margin located at the cemento-enamel junction (CEJ), and, in the other half, the margin was placed at the enamel. A rubber topper was used on the bur so that its active point would precisely penetrate 1.5mm into the tooth.

Restorative procedure

Each cavity was etched with 37% phosphoric acid, rinsed with water during 40s, dried with absorbent paper. A bonding agent (Single Bond, 3M Brazil, Ribeirão Preto, SP, Brazil) was applied on each cavity with a “microbrush n°2” (KG Sorensen, São Paulo, SP, Brazil), and it was dried with oil-free compressed air, before inserting the composite

resin (Z100 shade B3, 3M Brazil, Ribeirão Preto, SP, Brazil) filling. In order to avoid that the adhesive system reached the margin around the restorations, the excess of the adhesive system was removed of the microbrush, and so it could be applied inside the cavity. All materials were handled according to the manufacturer's instructions. All the class V cavities were restored in three oblique increments. The teeth were then stored in distilled water at 37°C for 7 days. After that, they were polished with aluminum oxide-coated flexible disks (Sof-lex, 3M Brasil, Ribeirão Preto, SP, Brazil). The teeth were subjected to thermocycling (500 cycles, 5°C and 55°C, 30s dwell time)[22, 23] during 10h. The root apices were sealed with acrylic resin and each tooth was covered with two layers of nail varnish except for the area approximately 1mm away from the interface tooth/restoration. Then, the teeth were immersed in 0.5% basic fuchsin dye solution. After 24h at 37°C, they were cleaned and sectioned through the middle of the restoration using a diamond saw (Isomet 1000, Buehler, Germany), with 300 rpm, and two sections were obtained.

At the end of the cutting procedure, eight teeth were lost, and 106 fragments were finally obtained. It was decided to include in the study the fragments where the highest dye penetration had occurred. Subjectivity was controlled by means of a pre-test study, where the examiners evaluated teeth fragments under stereomicroscope (Model SZX7, Olympus Corporation, Tokyo, Japan), with 20X magnification, and chose by consensus the ones with the highest dye penetration. Finally, 53 fragments were considered in the evaluation of marginal microleakage.

Two previously calibrated examiners (A and B) evaluated dye penetration in the gingival margin visually, under a stereomicroscope (20X original magnification), and evaluated digital images, by using the Image Tool software 3.0, which is of public domain, and developed by the University of Texas Health Science Center - San Antonio Dental School, USA – UTHSCSH. Each examiner performed two evaluations in two different occasions, independently, and under blind conditions. The interval between the two readings was 15 days. Intra- and inter-examiner agreement was obtained according to visual and digital methods.

Assessment Procedure

1 – Visual method : Stereomicroscope

The severity of the dye penetration was scored using a 5-point confidence scale:

INSERT TABLE 1

Figure 1 illustrates the criteria for classifying the visual examination under stereomicroscope.

INSERT FIGURE 1

2 – Digital method: Image Tool software

Each fragment was digitalized in a scanner (Model HP Scanjet 4670) and the marginal microleakage was obtained in millimeters (mm). The Image Tool software, produced a great resolution value at 600 dpi and 200% of image magnification, which were adopted in the present investigation, after they were previously tested to verify the image quality of digital images regarding marginal microleakage[24]. Figure 2 shows how marginal microleakage was measured.

INSERT FIGURE 2

Pre-test study

The pre-test study was performed in order to calibrate the two examiners (A and B) in marginal microleakage classification, according to visual and digital methods. Ten bovine incisor teeth, which were not included in the experimental study, were selected. The pre-test study was essential to determine the minimal loss of teeth, during cavity preparation, and to promote the examiner's calibration in the assessment of visual microleakage scores and digital images. Both examiners performed the measurements and established a consensus. The pre-test study was also important to establish which half of teeth would be used. Also, the initial and final marks of the marginal microleakage were established by consensus of both examiners into the Image Tool software.

Statistical Analysis

The estimation of intra- and inter-examiner agreement in the microleakage diagnosis was done by using:

- Kappa statistics[21], by point (κ) and by 95% of confidence interval ($CI_{95\%}$) in relation to the qualitative scale according to visual method. κ values were classified according to the patterns of[25] and
- Intraclass correlation coefficient[26], by point (ρ) and by 95% of confidence interval ($CI_{95\%}$), in relation to quantitative scale according to digital method.

The database file was analyzed using STATA software (StataCorp 2003. Stata Statistical Software: Release 8.0 College Station, TX: Stata Corporation).

Results and Discussion

1. Visual method : Stereomicroscope

Table 2 shows the intra- and inter-examiner agreement classifications, according to the visual method of evaluation (stereomicroscope).

INSERT TABLE 2

The intra-examiner agreement by point was almost perfect for examiner A ($\kappa = 0.87$), and substantial for examiner B ($\kappa = 0.76$). The respective confidence intervals showed a non-significant difference between examiners A and B, as well as an excellent level of inter-examiner agreement ($\kappa = 0.84$). The literature shows an inter-examiner reliability ranging from 0.77 to 0.99 in a study of the evaluation of the microleakage, in scores, using a stereomicroscope[27].

2. Digital method: Image Tool software

Considering the use of digital method (Image Tool) the intra and inter-examiner agreement were obtained as it can be seen in table 3.

INSERT TABLE 3

An almost perfect intra-examiner agreement was reached for each one of the examiners ($\rho=0.99$). The same value was obtained for the inter-examiner agreement ($\rho=0.99$), showing an almost perfect reproducibility with the digital assessment.

Microleakage is a major factor influencing the longevity of dental restorations so that the diagnosis should be as reliable as possible. This is a previously situation of the clinical application of a diagnostic method of the microleakage, giving the results with a high level of reliability. This study investigated the intra- and inter- examiner reproducibility of marginal microleakage assessments obtained by two previously calibrated examiners, according to visual (scores) and digital (numerical scale) methods. According to Corona[10], it is essential to give the reliability of a study with any kind of detection method. It was possible to observe that the visual method (stereomicroscope) provided a high level of intra- and inter-examiner agreement. A factor that helped to obtain this result was related to the calibration procedure between the examiners in the test study, which is indispensable in studies of this nature.

Marginal microleakage diagnosis is considered simple to be obtained when visual method is used. However, it represents a subjective method[1]. In addition, few studies mentioned the level of inter-examiner agreement when quantitative measurement in scores was applied[28]. Another limitation featured by such method is that the classification of intermediate intervals of marginal microleakage can be attributed in the same score. In the present study, the intra-examiner agreement was 0.88 and 0.76, respectively to A and B, and inter-examiner agreement was 0.84.

Based on technological development, several available softwares are able to provide numerical microleakage measurements, which consists a more objective result. One advantage of working with digital images is the possibility of being easier to manipulate them, by using zooming tools. Regarding the methods that are used to detect marginal microleakage, some authors have applied the quantitative assessment, which allows the

exact measurement of the restorations[29]. Procedures of quantitative microleakage assessment have been performed with different devices, such as Leica Qwin Plus image analysis program[29], and KS300-v2.0 software[30], and the results could not be directly compared with the present ones.

In relation to the use of the Image Tool software, few studies were performed to evaluate marginal microleakage[30, 31]. Therefore, the present study verified the software application to evaluate marginal microleakage in class V restorations, and so studied the reliability of such measurements. A remarkable finding was related to the necessity of a previous definition of the image quality, when dealing with the Image Tool software. The establishment of the ideal resolution and magnification for digital images were vital to define the initial and final points of microleakage on each image. Alvarenga[24] concluded that a good resolution and magnification would be 600dpi and 200% respectively, and they were applied in the present study.

Digital assessment by means of the Image Tool software provided microleakage measurements, and it was also shown as a reliable method, with an excellent reproducibility ($p=0.99$). Although this software was easily operated, and allowed the analysis of the images in a short time interval, it took longer to get images digitalized, when compared to the visual assessment. This could be considered a limitation of the digital method.

Despite such limitation, the authors suggest a previous calibration procedure to check the reproducibility intra and inter-examiners, regardless the method that is chosen to diagnose marginal microleakage.

In the evaluation of the quality control of dental materials, the microleakage assessment is highly recommended, using either visual or digital methods, where the levels of their reproducibility will be able to point out the reliability of the method used and, indeed, to contribute to the study of the efficacy of the material. This way, the present study could contribute to future clinical studies in the evaluation of material performance regarding marginal microleakage.

Conclusion

The diagnosis of marginal microleakage using visual and digital methods featured high levels of intra- and inter-examiner reproducibility.

Conflict of interest statement The authors declare that they have no conflict of interest.

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Table 1 Classification of marginal microleakage in scores[7]

<i>Score</i>	<i>Classification</i>
0	No leakage
1	Leakage extending one-third to the deepest point of the restoration
2	Leakage extending two-thirds to the deepest point of the restoration
3	Leakage extending to the deepest point of the restoration
4	Leakage extending beyond the deepest point of the restoration

Table 2 Intra- and inter-examiner agreement by point (κ) and by confidence interval ($CI_{95\%}$) for the evaluation of marginal microleakage, according to qualitative assessment - visual method.

Agreement	Examiner	κ	$CI_{95\%}$
Intra	A	0.87*	0.74 – 1.00
	B	0.76**	0.63 – 0.88
Inter	A – B	0.84*	0.75 – 0.94

** Substantial: 0.61 – 0.80; * Almost Perfect: 0.81 – 1.00

Table 3 Intra- and inter-examiner agreement by point (ρ) and by confidence interval ($CI_{95\%}$) for the evaluation of marginal microleakage, according to the quantitative assessment - digital method.

Agreement	Examiner	ρ	$CI_{95\%}$
Intra	A	0.99*	0.98 1.00
	B	0.99*	0.98 1.00
Inter	A – B	0.99*	0.98 1.00

* Almost perfect: 0.81-1.00

3.3 CAPÍTULO 3

ACCURACY OF DIGITAL IMAGE IN THE DETECTION OF MARGINAL MICROLEAKAGE: *IN VITRO* STUDY*

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***ACEITO para publicação no periódico Journal of Adhesive Dentistry (Anexo 3).**

Key words: dental leakage, diagnosis, validity of tests

Abstract

Purpose: The aim of this study was to evaluate the accuracy of Image Tool Software 3.0 (ITS 3.0) to detect marginal microleakage using the stereomicroscope as the validation criterion. *Materials and methods:* Class V cavities were prepared at the cement-enamel junction of 61 bovine incisors, and 53 halves of them were used. Using the stereomicroscope, microleakage was classified into a dichotomous scale, presence or absence. Next, ITS 3.0 was used to obtain measurements of the microleakage, so that 0.75 was taken as the cut-point, and values equal or greater than 0.75 indicated its presence, while values between 0.00 and 0.75 indicated its absence. Sensitivity and specificity were calculated by point and by the 95% confidence interval (95%CI). *Results:* The accuracy of the ITS 3.0 was verified with a sensitivity of 0.95 (IC95%: 0.89 – 1.00) and a specificity of 0.92 (IC95%: 0.84 – 0.99). *Conclusion:* Digital diagnosis of marginal microleakage by ITS 3.0 was sensitive and specific.

Introduction

Marginal microleakage leads to marginal staining and secondary caries, and if not treated in time, it can cause pulp pathology.^{4,5} These factors have been cited as the main reasons for restoration replacement.^{17, 14}

The control of marginal microleakage in dental practice is relevant in terms of restoration maintenance. Some considerations have to be made when a diagnostic test is used to detect marginal microleakage (MM).

Traditionally, MM is assessed by means of a qualitative measure with scores, leading to a degree of subjectivity. In such analyses, the teeth are sectioned, and dye penetration¹⁶ in the tooth-restoration junction is observed with a stereomicroscope to aid in the detection of MM. Hence, the researcher will be able to classify the MM according to the criterion adopted. One point to be considered is the analysis of the inter-observer agreement in MM diagnoses when they interpret the same images independently. This method may include a statistical method that takes into account that the interpretations could simply vary by chance. In the case of score classification, kappa statistics will be indicated to estimate the inter-observer agreement.¹⁰

Another issue is related to the use of digital imaging in dentistry, considering that image manipulation may enhance diagnostic interpretation. Software has been recommended for detecting bone defects, small endodontic files, and MM.⁶ Among the available software, some are low-cost packages or freeware, such as Image Tool Software 3.0 (ITS 3.0).⁷ A previous study¹ using ITS 3.0 indicated two factors in the acquisition of a high-quality image, resolution and magnification, and concluded that the ideal resolution was 600 dpi, and the ideal magnification levels were 200% and 300%, with similar results in the evaluation of MM diagnoses. In this case, MM is diagnosed numerically, and the measurements could be obtained by two observers, with an estimation of the inter-observer agreement by an intraclass correlation coefficient.

To guarantee reliability of the study, despite the need to verify the inter-observer agreement in the diagnosis, it is interesting to verify the level of accuracy of digital imaging. Considering the stereomicroscope as the validation criterion, the aim of this study was to verify the accuracy of ITS 3.0 to detect MM.

Materials and Methods

Sample size

Sixty-one bovine incisor teeth without cracks or fractures in the enamel were selected, and they were cleaned and stored in distilled water for seven days. One standardized class V cavity (4 mm wide, 3 mm high, and 1.5 mm deep) was manually prepared in the buccal surface on each tooth with a high-speed cylindrical diamond bur (#1092, KG Sorensen, São Paulo, SP, Brazil). One examiner prepared and checked the dimensions of each cavity with a periodontal explorer. Half of the cavity had the gingival margin located at the cement-enamel junction, while the other half had the margin placed at the enamel. A rubber topper was used on the bur so that its active point would penetrate precisely 1.5 mm into the tooth.

Restorative procedure

Each cavity was etched with 37% phosphoric acid for 30 s in enamel and 15 s in dentin, rinsed with water for 40 s and dried with absorbent paper. A bonding agent (Single Bond, Batch # 1105, 3M Brazil, Ribeirão Preto, SP, Brazil) was applied to each cavity with a “microbrush n°2” (KG Sorensen, São Paulo, SP, Brazil), and the cavity was dried with oil-free compressed air before inserting the composite resin (Filtek™ Z100 shade B3, Batch # 4004, 3M Brazil, Ribeirão Preto, SP, Brazil) filling. To avoid the adhesive system reaching the margin around the restorations, the excess adhesive was removed using a microbrush, and thus it could be applied inside the cavity. All materials were handled according to the manufacturer’s instructions. All the class V cavities were restored in three oblique increments. The teeth were then stored in distilled water at 37°C ($\pm 1^\circ\text{C}$) for seven days. After that, they were polished with aluminum oxide-coated flexible disks (Sof-lex, 3M Brazil, Batch # 4109, Ribeirão Preto, SP, Brazil). The teeth were subjected to thermo-cycling (500 cycles, 5°C to 55°C $\pm 1^\circ\text{C}$, 30 s dwell time) for 10 h. The root apices were sealed with acrylic resin, and each tooth was covered with two layers of nail varnish except for the area approximately 1 mm away from the interface of the tooth and restoration. Then the teeth were immersed in 0.5% basic fuchsine dye solution. After 24 h at 37°C ($\pm 1^\circ\text{C}$), they were cleaned and sectioned through the middle of the restoration using a diamond saw (Isomet 1000,

Model # 11-2180, Serial # 519-IPS-00641, Buehler, Germany) at 300 rpm, and two sections were obtained.

At the end of the cutting procedure, a total of 106 fragments were obtained, with eight teeth lost to damage during the cutting procedure. It was decided to include in the study the fragments where the highest dye penetration had occurred as the best way to detect and measure MM. Subjectivity was controlled by means of a pre-test study, in which the examiners evaluated teeth fragments under a stereomicroscope (Model SZX7, Olympus Corporation, Tokyo, Japan) with 20X magnification and chose by consensus the ones with the highest dye penetration. Finally, 53 fragments were considered for the evaluation of MM.

MM evaluation

The validation criterion was based on the stereomicroscope classification because it is the most commonly used to diagnose the MM *in vitro*,^{9,2,13} and it can be defined as the diagnosis most widely accepted as the best way to detect MM in research studies. The images were scored on a five-point confidence scale to assess the MM: 0 – definitely absent; 1 – probably absent; 2 – uncertain; 3 – probably present; and 4 – definitely present.

INSERT PICTURE 1

In relation to the use of ITS 3.0, each fragment was digitized on a scanner (Model HP Scanjet 4670), and the marginal microleakage was obtained in millimeters (mm). The ITS 3.0 produced a strong resolution value at 600 dpi and 200% image magnification, which were the settings adopted in the present investigation.

Two observers read the images 50 to 70 cm from the screen and classified them independently. The observers were previously calibrated, and a high level of inter-observer agreement ($\kappa = 0.84$) was reached. Furthermore, the use of digital images with ITS 3.0 gave the MM value numerically, which lead to a high level of inter-observer agreement ($\rho = 0.99$).

INSERT PICTURE 2

Statistical analysis

Measures of validity, such as sensitivity (Sen) and specificity (Spec), were obtained by point and by 95% confidence interval (IC95%).

According to the diagnosis made by two observers using a stereomicroscope, MM was diagnosed based on scores; according to the method using digital images (ITS 3.0), MM was diagnosed numerically. Parameters were established that made it possible to evaluate the accuracy of the digital method for the detection of MM, assuming the stereomicroscope as the validation criterion.

The diagnosis on a five-point confidence scale was converted to a dichotomous scale: absence or presence of microleakage. Therefore, the score classification was divided in two groups: scores 0 and 1 (absence of MM) and scores 2, 3 and 4 (presence of MM). The classification based on the numerical scale was also divided in two groups, in which the 0.75 mm was the cut-off point. Values from 0 to 0.75 mm indicated the absence of MM, whereas values equal to or greater than 0.75 were defined as the presence of MM (Table 1).

INSERT TABLE 1

Results

The results obtained for MM by both approaches, classification based on scores and measurements (in mm) and transformed into a dichotomous scale, can be seen in Table 2.

INSERT TABLE 2

High levels of Sen and Spec were observed, with the lower limit of the confidence interval at 0.89 for Sen and 0.84 for Spec.

Discussion

Among the properties that must be evaluated in the restorative materials, the MM method may be considered because it is directly related to the success or failure of the restorative procedure. Microleakage at the tooth/restoration junction can indicate

caries and consequently the need for restoration replacement. This way, the best marginal quality can be achieved to avoid postoperative sensitivity, marginal discoloration and caries¹¹.

In this study, the aim was to evaluate the accuracy of a digital method (ITS 3.0) of MM diagnosis by taking the stereomicroscope diagnosis of MM as the validation criterion in an *in vitro* study.

Although *in vitro* studies are often questionable, for reasons such as the lack of bacterial plaque on the restoration surface and pulpal pressure¹³, they play an important role in clinical research by allowing the prediction of the clinical behavior of dental materials based a previous evaluation of their performance. In addition, other studies^{3,8} mention the lack of correlation between laboratory and clinical behavior because *in vitro* conditions have an accelerated time of some factors, such as marginal degradation and thermal and masticatory stress. Another point to be considered is the conflicting data for microleakage in *in vitro* studies; certain authors¹⁵ state that the great variability in the methods used in such studies may influence the microleakage results. However, despite critics of the *in vitro* approach to the *in vivo* situation, it should be considered that *in vivo* studies impose a higher obstacle for research because it is difficult to obtain a large number of patients. There is also the difficulty related to the use of radiographs and clinical examination to detect MM precisely *in vivo*. According to Wenzel and Verdonschot, "It must be an ethical requirement that a diagnostic system is evaluated under *in vitro* conditions prior to testing on patients."¹⁸ Another issue is related to the difficulty of standardizing clinical conditions, such as oral hygiene, eating habits and parafunctional habits, which may affect the correct evaluation of the patients. It is recommended that laboratory studies must be used to predict the clinical behavior of the dental restorative materials because it is a viable method by which to avoid the exposure of patients to radiation, extractions or invasive procedures. Using previously extracted human and bovine teeth, the conditions to verify the MM can be gauged, without the deleterious effects cited above and without having to predict the clinical application of the restorative material.

In the present study, based on thermo-cycling (500 cycles, 5°C to 55°C ±1°C, 30 s dwell time) for 10 h using immersion in 0.5% basic fuchsin dye solution for 24 h at

37°C ($\pm 1^\circ\text{C}$), high levels of Sen and Spec were observed, so that Sen = 0.95 (0.89 – 1.00) and Spec=0.92 (0.84 – 0.99). These results demonstrate that high proportions of MM positives and MM negatives were correctly detected by the stereomicroscope, which was taken as the validation criterion.

Because the test under study (ITS 3.0) is based on a continuous variable, 0.75 was taken as the cut-off point. Thus, values lower than 0.75 were considered as MM absence, and values 0.75 and higher were considered as MM presence. One point to be raised is the vulnerability of a test based on a continuous variable because the accuracy results can be altered by changing the cut-off point. So, if we decrease the cut-off point, more cases of MM could be detected, increasing the sensitivity with fewer false negatives. However, more false positives would be observed, and the Spec would be decreased.

In addition to the accuracy of the digital imaging diagnosis stated above, more research is needed to provide the best methods to detect MM because there are few of it published.

Conclusion

The MM diagnosis can be made with digital imaging interpretation (ITS 3.0) due to its high Sen and Spec.

Clinical relevance

Beyond the evaluation of the material properties, the study of *in vitro* diagnostic methods is essential to obtain clues about the behavior of a dental material. Not only is the study of diagnostic methods essential, but so is the study of the validity of such methods compared to validation criteria. The study of accuracy in terms of the validity of the MM diagnostic method *in vitro* is of greater importance.

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Table 1. MM (presence and absence) by means of score classification (stereomicroscope) and ITS 3.0 measurements (in mm)

MM	MM	
	Presence	Absence
In score	2, 3, 4	0, 1
In mm	0.75	0 0.75

Table 2. Decision making diagnostic table for MM

MM (ITS 3.0)	Stereomicroscope (validation criterion)		Total
	Presence	Absence	
0.75 and +	39	1	40
0 – 0.75	2	11	13
Total	41	12	53

Sen = 0.95 (IC95%: 0.89 – 1.00)

Spec = 0.92 (IC95%: 0.84 – 0.99)

4 CONSIDERAÇÕES FINAIS

Procurou-se testar métodos para diagnóstico de microinfiltração marginal, de modo que apresentem aspectos de reprodutibilidade, de validade, garantindo controle de qualidade neste diagnóstico.

Os métodos para diagnóstico se constituem em instrumentos de coleta de dados que devem ser cercados dos mesmos cuidados que são adotados quando se usam termômetros, balanças, espectrofotômetros, estereomicroscópio, *softwares* para avaliação de cor, entre outros.

O pesquisador deve, a par da imprescindível realização de prova-piloto, verificar se o instrumento de medida é confiável (reprodutibilidade) e se avalia realmente o que se propõe a avaliar (validade). Desta forma, ao se utilizar um instrumento de medida de maneira criteriosa, a pesquisa fica enriquecida se alcançar altos níveis de reprodutibilidade e de validade, favorecendo a credibilidade nos resultados apresentados.

Em relação ao diagnóstico de microinfiltração marginal, o avanço da imagem digital tem possibilitado sua melhoria pela manipulação em relação a brilho, ao contraste, à cor, à inversão e à função *zooming*, sendo essa última bastante eficaz no diagnóstico de cárie^{10,11}.

Normalmente, o diagnóstico da microinfiltração marginal é dado em escores (0: ausência de infiltração; 1: infiltração em até um terço da parede circundante; 2: infiltração em até dois terços da parede circundante; 3: infiltração em toda a parede circundante; 4: infiltração após a parede circundante)¹², sendo um processo visual, portanto, com certo grau de subjetividade. Poderá ser avaliado numericamente e, se for considerado que os pontos inicial e final da microinfiltração devam ser assinalados pelo examinador, o mesmo aspecto de subjetividade irá persistir. Assim, deve-se considerar que a reprodutibilidade deva ser estimada, em termos de concordância intra-examinador e/ou interexaminador^{7,8,9}. Outra questão importante diz respeito ao viés de aferição, devendo ser controlado e, no caso específico do *software* ITS 3.0, apresentou-se com alto nível de reprodutibilidade intra- e interexaminador para microinfiltração *in vitro*. Outro aspecto de relevância é o da acurácia de um método diagnóstico, ou seja, o

quanto o resultado obtido reflete a situação real^{7,8,9}, discriminando corretamente quando o problema está “presente” ou “ausente”. Uma vez que a microinfiltração marginal é denotada em escala de Likert de 5 pontos, estabeleceu-se os critérios de “presença” para os escores 2, 3 ou 4 e de “ausência” para os escores 0 e 1. Para avaliação numérica, adotou-se o valor 0,75mm como ponto de corte, onde valores abaixo de 0,75 indicaram “ausência”. Ao se analisar a validade do *Image Tool Software*, verificou-se ser de alta sensibilidade e de alta especificidade, quando comparado ao critério de validação como sendo o estereomicroscópio.

Assim, o presente estudo considerou a situação clínica que o profissional vivencia na clínica, na verificação da microinfiltração marginal. Assim, na área odontológica, aspectos de controle de qualidade da informação (reprodutibilidade e validade) devem ser considerados para uma melhor valorização da metodologia adotada.

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THE USE OF DIGITAL IMAGE IN THE DIAGNOSIS OF MICROLEAKAGE

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ABSTRACT

Digital images can provide quantitative measures of marginal microleakage, and they have been applied as an effort to reduce the subjectiveness of the qualitative measurements, based on scores. However, no previously study verified the performance of different zooming procedures in the evaluation of microleakage.

Objective: The aim was to investigate the ideal resolution and magnification for digital images to detect marginal microleakage in vitro.

Methods: Sixty one class V cavities were prepared in bovine teeth at the enamel/cement junction, and restored with a composite resin (Single Bond and Z100). The restorations were polished (Sof-lex discs) and thermo cycled 500 times with baths of 30s at 50C and 55oC. Teeth fragments were obtained and digitalized. Three resolutions (200, 400 and 600 dpi) and four magnifications (100%, 200%, 300% and 400%) were applied, by using Image Tool software. Two calibrated examiners evaluated marginal microleakage on each resolution, and magnification, by consensus. It was applied Kruskal Wallis test (H) at 5% of significance.

Results: The 600 dpi resolution provided the best quality of the images. Different magnifications at 600 dpi resolution produced significant effects on the microleakage classification (H= 13,34; p<0.05). The statistical contrasts showed that the levels of magnification were similar for microleakage diagnosis, related to: 100%-400%, 200%-300%, 200%-400%, 300%-400%. The 200% and 300% magnifications showed the highest frequencies of well defined limits of microleakage in the images, correctly classified in 74% of definitely present microleakage, and 72% of definitely absent. The magnification of 200% and 300% showed the best diagnostic performance and they were statistically similar.

Conclusion: The 200% and 300% magnification are indicated and can be chosen to detect microleakage by

means of digital image produced by the Image Tool Software.

Keywords: Magnification, resolution, digital image, microleakage.

RESUMO

Imagens digitais podem fornecer mensurações quantitativas da micro infiltração marginal, e elas têm sido aplicadas com objetivo de diminuir a subjetividade das mensurações qualitativas, aferidas em escores. Entretanto, nenhum estudo anterior verificou a performance de diferentes ampliações na avaliação da micro infiltração.

Objetivo: O objetivo foi investigar a resolução e magnificação ideal para imagens digitais na detecção de micro infiltração marginal in vitro.

Métodos: Sessenta e uma cavidades classe V foram preparadas em dentes bovinos na junção cimento/esmalte, e restauradas com resina composta (Single Bond e Z100). As restaurações foram polidas (Discos Sof-lex) e termocicladadas 500 vezes em banhos de 30s a temperaturas de 5°C e 55°C. Os fragmentos de dentes foram obtidos e digitalizados. Três resoluções (200, 400 e 600 dpi) e quatro magnificações (100%, 200%, 300% e 400%) foram aplicadas, por meio do "software" Image Tool. Dois examinadores calibrados avaliaram a microinfiltração marginal em cada resolução e magnificação, por consenso. Foi aplicado o teste de Kruskal Wallis (H) com 5% de significância. Resultados: A resolução de 600 dpi promoveu a melhor qualidade de imagens. Diferentes magnificações em 600 dpi produziram efeitos significantes na classificação da micro infiltração (H= 13,34; p<0.05). O contraste estatístico mostrou que níveis de magnificação foram similares para o diagnóstico da micro infiltração, de acordo com: 100%-400%, 200%-300%, 200%-400%, 300%-400%. As magnificações de 200% e 300% mostraram as maiores frequências de limites bem definidos da micro infiltração nas imagens, corretamente classificadas como 74% de micro infiltração definitivamente presente, e 72% em

ANEXO 2

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Manuscript type: Original Article

All Authors: Fabio Augusto de Sant'Alvarenga, Marcelo Ferreira de Andrade, Alessandra Reis Souza Rattelli, Camila Pinelli, Kati Regina Victorino, Luonor de Castro Monteiro Loffredo.

Keywords: dental leakage; diagnosis; validity of tests

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ANEXO 4


#SAUSOC-49 : Impacto da saúde bucal na qualidade de vida

RESUMO	AVALIAÇÃO	EDIÇÃO
Submissão		
Autores	Fabio Augusto de Santi Alvarenga, Leonor de Castro Monteiro Loffredo, Cristiane Henriques, Camila Pinelli, Andréia Affonso Montandon, Fabiana Takatsui, Rodolpho Telarolli Junior, Ana Lúcia Colabone de Castro Monteiro, 	
Título	Impacto da saúde bucal na qualidade de vida	
Seção		
Editor	Ana Lebate 	
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ANEXO 5


#RBEPID-473: Dental anxiety and prior experience in a dental care setting

RESUMO | **AVALIAÇÃO** | EDIÇÃO**Submissão**

Autores Tiago Mendonça Dias, Sabrina Spinelli Cioffi, Cristina Presoto, Fábio Augusto de Santi Alvarenga, Juliana Alvares Duarte Campos, Leonor de Castro Monteiro Loffredo 

Título Dental anxiety and prior experience in a dental care setting

Seção Artigos Originais

Editor Sandra Suzuki 

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ANEXO 6

Trabalhos apresentados em congressos.

84th General Session & Exhibition of the IADR

Brisbane, Australia – June 28 – July 1 – 2006.

1576 The use of digital image in the diagnosis of microleakage

[F.A.D.S. ALVARENGA](#), L. LOFFREDO, and C. PINELLI, UNESP- Araraquara Dental School, Brazil, UNESP- Araraquara Dental School, Araraquara, SP, Brazil

Objective: The aim of this study was to determinate the ideal resolution and magnification for digital images used in the diagnosis of microleakage of composite restorations. Methods: Sixty one bovine tooth where used and it was prepared 61 class V cavities at the enamel/cement junction, which were restored with Single Bond and Z100 composite. After finished the restorations, they were polished with Sof-lex discs and thermo cyded 500 times with baths of 30 seconds at 5C and 55°C of temperature. Then they were cutted with a rotating diamond disc and the tooth fragments were digitalized with 200 dpi, 400 dpi and 600 dpi of resolution and in each resolution with 100%, 200%, 300% and 400% of magnification using Image Tool software. Two examiners classified the images according to microleakage, in scores, by consensus. It was applied Kruskal Wallis test (H) at 5% of significance. Results: The 600 dpi resolution was the best one because of the quality image provided by it. At 600 dpi, the magnifications produced significant differences in the effects of the microleakage classification (H= 32.83; p<0.05), and the statistical contrasts showed that the 200% and 300% of magnification were similar for the microleakage diagnosis, and, indeed, the limits were well defined. Conclusion: The magnifications of 200% and 300% are indicated in the microleakage diagnosis using digital image, so that, the researches could choose any one of them to clinical tasks.

[Seq #132 - Adhesive Materials: General](#)

11:00 AM-12:00 PM, Friday, 30 June 2006 Brisbane Convention & Exhibition Centre Exhibit Hall 1

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87th General Session & Exhibition of the IADR
Miami, Fla., USA – April 1-4 – 2009.



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3196 Accuracy of Digital Image in the Detection of Microleakage

Saturday, April 4, 2009: 1:45 p.m. – 3 p.m.

Location: Exhibit Hall D (Miami Beach Convention Center)

F.A.D.S. ALVARENGA, M.F. ANDRADE, C. PINELLI, K.R. VICTORINO, and L.D.C.M. LOFFREDO, Universidade Est. Paulista Julio Mesquita, Araraquara, Brazil

Marginal microleakage has traditionally been assessed in a qualitative manner. Recently, specific software packages have been introduced to provide a quantitative assessment to improve such evaluations. Objective: The aim of this study was to evaluate the accuracy of Image Tool Software 3.0 (ITS, Roswell, GA, USA) to detect marginal microleakage with a visual method based on stereomicroscopy as the validation criterion. Methods: Class V cavities were prepared at the cemento-enamel junction of 61 bovine incisors, and 53 halves were used. According to stereomicroscopy, microleakage was classified with scores of 0, 1 (absence or minimum microleakage), and 2, 3, or 4 (presence of microleakage). This classification was considered as the validation criterion. Marginal microleakage was evaluated with ITS under 600 dpi resolution and 200% image magnification. Values were produced quantitatively, and the 0.75 value was taken as the cut-off point: Values above 0.75 were indicative of the presence of microleakage, and values between 0.00 and 0.75 indicated its absence. Sensitivity (Sen) and Specificity (Spec) were calculated. The examiner was previously calibrated, and a pilot study was done. Results: The accuracy of the ITS was high, since the results were: Sen = 39/40 = 0.97, and Spec = 12/13 = 0.92. Conclusions: Digital diagnosis of marginal microleakage by ITS was very specific and sensitive, although it should be remembered that the vulnerability of a test based on a continuous variable can have validity results altered by changing the cut-off point.

[See more of: Adhesion Challenges](#)

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88th General Session & Exhibition of the IADR

Barcelona , Spain – July 14-17 – 2010.



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4137 The Use of OHIP-14 Among Brazilian Patients Under Treatment

Saturday, July 17, 2010: 3:30 p.m. - 4:45 p.m.

Location: Exhibit Hall (CCIB)

F.A.D.S. ALVARENGA, C. HENRIQUES, F. TAKATSUI, A.A.B. MONTANDON, R. TELAROLLI JR, C. PINELLI, M.F. ANDRADE, and L.C.M. LOFFREDO, Universidade Est. Paulista Julio Mesquita, Araraquara- SP, Brazil

Objectives: To apply the short-form of OHIP-14 to Brazilian adults under treatment. **Methods:** Cross-sectional study among 149 individuals aged 50 year-old and older. They were interviewed by a previously calibrated researcher who fulfilled the OHIP-14 formulary, on the seven dimensions of impact: functional limitation, physical pain, psychological discomfort, physical disability, psychological disability, social disability, and handicap. The participants answered according to frequency of impact on a 5-point Likert scale coded never (score 0), hardly ever (score 1), occasionally (score 2), fairly often (score 3), and often (score 4) using a six-month recall period. Cronbach's alpha was used and the prevalence of impacts was calculated. **Results:** The OHIP-14 showed an overall satisfactory internal reliability (alpha=0.78). The dimension that caused more impact was related to "physical pain" (OHIP=1.13 and OHIP=0.77, respectively to uncomfortable to eat, and painful aching), followed by "psychological discomfort" (OHIP=0.49 related to stress), with no handicapped individuals. OHIP-14 reached 4.99, showing a low impact of oral conditions on quality of life. In addition 83.3% of the participants reported at least one impact in a more frequently manner during the last six months, and 21.5% referred to be uncomfortable to eat. **Conclusion:** The OHIP-14 is a reliable instrument that focuses on the impact of oral conditions on quality of life and the "physical pain" predominated among patients under treatment.

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