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Larissa Lemos Nagipe

**ACURÁCIA DO MÉTODO DIAGNÓSTICO FOTOGRÁFICO
PARA DETECÇÃO DE LESÕES CARIOSAS ASSOCIADAS AO USO DE
APARELHO ORTODÔNTICO FIXO**

Santa Maria, RS
2020

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ORTODÔNTICO FIXO**

Dissertação apresentada ao Curso de Mestrado do Programa de Pós-Graduação em Ciências Odontológicas da Universidade Federal de Santa Maria (UFSM, RS), como requisito parcial para obtenção do título de **Mestre em Ciências Odontológicas.com Ênfase em Dentística**

Orientador: Prof. Dr. Júlio Eduardo do Amaral Zenkner

Santa Maria, RS
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Larissa Lemos Nagipe


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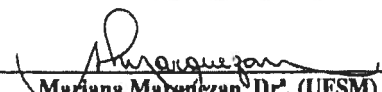
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RESUMO

ACURÁCIA DO MÉTODO DIAGNÓSTICO FOTOGRÁFICO PARA DETECÇÃO DE LESÕES CARIOSAS ASSOCIADAS AO USO DE APARELHO ORTODÔNTICO FIXO

AUTORA: Larissa Lemos Nagipe

ORIENTADOR: Prof. Dr. Júlio Eduardo do Amaral Zenkner

A presente dissertação está composta por um artigo científico cujo objetivo foi avaliar a acurácia do método diagnóstico fotográfico para detecção de lesões cariosas associadas ao uso de aparelho ortodôntico. A amostra foi composta por 38 indivíduos portadores de aparelho ortodôntico fixo em ambas as arcadas (grupo ET, “em tratamento”), sendo 16 do sexo masculino (42%) e 22 do sexo feminino (58%), com idade média (\pm desvio padrão[dp]) de 23 (\pm 8,6) anos e 10 pacientes sem aparelho fixo, avaliados imediatamente após a sua remoção (grupo IAT, “imediatamente após tratamento”), sendo 8 do sexo feminino e 2 do sexo masculino, com idade média (\pm dp) de 22 (\pm 10) anos. A amostra foi coletada entre os pacientes em tratamento ortodôntico no Curso de Especialização em Ortodontia da Faculdade de Ingá (UNINGÁ) - Unidade Santa Maria (RS) e no serviço odontológico da Base Aérea de Santa Maria - BASM. Inicialmente, foi realizado exame clínico visual-tátil para detecção de lesões de cárie, após limpeza profissional e secagem dos dentes, em equipamento odontológico, com espelho bucal e sonda da Organização Mundial de Saúde. Em seguida, um profissional treinado para a realização de fotografias odontológicas realizou todos os registros fotográficos padronizados. Com o auxílio de afastadores fotográficos e após a secagem dos dentes, as fotografias foram tiradas com uma câmera digital em cinco incidências: frontal, lateral direita, lateral esquerda, oclusal superior e oclusal inferior. Um único examinador treinado e calibrado para o índice de cárie realizou todas as avaliações clínicas e fotográficas subsequentes, usando o mesmo critério. Os parâmetros diagnósticos de sensibilidade, especificidade, acurácia, valor preditivo positivo e valor preditivo negativo foram calculados para o método diagnóstico fotográfico, considerando o exame clínico como padrão ouro. Dos 38 pacientes do grupo ET, a prevalência de lesões de cárie ativa foi de 92%. Apenas 3 indivíduos não apresentaram atividade de cárie. As fotografias digitais foram capazes de corretamente identificar 29 dos 35 indivíduos portadores de lesões ativas de acordo com padrão-ouro. Por outro lado, apenas 1 dos 3 pacientes sadios foi corretamente identificado por este método. Estes achados estão expressos nos parâmetros diagnósticos: sensibilidade 83%, especificidade 33%, acurácia 79%, valor preditivo positivo 93% e valor preditivo negativo 14%. Todos os 10 pacientes do grupo IAT apresentaram lesões ativas de acordo com o padrão ouro, dos quais 5 foram corretamente identificados pelas fotografias digitais feitas com a câmera. Em conclusão, este estudo mostrou que o método fotográfico apresentou acurácia satisfatória para a identificação de pacientes cárie-ativos, mostrando boa sensibilidade em pacientes utilizando aparelho ortodôntico fixo. No entanto, quando o método foi utilizado após a remoção do aparelho ortodôntico, não foi capaz de identificar adequadamente a presença de lesões cariosas ativas.

Palavras-chave: Cárie dentária. Diagnóstico. Detecção. Validação. Mensuração. Aparelho ortodôntico. Acurácia.

ABSTRACT

ACCURACY OF THE PHOTOGRAPHIC DIAGNOSTIC METHOD FOR THE DETECTION OF CARIES LESIONS ASSOCIATED WITH FIXED ORTHODONTIC APPLIANCES

AUTHOR: Larissa Lemos Nagipe

ADVISOR: Prof. Dr. Júlio Eduardo do Amaral Zenkner

The present dissertation consists of a scientific article whose objective was to evaluate the accuracy of the photographic diagnostic method for detecting caries lesions associated with the use of orthodontic appliances. The sample consisted of 38 patients with fixed orthodontic appliance in both arches (UT group, “under treatment”), 16 male (42%) and 22 female (58%), with a mean age (\pm standard deviation [sd]) of 23 (\pm 8.6) years and 10 patients without a fixed device, addressed immediately after their removal (IAT group, “immediately after treatment”), 8 female and 2 male, with a mean age (\pm sd) of 22 (\pm 10) years. The sample was recruited among individuals under treatment in the Specialization Course in Orthodontics, Faculty of Ingá (UNINGA) - Santa Maria Unit (RS) or in the dental service of Santa Maria Air Base – BASM. First, a visual-tactile clinical examination was performed to detect caries lesions, after professional tooth cleaning and drying, at a dental unit, with a clinical mirror and a probe from the World Health Organization. A professional trained to take dental photographs performed all standardized photographic records. With the aid of photographic retractors and after drying the teeth, the photographs were taken with a digital camera in five views: frontal, left lateral, right lateral, lower occlusal, and upper occlusal. A single trained and calibrated examiner for the caries index performed all clinical and photographic assessments, using the same criterion. The diagnostic parameters of sensitivity, specificity, accuracy, positive predictive value and negative predictive value were calculated for the photographic method considering the clinical examination as the gold standard. Of the 38 patients in the UT group, the prevalence of active caries was 92%. Only 3 individuals did not show caries activity. The digital photographs were able to correctly identify 29 of the 35 individuals with active caries according to the gold standard. On the other hand, only 1 of the 3 healthy patients was correctly identified by this method. These findings are expressed in the diagnostic parameters: sensitivity 83%, specificity 33%, accuracy 79%, positive predictive value 93% and negative predictive value 14%. All the 10 patients in the IAT group had active caries lesions, of whom only 5 were identified by the digital photographs taken with the camera. In conclusion, this study showed that the photographic examination had a satisfactory accuracy to detect caries-active patients during the fixed orthodontic therapy, showing a high sensitivity. However, when the method was used after the removal of the orthodontic appliance, it was unable to identify the presence of active caries lesions.

Key words: Dental cavity. Diagnosis. Detection. Validation. Measurement. Orthodontic appliance. Accuracy.

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1 ANTECEDENTES E JUSTIFICATIVA

Apesar da expressiva redução da experiência de cárie dentária observada nas últimas décadas, a doença ainda é um problema muito prevalente na população (PERES, et al., 2019). A doença cárie é um processo multifatorial, no qual há a destruição dos tecidos dentários decorrente do acúmulo prolongado de biofilme, diminuição do pH e desequilíbrio no processo desmineralização-remineralização dentária.

Superfícies irregulares como bandas, fios e braquetes ortodônticos favorecem o acúmulo de biofilme e limitam a autolimpeza que ocorre naturalmente, com o movimento da musculatura oral e saliva (SUNDARARAJ, et al., 2015). Além disso, esse acúmulo de biofilme está associado a uma higiene oral deficiente (BEHNAN et al., 2010; MAXFIELD et al., 2012), o que resulta no desenvolvimento de lesões cariosas associadas à terapia ortodôntica fixa (MIZRAHI, 1982; ENAIA; BOCK; RUF, 2011; TUFEKCI et al., 2011; SAGARIKA et al., 2012; LUCCHESI; CHERLONE, 2013; PINTO et al., 2018).

Segundo a metanálise de Sundararaj et al. (2015) que avaliou as taxas de prevalência e incidência de lesões de mancha branca durante o tratamento ortodôntico, a prevalência encontrada em pacientes em tratamento ortodôntico fixo por tempo maior ou igual a 12 meses foi de 68,4%. Mais recentemente, Pinto et al. (2018) avaliaram a relação entre duração do tratamento ortodôntico e atividade das lesões cariosas em uma amostra de 260 pacientes. Este estudo mostrou uma associação significativa entre maior duração do tratamento ortodôntico e maior prevalência/extensão de lesões de cárie ativas entre adolescentes e adultos jovens, evidenciando a necessidade de controle da doença cárie juntamente ao tratamento ortodôntico. Em vista disso, a cárie dentária tem sido consistentemente considerada uma decorrência comum associada ao tratamento ortodôntico fixo (AHMED; ISAIIF-UL-HAQUE; NAZIR, 2011; TUFEKCI et al., 2011; SUNDARARAJ et al., 2015, PINTO et al., 2018).

Muitos estudos avaliando a relação entre uso de aparelho ortodôntico fixo e cárie dentária utilizam fotografias das arcadas dentárias dos pacientes, tomadas para finalidade de documentação pós-tratamento ortodôntico, para o diagnóstico de lesões de cárie (BENKADDOUR et al., 2014; ENAIA; BOCK; RUF, 2011; JULIEN; BUSCHANG; CAMPBELL, 2013; RICHTER et al., 2011). É possível supor que tais fotografias subestimem a ocorrência das lesões de cárie, uma vez que são tomadas para outra finalidade, sem prévia limpeza e secagem das superfícies dentárias e sem abranger todos os dentes e superfícies.

O estudo de Chapman et al. (2010) foi conduzido para avaliar os fatores de risco para a incidência e severidade de lesões de mancha branca após tratamento ortodôntico fixo, através da avaliação de fotografias. Como um objetivo secundário, os autores compararam o método fotográfico com o exame clínico visual em uma sub-amostra de pacientes. A área abrangida pelas lesões cariosas medidas através das fotografias foi comparada com a área observada no exame clínico através do cálculo do coeficiente de correlação intraclasse, obtendo-se resultados satisfatórios. Neste estudo, apenas as superfícies vestibulares de oito dentes foram avaliadas (do primeiro pré-molar superior direito ao primeiro pré-molar superior esquerdo). Não há estudos avaliando parâmetros diagnósticos como sensibilidade, especificidade, valores preditivos e acurácia do método fotográfico para detecção de lesões de cárie em pacientes portadores de aparelho ortodôntico fixo.

O avanço da tecnologia fotográfica facilitou os registros de imagens clínicas odontológicas em mídias digitais, possibilitando a troca de informações e fotografias clínicas remotamente para consultorias em odontologia. Isto caracteriza o instrumento conhecido como “teleodontologia” (JAMPANI et al., 2011). A possibilidade da utilização de registros fotográficos para a identificação de lesões de cárie já foi previamente investigada. Na revisão sistemática que examinou a precisão diagnóstica da “teleodontologia” para detecção de lesões de cárie em comparação com o exame clínico visual, Estai et al. (2016) encontraram resultados de desempenho equivalentes. No mesmo sentido, Alabdullah e Daniel (2018) demonstraram em outra revisão sistemática que a “teleodontologia” pode ser comparada ao exame face-a-face para finalidade de triagem odontológica. No entanto, esta possibilidade não foi adequadamente testada em pacientes portadores de aparelho ortodôntico fixo.

**2 ARTIGO – ACCURACY OF THE PHOTOGRAPHIC METHOD FOR THE
DETECTION OF CARIES LESIONS ASSOCIATED WITH THE USE OF FIXED
ORTHODONTIC APPLIANCES**

Este artigo será submetido ao periódico *American Journal of Orthodontics and Dentofacial Orthopedics*, ISSN: 0889-5406; Fator de impacto = 1.960; Qualis A1. As normas para publicação estão descritas no Anexo B.

TITLE PAGE**Accuracy of the photographic method for the detection of caries lesions associated with the use of fixed orthodontic appliances**

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ABSTRACT

Introduction: This study evaluated the accuracy of the photographic diagnostic method for detecting caries lesions associated with the use of fixed orthodontic appliances.

Methods: The sample consisted of 38 individuals using a fixed appliance in both arches (UT group, “under treatment”) and 10 patients without a fixed appliance, evaluated immediately after its removal (IAT group, “immediately after treatment”). Digital photographs were taken using a digital camera in five views. After professional tooth cleaning and drying, a visual-tactile clinical examination was carried out to detect caries lesions. The diagnostic parameters of sensitivity, specificity, accuracy, positive predictive value (PV+) and negative predictive value (PV-) were calculated for the photographic method considering the clinical examination as the gold standard.

Results: The prevalence of active caries was 92% in the UT group. The digital photographs were able to correctly identify 29 of the 35 individuals with active caries according to the gold standard. On the other hand, only 1 of the 3 healthy patients was correctly identified by this method. These findings are expressed in the following diagnostic parameters: sensitivity 83%, specificity 33%, accuracy 79%, PV+ 93% and PV- 14%. All the 10 patients in the IAT group had active caries, of whom only 5 were identified by the photographs.

Conclusion: The photographic examination had a satisfactory accuracy to detect caries-active patients during the fixed orthodontic therapy. However, after the removal of the orthodontic appliance, it was unable to identify the presence of active caries lesions.

INTRODUCTION

Caries disease is a multifactorial process characterized by the destruction of the dental hard tissues due to the prolonged accumulation of biofilm associated with the frequent supply of fermentable carbohydrates, leading to an imbalance in the de-remineralization process. The development of caries lesions has been consistently considered a common adverse effect of the fixed orthodontic therapy¹⁻⁴. It occurs because the irregular surfaces such as bands, wires, and orthodontic brackets favor the accumulation of biofilm and limit the self-cleaning that naturally occurs with the movement of the oral musculature and saliva³. In addition, this accumulation of biofilm is associated with a poor oral hygiene among orthodontic patients^{5,6}.

Although the visual-tactile examination is the most commonly used method to detect caries lesions⁷, most studies evaluating the relationship between the use of fixed orthodontic appliances and dental caries use photographs of patients' dental arches for caries detection⁸⁻¹¹. It is possible to speculate whether such photographs, taken for the purpose of orthodontic documentation, may underestimate the occurrence of caries lesions. The study by Chapman et al.¹² was conducted to assess the risk factors for the incidence and severity of white spot lesions after fixed orthodontic treatment through the evaluation of photographs. As a secondary aim, the authors compared the photographic method with the visual clinical examination in a subsample of ten patients. The area covered by the caries lesions measured through the photographs was compared with the area observed in the clinical examination by calculating the intraclass correlation coefficient. The authors obtained satisfactory results; however, only the facial surfaces of the anterior eight maxillary teeth (from the upper right first premolar to the upper left first premolar) were included and the diagnostic parameters of sensitivity, specificity, predictive values and accuracy of the photographic method for detecting caries lesions among orthodontic patients was not properly assessed.

Therefore, the aim of this study was to assess the diagnostic accuracy of the photographic method for detecting caries lesions associated with the use of a fixed orthodontic appliance.

SUBJECTS AND METHODS

Study design and sample

This observational cross-sectional study evaluated 48 patients undergoing orthodontic treatment in one Specialization Course in Orthodontics and at the dental service of the Military Air Force of XXXXXX. This sample was composed of 38 individuals using a fixed appliance

in both arches (group UT, “under treatment”) and 10 patients without the fixed appliance, evaluated immediately after its removal (group IAT, “immediately after treatment”). Patients of both sexes, aged between 14 and 30 years, were considered eligible for the study.

Data collection

A professional trained to perform dental photographs took five standardized photographs of each patient, in the frontal, left lateral, right lateral, maxillary occlusal, and mandibular views, following the American Board of Orthodontics requirements for intra oral photographs (Fig. 1). Photographs were taken with the aid of photographic retractors and after tooth drying with air jets of a triple syringe from the dental unit, using a Canon EOS Rebel T6 digital photo camera, Canon EF 100mm f / 2.8 USM macro lens, and a Youngno circular flash YN14EX. The camera was set at the following settings: manual mode (M), f / 25 (aperture of the diaphragm); 1/160s (shutter speed); ISO 400; 1: 1 focus, 0.48 focal length; image resolution of 18 Mgpixel RAW and JPEG, flash in TTL mode.

After the photographs, clinical examinations were performed in a dental unit using a flat clinical mirror n. 5, and a World Health Organization probe. After tooth cleaning with toothbrush and prophylactic paste, the teeth were dried with an air-water syringe for 5 seconds and isolated with cotton rolls. Caries examination included the assessment of all dental surfaces, which were classified based on their clinical characteristics (color, brightness, and surface texture), as follows: inactive non-cavitated lesions, surface areas presenting a shiny appearance with or without different degrees of brownish discoloration; active non-cavitated lesions, opaque enamel with a dull-whitish surface; inactive cavitated lesions, localized surface destruction with arrested characteristics (shiny, hard surfaces with different degrees of brownish discoloration); active cavitated lesions, localized surface destruction with active characteristics (dull-whitish enamel and soft dentin with light brown color)¹³.

In the IAT group, clinical examination was performed immediately after the removal of the fixed appliance and the photographs were taken after polishing the tooth surfaces for the removal of the resin excesses.

Photographic analysis

For the detection of dental caries by the photographic method, intraoral photographs were examined using the same criterion used in the clinical diagnostic exam. The data were recorded on a clinical record equal to the one used in the clinical examination. All surfaces from first right molar to first left molar were evaluated in both arches. The photographic diagnosis

was always performed on the same computer (notebook Dell Inspiron I15-3567-A10P, 15.6" led screen), with standardized screen configurations and without magnifying the images. The evaluator was unaware of the clinical diagnosis at the time of the photographic evaluations.

Reproducibility

All clinical and photographic examinations were performed by a single examiner (LLN) who was trained and calibrated for caries examination by a reference examiner (PKM). After theoretical training sessions with photographs and clinical examinations, repeated examinations were performed on 15 subjects with a minimum time interval of 7 days to assess the examiner's reproducibility. Unweighted intra- and inter-examiner kappa values of 0.70 were obtained for the clinical examination. The intra-examiner reproducibility was also assessed for the photographic examination, and a kappa value of 0.75 was obtained.

Data analysis

The prevalence of caries activity was defined as the percentage of individuals presenting at least one active caries lesion, either non-cavitated or cavitated.

The diagnostic parameters of sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated for the photographic method considering the clinical examination as the gold standard.

Ethical aspects

The study protocol was approved by the Ethics Committee of the XXXXXXXX (CAAE 10325518.9.0000.5346). The patients or their legal guardians signed an informed consent form. Individuals received a report of their oral health status.

RESULTS

Sample description according to group is presented in Table I. In both groups, the sample was predominantly composed of young adults and females. In the 38 patients using fixed orthodontic appliance in both arches (group UT), the prevalence of caries activity was 92% (n=35 patients). Only three individuals showed no active caries lesion. UT patients presented, on average (\pm standard deviation[sd]), 6.2 (\pm 3.9) active lesions, ranging from 0 to 14. As shown in Table II, digital photographs were able to correctly identify 29 of the 35 individuals with active caries according to the gold standard. On the other hand, only one of the three healthy patients was correctly identified by this method. These findings are expressed in the

following diagnostic parameters: sensitivity 83%, specificity 33%, accuracy 79%, positive predictive value 93% and negative predictive value 14%.

According to the clinical examination, all patients from group IAT had active caries, with a mean (\pm sd) of 6.0 (\pm 4.2) lesions per patient, ranging from 2 to 14. In digital photographs taken with the camera, caries activity was identified in five patients. Due to the lack of healthy individuals, the diagnostic parameters could not be properly calculated in IAT group.

DISCUSSION

This study evaluated the diagnostic accuracy of the photographic method for detecting caries lesions associated with the use of fixed orthodontic appliances in two groups of patients. Among those individuals using a fixed orthodontic appliance in both arches (UT group), the photographic method was sufficiently accurate for the detection of active caries lesions (79%), showing a high sensitivity (83%). On the other hand, among those patients examined immediately after the removal of the fixed apparatus (IAT group), only a half of the patients clinically detected with active caries could be diagnosed using the photographs. To the best of our knowledge, this is the first study investigating the accuracy of the photographic method among orthodontic patients.

Previous studies have already shown that the use of orthodontic braces increases the susceptibility to the development of caries lesions. The meta-analysis by [Sundararaj et al.](#)³ evaluated the prevalence and incidence rates of white spot lesions during orthodontic treatment by addressing 14 studies. The prevalence found in patients undergoing fixed orthodontic treatment for a period greater than or equal to 12 months was 68.4% and an incidence of 45.8% was found after 36 months. Similarly, the study by [Pinto et al.](#)⁴ assessed the relationship between the duration of orthodontic treatment and caries activity in a sample of 260 patients. This study showed a significant association between longer duration of orthodontic treatment and higher prevalence/extent of active caries lesions among adolescents and young adults, showing the need to control the caries disease throughout orthodontic treatment. More recently, a longitudinal study followed 135 individuals over 1 year and found a significantly higher caries increment/incidence among those using fixed orthodontic appliances than the control individuals, without the apparatus¹⁴. Based on these findings, it is possible to speculate that the orthodontist has not been able to control the development of caries during the therapy, which would require the execution of a time-consuming caries examination during the usual short orthodontic consultations. The use of digital photographs taken with DSLR cameras have

proved to be an accurate method for the detection of caries lesions^{15,16}, but it has not been properly tested among orthodontic patients.

Regarding the UT group, there was a high prevalence of caries activity in the patients evaluated and the digital photographs were able to correctly identify most of them (29 out of 35). On the other hand, only one of the three healthy patients was correctly identified by this method. These findings resulted in a high sensitivity (83%) but a very low specificity (33%). As shown in Table II, six individuals were regarded as false negative cases since they were detected with active lesions in the clinical exam (gold standard) but not in the photographs. It is possible that many surfaces are difficult to be adequately assessed in the photos, such as second molars and the lingual/palatal tooth surfaces. In addition, the lack of the tactile examination may also have contributed because in the photos the diagnosis is restricted to the visual inspection. Therefore, it is possible that some lesions that were classified in the clinical examination as active due to its roughness were classified as inactive in the photographic examination due to the lack of the tactile sensation. On the other hand, in regard to the two cases of false positives, it is possible to speculate that the presence of dental plaque in some sites may have been mistakenly classified as caries lesions in the photographs. It is important to emphasize that no tooth cleaning was performed before the photographs because we intended to simulate the conditions under which these photos are usually taken. Despite the recommendation of tooth cleaning prior to the photographs provided by the American Board of Orthodontics, this is not a reality in XXXXX and, we can assume, in other countries. The low specificity observed in the study indicates that the photographic method may overdiagnose healthy patients, but no major conclusion can be drawn due to the reduced number of healthy patients included in the sample. Even so, digital photographs were sensitive to detect active caries in patients using fixed orthodontic appliances.

Regarding the IAT group, only half of the prevalence detected in the clinical examination was detected in the photos. If the calculation of the diagnostic parameters had been possible, it would result in a sensitivity of 50%. Comparing with the data obtained in the UT group (sensitivity of 83%), we can speculate that the polishing of the surfaces to remove the resin excesses may have contributed to the high percentage of false negative cases. By superficially removing the more evident areas of white spot lesions, active lesions detected by the clinical exam may not have been properly visualized in the photographs. Therefore, we can assume that studies evaluating post-treatment photos really underestimate the occurrence of caries during orthodontic treatment.

The orthodontic documentation is widely indicated for several purposes as diagnosis and treatment planning, to assess the ongoing orthodontic treatment, to compare the pre- and post-treatment records, among others. Photographs are an essential part of this documentation, including a full set of extra- and intra-oral images, both at the start and completion of the treatment and, ideally, some mid-treatment photographs showing key-stages in treatment¹⁷. In this context, based on the findings of the present study, mid-treatment digital photographs taken to assess ongoing orthodontic treatment could be used for the screening of patients to control caries lesions due to its high sensitivity. On the other hand, post-treatment photographs may underestimate patient's caries activity and an important proportion of individuals who would benefit from caries control measures would not be referred for treatment.

Among the strengths of this study, we could emphasize its pioneering aspect, being the first study to evaluate the diagnostic accuracy of the photographic method for detecting caries stains associated with the use of fixed orthodontic appliance; the single examiner, trained and calibrated for the caries index. One important limitation of this study can be considered its small sample, with and unbalance between sick and healthy patients. Few healthy individuals compromised the assessment of specificity. One could argue that the fact that no tooth cleaning was performed before the photographs in the UT group may have influenced the study findings; however, we chose to simulate the 'reality' as much as possible. The same applies to the fact that we took the photos in the IAT group after polishing.

CONCLUSION

In conclusion, this study showed that the photographic examination had a satisfactory accuracy to detect caries-active patients during the fixed orthodontic therapy, showing a high sensitivity. However, when the method was used after the removal of the orthodontic appliance, it was unable to identify the presence of active caries lesions.

REFERENCES

1. Ahmed I, Saif-Ul-Haque, Nazir R. Carious lesions in patients undergoing orthodontic treatment. *J Pak Med Assoc* 2011; 61: 1176–1179.
2. Tufekci E, Dixon J S, Gunsolley J C, Lindauer S J. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. *Angle Orthod* 2011; 81: 206–210.
3. Sundararaj D, Venkatachalapathy S, Tandon A, Pereira A. Critical evaluation of incidence and prevalence of white spot lesions during fixed orthodontic appliance treatment: A meta-analysis. *J Int Soc Prev Community Dent* 2015; 5: 433-439.
4. Pinto A S, Alves L S, Maltz M, Susin C, Zenkner J E A. Does the Duration of Fixed Orthodontic Treatment Affect Caries Activity among Adolescents and Young Adults? *Caries Res* 2018; 52: 463-467.
5. Khalaf K. Factors Affecting the Formation, Severity and Location of White Spot Lesions during Orthodontic Treatment with Fixed Appliances. *J Oral Maxillofac Res* 2014; 5(1):e4.
6. Lucchese A, Gherlone E. Prevalence of white-spot lesions before and during orthodontic treatment with fixed appliances. *Eur J Orthod* 2013; 35: 664–668.
7. Pitts N B. Current methods and criteria for caries diagnosis in Europe. *J Dent Educ* 1993; 57: 409-14.
8. Benkaddour A, Bahije L, Bahoum A, Zaoui F. Orthodontics and enamel demineralization: clinical study of risk factors. *Int Orthod* 2014; 12: 458-466.
9. Enaia M, Bock N, Ruf S. White-spot lesions during multibracket appliance treatment: A challenge for clinical excellence. *Am J Orthod Dentofacial Orthop* 2011; 140: 17–24.
10. Julien K C, Buschang P H, Campbell P M. Prevalence of white spot lesion formation during orthodontic treatment. *Angle Orthod* 2013; 83: 641-647.
11. Richter A E, Arruda A O, Peters M C, Sohn W. Incidence of caries lesions among patients treated with comprehensive orthodontics. *Am J Orthod Dentofacial Orthop* 2011; 139: 657-664.
12. Chapman J A, Roberts W E, Eckert G J, Kula K S, Cabezas C G. Risk factors for incidence and severity of white spot lesions during treatment with fixed orthodontic appliances. *Am J Orthod Dentofacial Orthop* 2010; 138: 188-94.
13. Maltz M, Silva B B, Carvalho D Q, Volkweis A. Results after two years of non-operative treatment of occlusal surface in children with high caries prevalence. *Braz Dent J* 2003; 14: 48-54.

14. Pinto A S, Alves L S, Maltz M, Zenkner J E A. Association between fixed orthodontic treatment and dental caries: a 1-year longitudinal study. *Braz Oral Res* 2021; 35:e002.
15. Estai M, Bunt S, Kanagasingam Y, Kruger E, Tennant M. Diagnostic accuracy of teledentistry in the detection of dental caries: a systematic review. *J Evid Based Dent Pract* 2016 Sep; 16(3):161-172.
16. Alabdullah H, Daniel J A. Systematic Review on the Validity of Teledentistry. *Telemed J E Health* 2018; 8: 639-648.
17. Sandler J, Murray A. Digital photography in orthodontics. *J Orthod* 2001 Sep;28(3):197-201.

FIGURE

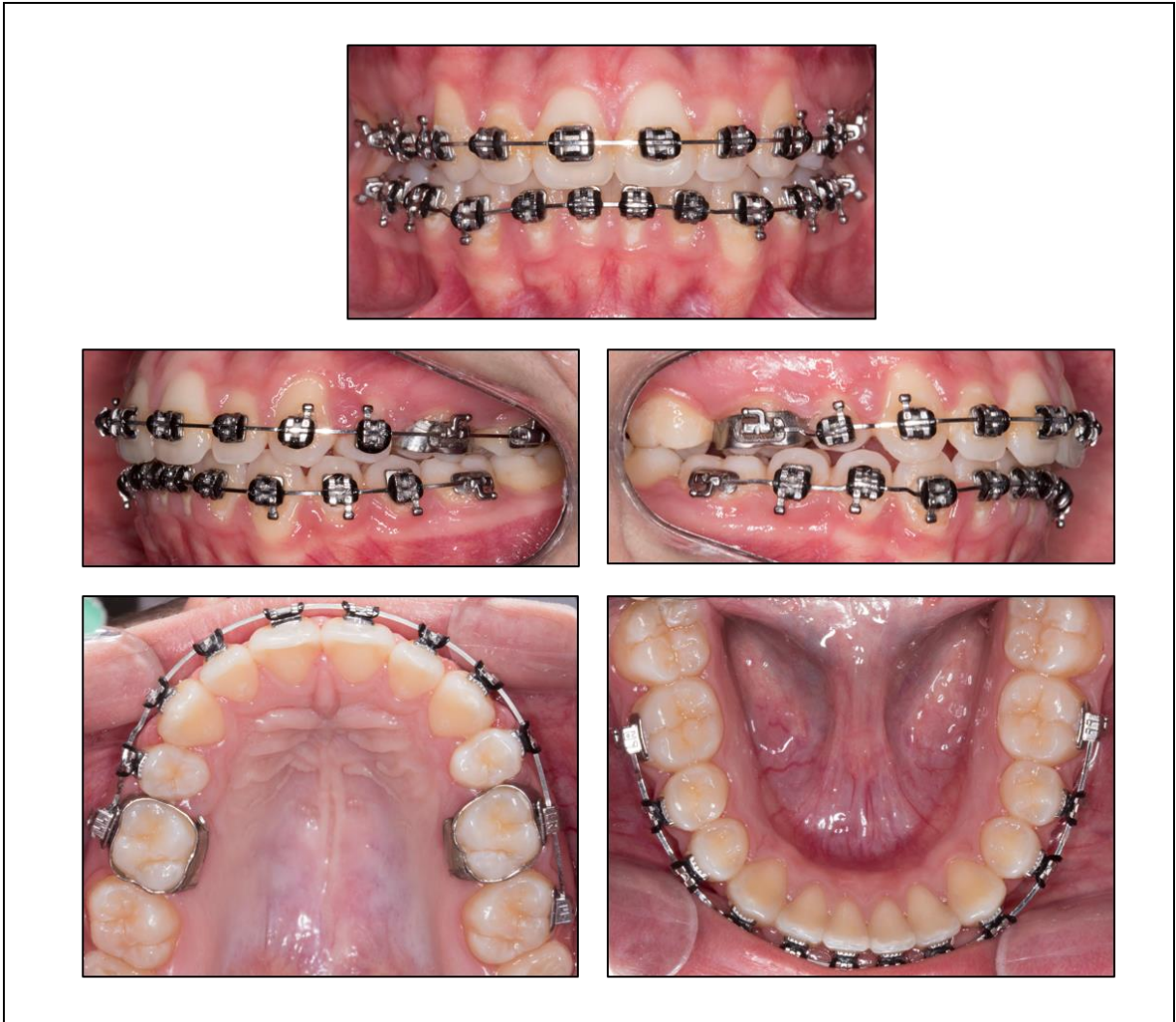


Figure 1. Example of the five photographs taken of each patient.

TABLES

Table 1. Sample description according to group.

	UT (n=38)	IAT (n=10)
Sex, m:f	16:22	2:8
Age, mean (\pmsd)	23 (\pm 8.6)	22 (\pm 10)
Active lesions		
Prevalence	92%	100%
Mean (\pm sd)	6.2 (\pm 3.9)	6 (\pm 4.2)
Median (p25; p75)	6 (3; 9)	5 (3; 8)
Range (min-max)	0-14	2-14

UT = under treatment;

IAT = immediately after treatment.

Table 2. Comparison of clinical exam and digital photographs for the detection of caries prevalence among patients using fixed orthodontic appliances (n=38).

		Clinical examination (gold standard)		
		Present	Absent	Total
Photographic method	Present	29 (TP)	2 (FP)	31
	Absent	6 (FN)	1 (TN)	7
	Total	35	3	38

TP = true positives; FP = false positives; TN = true negatives; FN = false negatives.

3 CONCLUSÃO

Com base nos resultados desta dissertação, foi possível concluir que o método fotográfico apresentou acurácia satisfatória para a identificação de pacientes cárie-ativos, mostrando boa sensibilidade em pacientes utilizando aparelho ortodôntico fixo. No entanto, quando o método foi utilizado após a remoção do aparelho ortodôntico, não foi capaz de identificar adequadamente a presença de lesões cariosas ativas.

REFERÊNCIAS

- AHMED, I.; SAIF-UL-HAQUE; NAZIR, R. Carious lesions in patients undergoing orthodontic treatment. **Journal of the Pakistan Medical Association**, v.61, n. 12, p. 1176–1179, 2011.
- ALABDULLAH, H.; DANIEL, J.A. Systematic Review on the Validity of Teledentistry. **Telemedicine Journal and e-Health**, v. 8, p. 639-648, 2018.
- BEHNAN, S. M. et al. In-vitro evaluation of various treatments to prevent demineralization next to orthodontic brackets. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 138, n. 6, p. 712. e1-7, 2010.
- BENKADDOUR, A. et al. Orthodontics and enamel demineralization: clinical study of risk factors. **International Orthodontics**, v. 12, n. 4, p. 458-466, 2014.
- CHAPMAN, J.A. et al. Risk factors for incidence and severity of white spot lesions during treatment with fixed orthodontic appliances. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 138, n. 2, p. 188-94, 2010.
- ENAIA, M.; BOCK, N.; RUF, S. White-spot lesions during multibracket appliance treatment: A challenge for clinical excellence. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 140, n. 1, p. e17–24, 2011.
- ESTAI, M. et al. Diagnostic accuracy of teledentistry in the detection of dental caries: a systematic review. **The Journal of evidence-based dental practice**, v. 16, n. 3, p. 161-172, 2016.
- JAMPANI, N.D. et al, Applications of teledentistry: A literature review and update. **Journal of International Society of Preventive and Community Dentistry**, v. 1, n. 2, p. 37-44, 2011.
- JULIEN, K.C.; BUSCHANG, P.H.; CAMPBELL, P.M.; Prevalence of white spot lesion formation during orthodontic treatment. **The Angle Orthodontist**, v.83, p. 641-647, 2013
- LUCCHESI, A.; GHERLONE, E. Prevalence of white-spot lesions before and during orthodontic treatment with fixed appliances. **European Journal of Orthodontics**, v. 35, n. 5, p. 664–668, 2013.
- MAXFIELD, B.J. et al. Development of white spot lesions during orthodontic treatment: perceptions of patients, parents, orthodontists, and general dentists. **American Journal of Orthodontics and Dentofacial Orthopedics**, v. 141, n. 3, p. 337-44, 2012.
- MIZRAHI, E. Enamel demineralization following orthodontic treatment. **American Journal of Orthodontics**, v.82, n. 1, p. 62–66, 1982.
- PERES, M.A. et al. Oral diseases: a global public health challenge. **The Lancet**, v.394, n. 10194, p.249-260, 2019

- PINTO, A.S. et al. Does the Duration of Fixed Orthodontic Treatment Affect Caries Activity among Adolescents and Young Adults? **Caries Research**, v. 52, n. 6, p. 463-467, 2018.
- RICHTER, A.E. et al. Incidence of caries lesions among patients treated with comprehensive orthodontics. **American Journal of Orthodontics and Dentofacial Orthopedics**, v.139, p.657-664, 2011.
- SAGARIKA, N. et al. Prevalence of white spot lesion in a section of Indian population undergoing fixed orthodontic treatment: An in vivo assessment using the visual International Caries Detection and Assessment System II criteria. **Journal of Conservative Dentistry**, v. 15, n. 2, p. 104–108, 2012.
- SUNDARARAJ, D. et al. Critical evaluation of incidence and prevalence of white spot lesions during fixed orthodontic appliance treatment: A meta-analysis. **Journal of International Society of Preventive and Community Dentistry**, v. 5, n. 6, p. 433-439, 2015.
- TUFEKCI, E. et al. Prevalence of white spot lesions during orthodontic treatment with fixed appliances. **The Angle Orthodontist**, v. 81, n. 2, p. 206–210, 2011.

APÊNDICE A: FICHA DE EXAME CLÍNICO

Nome: _____ Data exame: ___/___/_____

CÁRIE					
	V	P/L	O	D	M
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- 0 - hígido
- 1 - mba
- 2 - mbi
- 3 - cca esmalte
- 4 - cci esmalte
- 5 - cca dentina
- 6 - cci dentina
- 7 - sombra sem cav ativa
- 8 - sombra com cav ativa
- 9 - restaurado
- 10 - exo indicada
- 11 - extraído
- 12 - ausente
- 13 - prótese fixa
- 14 - tártaro
- 15 - hipoplasia de esmalte
- 16 - selante
- 17 - sobra sem cav inativa
- 18 - sombra com cav inativa
- 19 - agenesia
- 20 - exo por indicação ortodôntica
- 21 - provisório

-Má oclusão: _____

-Data de instalação:

Arco superior: _____

Arco inferior: _____

-Bandas: _____

-Tubos: _____

**APÊNDICE B: TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO /
MAIORES DE IDADE**

**UNIVERSIDADE FEDERAL DE SANTA MARIA
CENTRO DE CIÊNCIAS DA SAÚDE
PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS ODONTOLÓGICAS**

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Título do estudo: Cárie dentária e hiperplasia gengival em pacientes ortodônticos: diagnóstico e tratamento

Pesquisador responsável: Luana Severo Alves

Instituição/Departamento: Universidade Federal de Santa Maria/Depto de Odontologia Restauradora

Telefone e endereço postal completo: (55) 3220 9279. Rua Floriano Peixoto, 1184, sala 115. 97015-372. Santa Maria – RS.

Local da coleta de dados: Faculdade Ingá (UNINGÁ) – Unidade de Santa Maria (RS)

Prezado(a) Senhor(a):

Eu, Luana Severo Alves, responsável pela pesquisa “Cárie dentária e hiperplasia gengival em pacientes ortodônticos: diagnóstico e tratamento” o convido a participar como voluntário deste estudo. Você precisa decidir se autoriza sua participação ou não. Por favor, não se apresse em tomar a decisão. Leia cuidadosamente o que se segue e pergunte ao responsável pelo estudo qualquer dúvida que você tiver. Após ser esclarecido sobre as informações a seguir, no caso de autorizar sua participação no estudo, assine ao final deste documento, que está em duas vias. Uma delas é sua e a outra é do pesquisador responsável. Em caso de recusa, você não será penalizado de forma alguma.

Objetivos do estudo. Avaliar a validade do método fotográfico para detecção de cárie dentária, e avaliar a percepção de pacientes sobre cárie dentária.

Importância do estudo. Acreditamos que este estudo seja importante, pois possibilitará definir se fotografias podem ser utilizadas para a detecção de cárie dentária após tratamento ortodôntico de modo confiável, facilitando novas pesquisas sobre o tema.

Procedimentos. Sua participação nesta pesquisa consistirá no preenchimento de um questionário, contendo perguntas pessoais (socioeconômicas e comportamentais) e exame clínico, realizado juntamente com a sua primeira consulta após a remoção do aparelho fixo.

Benefícios. Ao exame clínico, você receberá uma limpeza de seus dentes. Você será informado a respeito da sua condição de saúde bucal ao final do tratamento ortodôntico fixo. Você receberá uma escova dental.

Desconfortos e riscos. É possível que aconteça algum desconforto durante o preenchimento do questionário (cansaço visual) ou durante a realização do exame clínico (cansaço devido à abertura de boca). Para evitar estes desconfortos, você poderá descansar durante o preenchimento do questionário, e também durante os exames. Os riscos previsíveis são aqueles inerentes a uma consulta odontológica de rotina. Todas as medidas de biossegurança serão tomadas, bem como a utilização de óculos de proteção do paciente, devido ao uso de instrumentos pérfuro-cortantes (sonda).

Sigilo. As informações desta pesquisa serão confidenciais e poderão ser divulgadas apenas em eventos ou publicações, sem a identificação dos voluntários, a não ser entre os responsáveis pelo estudo, sendo assegurado o sigilo sobre sua participação.

Durante todo o período da pesquisa você terá a possibilidade de tirar qualquer dúvida ou pedir qualquer outro esclarecimento. Para isso, entre em contato com algum dos pesquisadores ou com o Comitê de Ética em Pesquisa da UFSM. Caso você tenha alguma despesa ou eventual dano decorrentes da sua participação nesta pesquisa, será ressarcido ou indenizado pela equipe de pesquisadores.

Você tem garantida a possibilidade de não aceitar participar ou de retirar sua permissão a qualquer momento, sem nenhum tipo de prejuízo pela sua decisão.

Autorização

Eu _____, tendo lido o presente termo e estando devidamente esclarecido(a) e no uso de meu livre arbítrio autorizo o a participar do projeto de pesquisa acima nominado e resumidamente descrito. Estou ciente de que posso a qualquer tempo retirar a presente autorização por minha livre vontade e sem qualquer prejuízo aos menores envolvidos, bastando para isso comunicar por escrito o profissional acima citado. Atesto que recebi uma cópia deste termo, que foi preenchido em duas vias.

DATA: ____ / ____ / ____

ASSINATURA: _____

APÊNDICE C: TERMO DE ASSENTIMENTO INFORMADO**UNIVERSIDADE FEDERAL DE SANTA MARIA
CENTRO DE CIÊNCIAS DA SAÚDE
PROGRAMA DE PÓS-GRADUAÇÃO EM CIÊNCIAS ODONTOLÓGICAS****TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO**

Título do estudo: Cárie dentária e hiperplasia gengival em pacientes ortodônticos: diagnóstico e tratamento

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Local da coleta de dados: Faculdade Ingá (UNINGÁ) – Unidade de Santa Maria (RS)

Prezado(a) Senhor(a):

Eu, Luana Severo Alves, responsável pela pesquisa “Cárie dentária e hiperplasia gengival em pacientes ortodônticos: diagnóstico e tratamento” convido seu filho/filha a participar como voluntário deste estudo. Você precisa decidir se autoriza sua participação ou não. Por favor, não se apresse em tomar a decisão. Leia cuidadosamente o que se segue e pergunte ao responsável pelo estudo qualquer dúvida que você tiver. Após ser esclarecido sobre as informações a seguir, no caso de autorizar a participação de seu filho/filha no estudo, assine ao final deste documento, que está em duas vias. Uma delas é sua e a outra é do pesquisador responsável. Em caso de recusa, você não será penalizado de forma alguma.

Objetivos do estudo. Avaliar a validade do método fotográfico para detecção de cárie dentária, e avaliar a percepção de pacientes sobre cárie dentária.

Importância do estudo. Acreditamos que este estudo seja importante, pois possibilitará definir se fotografias podem ser utilizadas para a detecção de cárie dentária após tratamento ortodôntico de modo confiável, facilitando novas pesquisas sobre o tema.

Procedimentos. A participação de seu filho/filha nesta pesquisa consistirá no preenchimento de um questionário, contendo perguntas pessoais (sócio-econômicas e comportamentais) e exame clínico, realizado juntamente com a primeira consulta após a remoção do aparelho fixo.

Benefícios. Ao exame clínico, seu filho/filha receberá uma limpeza de seus dentes. Você será informado a respeito da sua condição de saúde bucal ao final do tratamento ortodôntico fixo. Seu filho/filha receberá uma escova dental.

Desconfortos e riscos. É possível que aconteça algum desconforto durante o preenchimento do questionário (cansaço visual) ou durante a realização do exame clínico (cansaço devido à abertura de boca). Para evitar estes desconfortos, eu filho/filha poderá descansar durante o preenchimento do questionário, e também durante os exames. Os riscos previsíveis são aqueles inerentes a uma consulta odontológica de rotina. Todas as medidas de biossegurança serão tomadas, bem como a utilização de óculos de proteção do paciente, devido ao uso de instrumentos perfuro-cortantes (sonda).

Sigilo. As informações desta pesquisa serão confidenciais e poderão ser divulgadas apenas em eventos ou publicações, sem a identificação dos voluntários, a não ser entre os responsáveis pelo estudo, sendo assegurado o sigilo sobre sua participação.

Comitê de Ética em Pesquisa da UFSM:
Avenida Roraima, 1000 - Prédio da Reitoria - 2º andar - Sala Comitê de Ética
Cidade Universitária - Bairro Camobi - CEP 97105-900 - Santa Maria - RS
FONE: (55) 3220 93 62. E-mail: cep.ufsm@gmail.com

Durante todo o período da pesquisa você terá a possibilidade de tirar qualquer dúvida ou pedir qualquer outro esclarecimento. Para isso, entre em contato com algum dos pesquisadores ou com o Comitê de Ética em Pesquisa da UFSM. Caso você tenha alguma despesa ou eventual dano decorrentes da participação de seu filho/filha nesta pesquisa, será ressarcido ou indenizado pela equipe de pesquisadores.

Você tem garantida a possibilidade de não aceitar participar ou de retirar sua permissão a qualquer momento, sem nenhum tipo de prejuízo pela sua decisão.

Autorização do responsável

Eu _____, responsável pelo menor _____ tendo lido o presente termo e estando devidamente esclarecido(a) e no uso de meu livre arbítrio autorizo-o a participar do projeto de pesquisa acima nominado e resumidamente descrito. Estou ciente de que posso a qualquer tempo retirar a presente autorização por minha livre vontade e sem qualquer prejuízo aos menores envolvidos, bastando para isso comunicar por escrito o profissional acima citado. Atesto que recebi uma cópia deste termo, que foi preenchido em duas vias.

DATA: ____ / ____ / ____

ASSINATURA: _____

TERMO DE ASSENTIMENTO

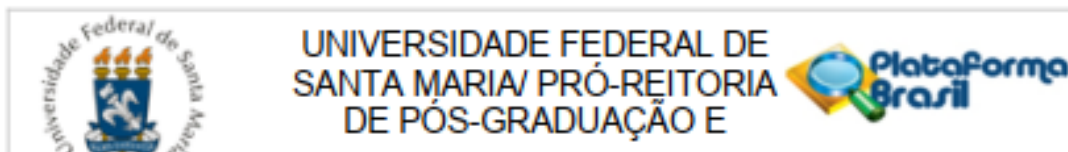
Seu pai/mãe já autorizou a sua participação nessa pesquisa, mas se você não quiser, não tem problema. A decisão é sua e caso você decida não participar, ninguém ficará bravo com você e não haverá nenhuma punição.

Autorização do menor

Eu, _____, entendi que a pesquisa é sobre o efeito da escovação com gel de flúor para o controle da cárie dentária em pessoas que usam aparelho ortodôntico fixo. Também compreendi que fazer parte dessa pesquisa significa que terei meus dentes e minha boca examinados pelas dentistas. Eu aceito participar dessa pesquisa.

Assinatura do voluntário

**ANEXO A: PARECER DO COMITÊ DE ÉTICA EM PESQUISA DA
UNIVERSIDADE FEDERAL DE SANTA MARIA**



PARECER CONSUBSTANCIADO DO CEP

DADOS DO PROJETO DE PESQUISA

Título da Pesquisa: Cárie dentária e hiperplasia gengival em pacientes ortodônticos: diagnóstico e tratamento

Pesquisador: LUANA SEVERO ALVES

Área Temática:

Versão: 1

CAAE: 10325518.9.0000.5346

Instituição Proponente: Universidade Federal de Santa Maria/ Pró-Reitoria de Pós-Graduação e

Patrocinador Principal: Financiamento Próprio

DADOS DO PARECER

Número do Parecer: 3.254.506

Apresentação do Projeto:

Este projeto tem como objetivo geral estudar a cárie dentária e a hiperplasia gengival em pacientes ortodônticos. Trata-se de um projeto guarda-chuva envolvendo dois Subprojetos, com os seguintes objetivos específicos: Subprojeto 1 - Avaliar o nível de conhecimento sobre cárie dentária em pacientes iniciando tratamento ortodôntico fixo; Avaliar a incidência/extensão de cárie dentária após 1 e 2 anos de tratamento ortodôntico fixo em pacientes submetidos a um protocolo para controle da cárie dentária; Avaliar a incidência/extensão de hiperplasia gengival após 1 e 2 anos de tratamento ortodôntico fixo; Subprojeto 2 - Avaliar a percepção dos pacientes sobre lesões cariosas após tratamento ortodôntico fixo; Estudar a acuidade diagnóstica do método fotográfico para detecção de lesões cariosas associadas ao uso de aparelho ortodôntico fixo. As amostras serão compostas por pacientes do Curso de Especialização em Ortodontia da Faculdade Ingá (UNINGÁ) – Unidade de Santa Maria (RS). O Subprojeto 1 será um ensaio clínico randomizado, envolvendo 240 pacientes iniciando tratamento ortodôntico, que serão aleatoriamente randomizados para um de dois grupos: G0, controle, sem intervenção; ou G1, intervenção com escovação profissional com gel de flúor fosfato acidulado 1,23%, uma vez por mês durante dois anos. Os indivíduos responderão a um questionário estruturado contendo perguntas demográficas, socioeconômicas, hábitos de higiene bucal e questões sobre o nível de conhecimento dos indivíduos sobre cárie e gengivite. Em seguida, serão submetidos ao exame clínico composto por Índice de placa bacteriana, Índice de sangramento gengival, Índice de



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Continuação do Parecer: 3.254.506

Seymour, limpeza e secagem dos dentes, e índice de cárie dentária. Os exames gengivais serão realizados a cada três meses, e o exame de cárie a cada seis meses, durante dois anos. A associação entre os grupos e os desfechos será avaliada utilizando modelos de regressão de Poisson. O Subprojeto 2 será um estudo observacional transversal, envolvendo uma amostra de 100 pacientes finalizando tratamento ortodôntico, que terão suas fotografias intraorais pós-tratamento ortodôntico comparadas com exame clínico visando à detecção de lesões cariosas. Os participantes responderão a um questionário estruturado contendo perguntas demográficas, socioeconômicas, hábitos de higiene bucal e questões relativas à percepção sobre lesões de cárie, com base em uma fotografia clínica. O exame clínico para detecção de cárie dentária será realizado após limpeza e secagem dos dentes. Os dados do exame fotográfico serão comparados com os do exame clínico (padrão-ouro). Serão determinadas para o exame fotográfico as grandezas de sensibilidade, especificidade, valores preditivos positivo e negativo e a acurácia.

Objetivo da Pesquisa:

OBJETIVO GERAL: estudar a cárie dentária e a hiperplasia gengival em pacientes ortodônticos.

OBJETIVOS ESPECÍFICOS:

Subprojeto 1:

- Avaliar o nível de conhecimento sobre cárie dentária em pacientes iniciando tratamento ortodôntico fixo;
- Avaliar a incidência/extensão de cárie dentária após 1 e 2 anos de tratamento ortodôntico fixo em pacientes submetidos a um protocolo para controle da cárie dentária;
- Avaliar a incidência/extensão de hiperplasia gengival após 1 e 2 anos de tratamento ortodôntico fixo;

Subprojeto 2:

- Avaliar a percepção dos pacientes sobre lesões cariosas após tratamento ortodôntico fixo;
- Estudar a acurácia diagnóstica do método fotográfico para detecção de lesões cariosas associadas ao uso de aparelho ortodôntico fixo.

Avaliação dos Riscos e Benefícios:

De acordo com os pesquisadores:



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Continuação do Protocolo: 3.254.506

Subprojeto 1:

Riscos: É possível que aconteça algum desconforto durante o preenchimento do questionário (cansaço visual) ou durante a realização dos exames clínicos (cansaço devido à abertura de boca). Para evitar estes desconfortos, você poderá descansar durante o preenchimento do questionário, e também durante os exames. Os riscos previsíveis são aqueles inerentes a uma consulta odontológica de rotina com aplicação de gel de flúor. Todas as medidas de biossegurança serão tomadas, bem como a utilização de óculos de proteção do paciente, devido ao uso de instrumentos perfuro-cortantes (sonda). Se você apresentar lesões de cárie em algum dos exames clínicos, independente do grupo a que pertencer (controle ou intervenção), será encaminhado para tratamento na Instituição e excluído do acompanhamento.

Benefícios: A cada exame clínico de cárie (de 6 em 6 meses), você receberá uma limpeza de seus dentes. Você será informado a respeito da sua condição de saúde bucal ao longo do tratamento ortodôntico. Espera-se que você tenha menor risco de desenvolver cárie dentária.

Subprojeto 2:

Riscos: É possível que aconteça algum desconforto durante o preenchimento do questionário (cansaço visual) ou durante a realização do exame clínico (cansaço devido à abertura de boca). Para evitar estes desconfortos, você poderá descansar durante o preenchimento do questionário, e também durante os exames. Os riscos previsíveis são aqueles inerentes a uma consulta odontológica de rotina. Todas as medidas de biossegurança serão tomadas, bem como a utilização de óculos de proteção do paciente, devido ao uso de instrumentos perfuro-cortantes (sonda).

Benefícios: Ao exame clínico, você receberá uma limpeza de seus dentes. Você será informado a respeito da sua condição de saúde bucal ao final do tratamento ortodôntico fixo. Você receberá uma escova dental.

Comentários e Considerações sobre a Pesquisa:

Pesquisa científica envolvendo 2 subprojetos na área de Odontologia, um ensaio clínico randomizado e um estudo observacional transversal.



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Continuação do Parecer: 3.254.506

Considerações sobre os Termos de apresentação obrigatória:

Termos apresentados de forma satisfatória:

- 1) Registro GAP
- 2) Registro Plataforma Brasil
- 3) Folha de rosto Plataforma Brasil
- 4) Projeto de pesquisa
- 5) Termo de confidencialidade
- 6) Autorização Institucional
- 7) TCLE para subprojeto 1 – adulto
- 8) TCLE para subprojeto 1 – menores (com assentimento)
- 9) TCLE para subprojeto 2 – adulto
- 10) TCLE para subprojeto 2 – menores (com assentimento)

Recomendações:

No Termo de confidencialidade e nos Termos de consentimento livre e esclarecido, ao citar o local de coleta de dados (Faculdade Ingá (UNINGÁ) – Unidade de Santa Maria (RS)), informar o endereço completo.

Conclusões ou Pendências e Lista de Inadequações:

-

Considerações Finais a critério do CEP:

Este parecer foi elaborado baseado nos documentos abaixo relacionados:

Tipo Documento	Arquivo	Postagem	Autor	Situação
Informações Básicas do Projeto	PB_INFORMAÇÕES_BÁSICAS_DO_PROJETO_1279217.pdf	26/03/2019 20:20:04		Acelto
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_menores_sub2_ok2.docx	26/03/2019 20:19:13	LUANA SEVERO ALVES	Acelto
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_menores_sub1_ok2.docx	26/03/2019 20:19:05	LUANA SEVERO ALVES	Acelto



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Continuação do Parecer: 3.254.598

TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_malores_sub2_ok2.docx	26/03/2019 20:18:49	LUANA SEVERO ALVES	Acelto
TCLE / Termos de Assentimento / Justificativa de Ausência	TCLE_malores_sub1_ok2.docx	26/03/2019 20:18:41	LUANA SEVERO ALVES	Acelto
Projeto Detalhado / Brochura Investigador	Projeto_orto_Plataforma_Brasil_ok2.pdf	26/03/2019 20:18:27	LUANA SEVERO ALVES	Acelto
Outros	projeto_portal_UFSM_62542.pdf	20/12/2018 11:21:56	LUANA SEVERO ALVES	Acelto
Declaração de Pesquisadores	termo_de_confidencialidade.pdf	20/12/2018 11:20:41	LUANA SEVERO ALVES	Acelto
Declaração de Instituição e Infraestrutura	autorizacao_uninga.pdf	20/12/2018 11:19:12	LUANA SEVERO ALVES	Acelto
Folha de Rosto	folha_de_rosto_assinada.pdf	20/12/2018 11:10:25	LUANA SEVERO ALVES	Acelto

Situação do Parecer:

Aprovado

Necessita Apreciação da CONEP:

Não

SANTA MARIA, 09 de Abril de 2019

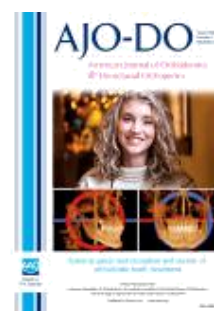
Assinado por:
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(Coordenador(a))

ANEXO B: NORMAS PARA PUBLICAÇÃO NO PERIÓDICO AMERICAN JOURNAL OF ORTHODONTICS AND DENTOFACIAL ORTHOPEDICS

Official Journal of the [American Association of Orthodontists](#), its constituent societies, the American Board of Orthodontics, and the College of Diplomates of the American Board of Orthodontics

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ISSN: 0889-5406

DESCRIPTION

Published for more than 100 years, the *American Journal of Orthodontics and Dentofacial Orthopedics* remains the leading **orthodontic** resource. It is the official publication of the [American Association of Orthodontists](#), its constituent societies, the American Board of Orthodontics, and the College of Diplomates of the American Board of Orthodontics. Each month its readers have access to original peer-reviewed articles that examine all phases of **orthodontic treatment**. Illustrated throughout, the publication includes tables, color photographs, and statistical data. Coverage includes successful diagnostic procedures, imaging techniques, bracket and archwire materials, extraction and impaction concerns, orthognathic surgery, TMJ disorders, removable appliances, and adult therapy.

According to the 2017 Journal Citation Reports®, published by Thomson Reuters, *AJO-DO* is the highest ranked orthodontic title by number of citations. *AJO-DO* ranks 30th of 91 journals for total citations in the Dentistry, Oral Surgery and Medicine category, and has a five year impact factor of 2.201.

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GUIDE FOR AUTHORS

General Information

The *American Journal of Orthodontics and Dentofacial Orthopedics* publishes original research, reviews, case reports, clinical material, and other material related to orthodontics and dentofacial orthopedics.

Submitted manuscripts must be original, written in English, and not published or under consideration elsewhere. Manuscripts will be reviewed by the editor and consultants and are subject to editorial revision. Authors should follow the guidelines below.

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On the cover

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BEFORE YOU BEGIN

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These guidelines are supplemental to the [Guidelines for Original Articles](#), which describe how to meet general submission requirements, such as figure formats, reference style, required releases, and blinding. However, we have made these guidelines more relevant to orthodontics and have adapted the reporting template to encourage transparent and pertinent reporting by introducing subheadings corresponding to established PRISMA items.

Further information on reporting of systematic reviews can also be obtained in the Cochrane Handbook for Systematic Reviews of Interventions (<http://www.cochrane-handbook.org>).

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