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AVALIAÇÃO LONGITUDINAL DE LESÕES CARIOSAS INATIVAS EM MOLARES PERMANENTES: RESULTADOS DE 4-5 ANOS

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

Orientador: Prof. Dr. Júlio Eduardo do Amaral Zenkner
Coorientadora: Prof[a]. Dr[a]. Luana Severo Alves

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RESUMO

AVALIAÇÃO LONGITUDINAL DE LESÕES CARIOSAS INATIVAS EM MOLARES PERMANENTES: RESULTADOS DE 4-5 ANOS

AUTORA: Ângela Dalla Nora
ORIENTADOR: Júlio Eduardo do Amaral Zenkner

O objetivo desta dissertação é apresentar um artigo resultante de um estudo de coorte prospectivo. Buscou-se avaliar o comportamento clínico e o risco de progressão de lesões de cárie inativas não cavitadas e minimamente cavitadas em superfícies oclusais de molares permanentes ao longo de 4-5 anos. A amostra foi estimada em 250 escolares que foram selecionados por conveniência entre crianças de uma escola localizada no município de Santa Maria. Inicialmente, avaliou-se a presença de biofilme e de lesões cariosas nas superfícies oclusais de molares permanentes bem como seu estágio eruptivo. A exata localização dos sítios com lesões cariosas inativas foi registrada por meio de desenhos das superfícies oclusais a fim de garantir o monitoramento da mesma lesão ao longo do tempo. Decorridos 4-5 anos, novo exame clínico foi realizado conforme o exame inicial, por um examinador cegado em relação à situação inicial dos dentes. Os dados categóricos foram descritos por frequências absolutas e relativas (taxas). Modelos de regressão logística ajustados para dados aglomerados foram utilizados para estimar a incidência/progressão de cárie. Dos 258 indivíduos integrantes da amostra, foram reexaminados 193 (74,8%) com idade média de 17,9 (±2.9) anos, após um período de 4-5 anos. Ao avaliar a progressão das lesões, considerando o critério de "Atividade", 30,6% (n=59) deles apresentaram pelo menos um molar com lesão ativa, restaurado ou extraído. De acordo com este critério, lesões inativas tiveram em torno de 2 vezes maior risco de progressão quando comparadas com superfícies hígidas (OR = 2,34; IC 95% = 1,51-3,62). Baseado no critério de "Severidade", 13% (n=25) da amostra apresentou pelo menos um molar com progressão para cavidade em dentina, restauração ou extração. Lesões de cárie inativas também apresentaram um risco significativamente maior de progressão quando comparadas com superfícies hígidas de acordo com este critério (OR = 2,69; IC 95% = 1,50-4,83). Este estudo mostrou que a maioria dos sítios diagnosticados como cárie-inativos (85-90%) não apresentou progressão ao longo do período observacional. Ainda assim, eles apresentaram taxas de progressão mais elevadas do que as superfícies oclusais hígidas.

Palavras-chave: Estudo clínico. Cárie dentária. Molar. Dentição permanente. Progressão da doença. Risco.

ABSTRACT

LONG-TERM FOLLOW-UP OF INACTIVE OCCLUSAL CARIES LESIONS: 4-5-YEAR RESULTS

AUTHOR: Ângela Dalla Nora
ADVISOR: Júlio Eduardo do Amaral Zenkner

The aim of this dissertation is to present a resulting article from a prospective cohort study. We evaluated the clinical behavior and the progression risk of non cavitated and minimally cavitated inactive carious lesions on the occlusal surfaces of permanent molars over 4-5 years. The estimated sample size was 250 students who were selected by convenience among children attending a school in the municipality of Santa Maria. Initially, the presence of plaque accumulation and carious lesion on the occlusal surfaces of permanent molars was assessed, as well as their eruption stage. The exact location of carious site was recorded by means of drawings the occlusal surfaces to ensure the monitoring of the same lesion over time. After 4-5 years, another clinical examination was performed according to the baseline examination by an examiner who was blinded in regards to the teeth situation at the first examination. Categorical data were described by absolute and relative frequencies (rates). Logistic regression model adjusted for data clusters was used to estimate the incidence/progression of caries. From 258 children, a total of 193 (74.8%) with a mean age of 17.9 (±2.9) years were examined after 4-5 years. When evaluating the progression of lesions considering the criterion of "Activity", 30.6% (n=59) of the sample had at least one molar with active lesion, filled or extracted. For this criterion, inactive lesions had around a 2-fold higher chance of progression when compared to sound surfaces (OR=2.34; IC 95% = 1.51-3.62). Based on the "severity" criterion, 13% (n=25) of the sample had at least one molar that progressed to dentin cavity, filling or extraction. Inactive carious lesion also had a significantly higher chance of progression when compared to sound surfaces according to this criterion (OR = 2.69, 95% CI = 1.50-4.83). In conclusion, this longitudinal study showed that the vast majority of lesions (85-90%) identified as inactive enamel caries at baseline have not progressed over 4-5 years. Despite this fact, it was possible to detect an increased risk for caries progression in caries-inactive occlusal sites compared with the sound ones.

Key words: Dental caries. Clinical study. Molar. Permanent dentition. Progression disease. Risk.

SUMÁRIO

1 INTRODUÇÃO E REVISÃO DE LITERATURA

O perfil da doença cárie tem-se alterado significativamente nas últimas décadas, exigindo uma evolução nos processos de diagnóstico e tratamento. A implementação do flúor na água de abastecimento como medida de saúde pública, provocou uma redução na incidência da doença (NYVAD, 2005). A velocidade de progressão diminuiu (BAELUM et al., 2006; BARMES, 1999; KRASSE, 1996; PITTS; FYFFE, 1988), com longos períodos de tempo entre a detecção clínica da lesão cariosa restrita ao esmalte e o estágio de cavitação. Como consequência, pesquisas epidemiológicas têm revelado que lesões não cavitadas são mais prevalentes que cavitadas (AMARANTE et al.,1998; BISCARO et al., 2000; ISMAIL, 1997). Um estudo clínico de diagnóstico observou que ao incluir a detecção de lesões incipientes os índices CPOD e CPOS chegaram a duplicar, enquanto o número de pacientes considerados "livres de cárie" decresceu à quarta parte do anteriormente observado (PITTS; FYFFE, 1988).

Esta nova realidade reforça a importância do diagnóstico de lesões incipientes, principalmente em populações com baixa prevalência de cárie, as quais podem constituir os únicos sinais clínicos indicativos da presença da doença. Resultados encontrados em um estudo de acurácia utilizando o sistema de diagnóstico de lesões de cárie ICDAS (International Caries Detection and Assessment System), o qual engloba o diagnóstico de lesões incipientes, o considerou válido para detectar lesões e predizer sua profundidade (EKSTRAND et al., 2007). O diagnóstico de atividade de cárie na pesquisa clínica tem sido objeto de crescente interesse na literatura contemporânea por englobar o conceito dinâmico de progressão da lesão de cárie (FONTANA et al., 2011; MACHIULSKIENE et al.,1998). As superfícies oclusais de molares permanentes constituem os sítios dentários mais atingidos pela doença cárie. O diagnóstico de lesões incipientes oclusais é um desafio devido às suas características anatômicas e o difícil acesso no exame visual (CARVALHO, 2014; GUEDES et al., 2016; SCHWENDICKE et al., 2015).

A literatura assegura que a progressão da lesão de cárie pode ser interrompida em qualquer estágio de desenvolvimento em quase todos os indivíduos, desde que condições clínicas "livres de biofilme" sejam obtidas (NYVAD; FEJERSKOV, 1997). No entanto, pouco se sabe sobre o comportamento clínico das lesões de cárie diagnosticadas como inativas. Maltz e colaboradores (MALTZ et al., 2006)

demonstraram em um estudo *in* situ que estas lesões, uma vez inativadas, tornam-se mais resistentes a novos desafios cariogênicos. De maneira semelhante dois estudos anteriores já haviam demonstrado esta tendência (IIJIMA Y, 2000; KOULOURIDES; CAMERON, 1980).

Estudos clínicos longitudinais não tem demostrado este incremento na resistência a novos desafios cariogênicos. Em um acompanhamento de três anos, Nyvad e colaboradores (NYVAD et al., 2003) demonstraram a validade de um critério de diagnóstico clínico para determinação da atividade das lesões. Além disso, testaram a efetividade de um programa de escovação supervisionada com dentifrício fluoretado na inibição da cárie dentária. Ao final do período observacional 30% das lesões não cavitadas inativas oclusais progrediram e apresentaram aproximadamente cinco vezes maior risco para cavitação, restauração ou extração quando comparadas com superfícies hígidas. Zandoná e colaboradores (ZANDONA et al., 2012) realizaram um estudo longitudinal de quatro anos avaliando a história natural da cárie dentária em uma população com alta prevalência da doença. O estudo mostrou que a superfície oclusal é mais suscetível à cavitação ao revelar que lesões oclusais não cavitadas inicialmente diagnosticadas como inativas tiveram uma taxa de progressão para cavidade de 37% (ICDAS 1) a 41% (ICDAS 2). Em estudo de um ano de acompanhamento de lesões de cárie inativas não cavitadas e minimamente cavitadas, Zenkner e colaboradores observaram que lesões inativas em esmalte mostraram taxa de progressão semelhante àquela das superfícies hígidas em superfícies oclusais de molares permanentes (ZENKNER et al., 2015).

Assim sendo, há uma divergência entre os resultados dos estudos sobre o comportamento clínico de lesões de cárie não cavitadas e minimamente cavitadas inativas (ZANDONA et al., 2012; MALTZ et al., 2006; NYVAD et al., 2003). Parece imperioso, do ponto de vista clínico, compreender se tais lesões são apenas cicatrizes de processos desmineralização-remineralização vivenciados no passado, ou se são, na verdade, tão ou mais suscetíveis aos desafios cariogênicos quanto o esmalte sadio. Compreender tal questionamento é indispensável para uma conduta clínica baseada em evidências.

O objetivo desta dissertação é apresentar um artigo que busca mostrar o comportamento clínico de lesões de cárie inativas em superfícies oclusais de molares permanentes em um período de acompanhamento de 4-5 anos. Além disso, estimar a

chance de progressão de cárie nestas superfícies em comparação com sítios oclusais hígidos.

A hipótese inicial do estudo é a de que lesões não cavitadas ou minimamente cavitadas inativas tenham comportamento clínico e progressão semelhante aos das superfícies hígidas.

Esta dissertação está baseada nas normativas da Universidade Federal de Santa Maria. Por se tratar de pesquisa envolvendo seres humanos, o projeto de pesquisa deste trabalho foi submetido à apreciação pelo Comitê de Ética em Pesquisa da Universidade Federal de Santa Maria, tendo sido aprovado (ANEXO 1).

O artigo que será enviado para publicação na revista *"Journal of Dental Research".*

2 ARTIGO

Long-term follow-up of inactive occlusal caries lesions: 4-5-year results

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Abstract

The aims of this prospective cohort study were: (1) to assess the clinical behavior of inactive caries lesion on the occlusal surfaces of permanent molars over 4-5 years and (2) to estimate the chance of caries progression in these surfaces compared with sound occlusal sites. Clinical examinations were conducted at baseline (n=258) and after 4-5 years and included the recording of dental plaque at the occlusal surfaces, tooth cleaning, air drying, detection of caries lesions and recording of the eruption stage of permanent molars. After 4-5 years, a total of 193 schoolchildren were followed (follow-up rate of 74.8%), totalizing 1,152 teeth [554 (48.1%) sound molars and 598 (51.9%) molars with inactive occlusal enamel lesions]. According to the criterion of "Activity", 30.6% (n=59) of children presented at least one molar with active lesion, filled or extracted; inactive lesions were around at a 2-fold increased chance for caries progression than sound surfaces (OR=2.34 95%CI=1.51-3.62). According to the criterion of "Severity", 13% (n=25) of children presented at least one molar progressing to dentine cavity, filling or extraction; inactive caries lesions also presented a significantly higher chance for caries progression when compared with sound surfaces (OR=2.69, 95% CI=1.50-4.83). In conclusion, this longitudinal study showed that the vast majority of lesions (85-90%) identified as inactive enamel caries at baseline have not progressed over 4-5 years. Despite this fact, it was possible to detect an increased chance for caries progression in caries-inactive occlusal sites compared with the sound ones.

Introduction

The pattern of development and progression of dental caries has changed substantially in the last decades. It has been observed higher proportion of lesions at the non-cavitated stage compared with the proportion of cavities in different populations worldwide (Amarante et al. 1998; Ismail 1997). In this scenario, the assessment of caries activity in clinical research aiming the detection of its progression has been subject of growing interest (Ekstrand et al. 2007; Guedes et al. 2014; Nyvad and Fejerskov 1997). By definition, inactive caries lesions do not tend to progress over time because there is no ongoing mineral loss, thus being considered just as scars of past episodes of the caries process. However, it is not clear if these lesions are prone to further demineralization episodes (caries progress) over time. This knowledge is of major importance to define the need for monitoring or treatment of such lesions.

Few studies have assessed the issue of inactive caries lesions in the literature. *In situ* studies demonstrated that active non-cavitated lesions, once inactivated, can develop higher acid resistance to new cariogenic challenges than do sound enamel (Iijima and Takagi 2000; Koulourides and Cameron 1980; Maltz et al. 2006). This increased acid resistance may be attributed to modifications occurring in the native crystals, partly dissolved during the carious process (demineralization). Considering the possibility of remineralization, the crystal will be repaired and this section will contain less carbonate, being less soluble and therefore more resistant to future dissolution events. These findings suggesting that inactive lesions may be less susceptible to carious process than sound surfaces have not been clinically confirmed. Nyvad et al. (2003) showed that, even in the presence of fluoride, inactive enamel lesions presented a higher risk of progression to cavitation, filling or extraction than the sound enamel (Nyvad et al. 2003). In another study, performed in a high-risk rural population of

children and adolescents, Ferreira-Zandoná et al. (2012) also showed that inactive occlusal enamel lesions were affected by higher progression rates than sound occlusal surfaces. These two studies, however, considered the occlusal surface as one entity while it is known that this surface has different ecological niches. Therefore, it is not possible to ensure that the same lesion was monitored over time.

In the 1-year follow-up, we found that inactive occlusal enamel lesions and sound surfaces in permanent molars showed similar progression rates at site level (Zenkner et al. 2015). Nevertheless, as a slowly progressing disease, dental caries requires longer periods of monitoring to observe clinically detectable alterations. Therefore, the aims of this study were: (1) to assess the clinical behavior of inactive caries lesion on the occlusal surfaces of permanent molars over 4-5 years and (2) to estimate the risk of caries progression in these surfaces compared with sound occlusal sites. The hypothesis was that the risk of caries development and progression on occlusal surfaces of molar teeth presenting inactive enamel lesions was equivalent to those with sound occlusal surfaces.

Subjects and methods

This prospective cohort study followed 193 schoolchildren over a 4-5-year period. The study protocol was approved by the Ethical Committee of the Federal University of Santa Maria, Brazil (CAAE 0097.0.243.000-08), parents/legal guardians signed a written informed consent and the children agreed to participate. This study was conducted following STROBE guidelines.

Sample

The number of scholars to be enrolled in the study was estimated in 200 considering an attributed difference of 15% in caries incidence/progression between sound and caries inactive occlusal sites, a statistical power of 80%, a significance level of 5%, and a design effect for clustering of 2.0. Attributing an estimated dropout rate of 25%, a total of 250 children were required (Zenkner et al. 2015).

Children were recruited among those attending one public school in the municipality of Santa Maria, a midsize city located in southern Brazil. The schoolchildren population has frank access to fluoridated water (0.7-0.8 ppmF) and to fluoridated dentifrices as well as to an oral hygiene and caries treatment program at the school. This may be considered a low caries prevalence population, with a mean DMFT of 0.9 at the age of 12 years (Piovesan et al. 2011).

To fulfill the inclusion criteria, each child had to be free of any active carious lesion and also to present at least one sound permanent molar and a permanent molar harboring an inactive enamel caries lesion (non-cavitated and/or cavitated in enamel). Out of 371 screened scholars, 258 were included in the study.

Data collection

At baseline, in 2010, the clinical examinations were performed by a single examiner using a dental set, dental mirror and a WHO probe. The examiner was trained and calibrated to the presence of caries lesions, caries activity, eruption stage and the presence of dental plaque, as previously described (Zenkner et al. 2015). Clinical examinations included the recording of dental plaque at the occlusal surfaces, tooth cleaning by means of dental prophylaxis, and air drying, followed by detection of caries lesions and recording of the eruption stage of each permanent molar.

Visible occlusal plaque was mapped on standardized drawings of the occlusal groove-fossa-system and registered as (0) no visible plaque, (1) hardly detectable plaque restricted to the groove-fossa system, (2) easily detectable plaque on the groove-fossa-system, and (3) occlusal surfaces partially or totally covered with heavy plaque accumulation (Carvalho et al. 1989). Concerning to the presence of caries lesions, the status of enamel surface was classified as (0) normal enamel translucency after air drying, (1) opaque enamel with dull-whitish surface (active lesion, non-cavitated or cavitated), and (2) shiny appearance of the surface of the opaque area with different degrees of brownish discoloration (inactive lesion, non-cavitated or cavitated) (Carvalho et al. 1989). The eruption stage of permanent molars was recorded as follows: (1) the occlusal surface partially erupted; (2) the occlusal surface fully erupted, but more than half of the tooth facial surface was covered with gingival tissue; (3) the occlusal surface fully erupted, and less than half of the tooth facial surface was covered with gingival tissue; and (4) full occlusion (Carvalho et al. 1989).

At follow-up, in 2014 and 2015, clinical examinations were performed using the same methodology. At the follow-up examination, the dental status of "filled, "sealed" or "extracted" were also considered. These examinations were performed by two examiners (JEZ e ADN), being one of them the same examiner of the baseline assessments. Both examiners were trained and calibrated to all adopted criteria ($k>0.70$), and they were blinded to the results of the baseline examinations. The follow-up examinations were performed at a dental unit or at home visits. Portable equipment was used to ensure drying and illumination at home visits.

Data analysis

Schoolchildren who were lost to follow-up and those who remained in the study were compared in regard to their baseline characteristics using the chi-square test. The percentage of new caries lesions on sound occlusal sites and of lesions that progressed on sites presenting inactive enamel lesions were also compared using the chi-square test.

At site level, a logistic regression model was used to estimate the chance of caries incidence and progression over the study period. The dependent variable was caries progression, which was defined by two different criteria. Progression by activity was defined as the presence of an active caries lesion at the follow-up examination (Zenkner et al. 2015). Progression by severity was defined as the presence of a dentine cavity at the follow-up exam. Fillings and extractions were considered as progressing sites in both criteria. The independent variables were the site status of the occlusal surfaces (reference: sound vs. inactive lesion), eruption stage (reference: fully erupted vs. partially erupted), occurrence and distribution of plaque on the occlusal surfaces (reference: none and hardly detectable plaque vs. easily detectable plaque), type of molar (reference: first molar vs. second molar), and dental arch (reference: upper vs. lower). All independent variables were maintained in the adjusted model irrespective of their p values. In order to adjust estimates for data clustering, logistic regression models were fitted using generalized estimating equation (GEE) with exchangeable working correlation matrices.

Furthermore, the number of surfaces to be followed aiming to prevent the progression of one to cavitation was also calculated. This measure is based on the "number needed to treat (NNT)", widely used in clinical trials (Cook and Sackett 1995), which was adapted to observational studies and named "number needed to be assessed (NNA)" (Piovesan et al. 2012). This parameter was calculated using the formula NNA =

1/ARR, where ARR (absolute risk reduction) was calculated dividing the risk for progression of inactive caries lesions by the risk for progression of sound surfaces. NNA was calculated for both criteria (activity and severity).

Data were analyzed using SPSS, version 18.0.

Results

After 4-5 years (mean 4.6±0.4 years), a total of 193 scholars were available for follow-up, resulting in a follow-up rate of 74.8% (Figure 1). The mean age was 13.3 (±3) years at baseline and 17.9 (±2.9) at the follow-up, being 49.7% (n=96) boys and 50.3% (n=97) girls. Each child contributed with a mean number of 6 sample units, ranging from 2 to 12 teeth. Comparing the characteristics of children who were lost to follow-up with those who remained in the study, no statistical difference ($p>0.05$) was found considering gender, age, status of occlusal surface, dental arch and type of molar. However, re-examined children had a higher proportion of partially erupted teeth ($p= 0.001$) and of molars with thick plaque accumulation ($p=0.02$) than their counterparts who were lost to follow-up.

Over the study period, 554 (48.1%) molars with sound occlusal surfaces and 598 (51.9%) molars with inactive occlusal enamel lesions were monitored. Table 1 describes the sample at site level.

Migrations at site level from the baseline to the follow-up examination are presented in Table 2. The vast majority of sound occlusal surfaces did migrate to inactive non-cavitated caries lesions. Considering the inactive non-cavitated occlusal sites at baseline, it was observed that 73.4% remained in the same category or clinically disappeared after 4-5 years (n=53 + 351, respectively). The majority of the sound and inactive non-cavitated lesions progressing to enamel cavitation remained caries inactive.

The quasi-totality of the cavitated inactive lesions detected at the baseline was filled at the follow-up.

When we considered the criterion "activity", 30.6% (n=59) of the children presented at least one molar with active lesion, filling or had been extracted. At site level, the progression rate was 5.1% (n=28) in the sound sites and 14.5% (n=87) in inactive caries lesions ($p<0.001$). Adjusted logistic regression analysis showed that inactive lesions presented around a 2-fold increased chance for caries progression than sound surfaces (OR=2.34 95%CI=1.51-3.62) (Table 3).

On the other hand, when we considered the criterion "severity", 13% (n=25) of the children presented at least one molar progressing to dentine cavity, filling or extraction. At site level, 3.2% (n=18) of the sound occlusal sites have progressed, contrasting with a progression rate of 9.7% (n=58) observed in the inactive caries lesions ($p<0.05$). In the chance assessment analysis, after adjustment for important co-factors, inactive caries lesions presented a significantly higher chance for caries progression when compared with sound surfaces (OR=2.69, 95%CI=1.50-4.83) (Table 3). In the adjusted analysis, caries progression was also associated with the presence of easily visible plaque accumulation (OR=2.10, 95%CI=1.16-3.79), second molar (OR=0.42, 95%CI=0.24-0.74) and the lower dental arch (OR=1.88, 95%CI=1.18-3.00).

The NNA was 11 for the criterion "activity" and 15 for the criterion "severity".

Discussion

This long-term longitudinal study assessed the clinical behavior and the risk of progression of inactive occlusal caries lesion of permanent molars after 4-5 years at site level. The main finding was that the lesions diagnosed as inactive caries lesions presented higher progression rates than did sound occlusal surfaces for the two adopted

criteria. However, 10-15 inactive occlusal enamel lesions should to be followed up to prevent the progression of one of them.

After a follow-up period of 12 months, our research group failed to observe any difference in caries activity rates between the two comparison groups. This fact may be attributed to the lack of statistical power and to the slow progression of dental caries observed in a low-caries population with frank access to fluoride. Notwithstanding, after 4-5 years of follow-up it was possible to detect a clear difference in progressions by activity criterion; the caries inactive sites presenting a 3-fold increased progression rate when compared with sound sites. Of the factors included in the multivariable model, the presence of thick plaque covering the occlusal site presented a borderline association with caries activity. The lack of a significant association may be attributed to the decreasing proportion of sites presenting thick plaque accumulation from the baseline (23.1%) to the follow-up (7.2%), which demonstrates that this schoolchildren population has improved its oral hygiene levels over the study period.

Considering the criterion of progression to dentine cavity, filling or extraction, the sites harboring inactive caries lesions at baseline showed progression rates higher than sound occlusal sites. This is in accordance with the results by Nyvad et al. (2003) who found that 30% of the inactive occlusal enamel lesions have progressed over a 3-year period, even in the presence of fluoride. Moreover, the authors showed that these lesions had around a 5-fold increased risk to progress to cavitation, filling or extraction when compared with sound surfaces. Similarly, Ferreira-Zandoná et al. (2012) showed that 18-33% of the surfaces with inactive enamel lesions progressed to cavitation within 2 years of observation, which contrasted with the progression rate of 6% observed in sound occlusal surfaces in that study. The overall higher progression rates found in these two longitudinal studies may be associated with the higher caries prevalence

observed in those populations. Our results, obtained from a low prevalence, caries controlled population, and considering a site level follow-up, confirm their findings. It is important to point that our results add knowledge to this research field, once it detected a similar behavior of the carious enamel occlusal sites in a low prevalence population and adopting a careful observation of each ecological niche of the studied occlusal surfaces.

In this study, the teeth presenting fillings at the follow-up examination were considered as progression, as usually done in previous studies (Ferreira Zandoná et al. 2012; Nyvad et al. 2003; Zenkner et al. 2015). As shown in Table 2, the vast majority of progressions of the inactive cavitated lesions were fillings (activity criteria = 16/19; severity criteria = 16/18). It is possible to speculate that such lesions, restored by other professionals, may have been filled due to the pure presence of an enamel cavity. This fact alone does not mean that the lesions have progressed to a severer condition. In order to assess the impact of the fillings in our results, we conducted an additional analysis disregarding the fillings as progression. Irrespective of the progression criteria used, no difference was observed in the found associations; inactive lesions presented an increased risk for caries progression than did sound surfaces (activity criteria: adjusted OR=2.33, 95%CI=1.30-4.18, p=0.005; severity criteria: adjusted OR=2.85, 95%CI =1.14-7.12, p=0.025).

The attrition rate of 25.2% may be considered as a limitation of this study; however, the schoolchildren who were reexamined after 4-5 years and those who were lost to follow-up were similar in regard to most of the baseline characteristics. The differences regarding plaque accumulation and eruption stage do not appear to affect our findings once there was a higher proportion of dental surfaces with thick plaque and partial eruption among those who remained in the study. Considering the natural history

of the disease (Ferreira Zandoná et al. 2012), the 4-5-year observational period may be seen as strength of this study, once this is time enough to detect migrations of a sound or incipient carious site to dentine cavity or even to restorative treatment. The drawing and registration of each caries lesion on the occlusal surfaces at baseline were able to ensure that the monitoring of this study was performed at site level. This may be considered as a guarantee of the correct identification of every new caries lesion and every lesion in progression during the observational period.

Our results, considered altogether with other similar long-term surveys (Ferreira Zandoná et al. 2012; Nyvad et al. 2003), indicate that, despite the enhancement in enamel resistance that occurs during the re-mineralization process, it seems to not transmute the inactive lesion to a surface insusceptible to dental caries development. This fact seems to demand some additional care concerning the clinical management of such lesions. The values of NNA parameter found for this sample point to the need of following 10-15 inactive occlusal enamel lesions to prevent the progression of one of them, during the observational period of 4-5 years. Even considering the low progression rates found to sound and to carious sites in this study, it seems to us that a long-term follow-up is an adequate and feasible approach to these enamel carious sites.

In conclusion, this longitudinal study showed that the vast majority of lesions (85-90%) identified as inactive enamel caries at baseline have not progressed over 4-5 years. Despite this fact, it was possible to detect an increased risk for caries progression in caries-inactive occlusal sites compared with the sound ones. Considering that dental caries is a chronic and recurrent disease, even caries-inactive individuals should be monitored over time.

Acknowledgments

We acknowledge the support of the National Coordination of Post-graduate Education (CAPES), Ministry of Education, Brazil. The authors declare no conflict of interest related to this study.

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Figure legend

Figure 1. Flow chart of the study.

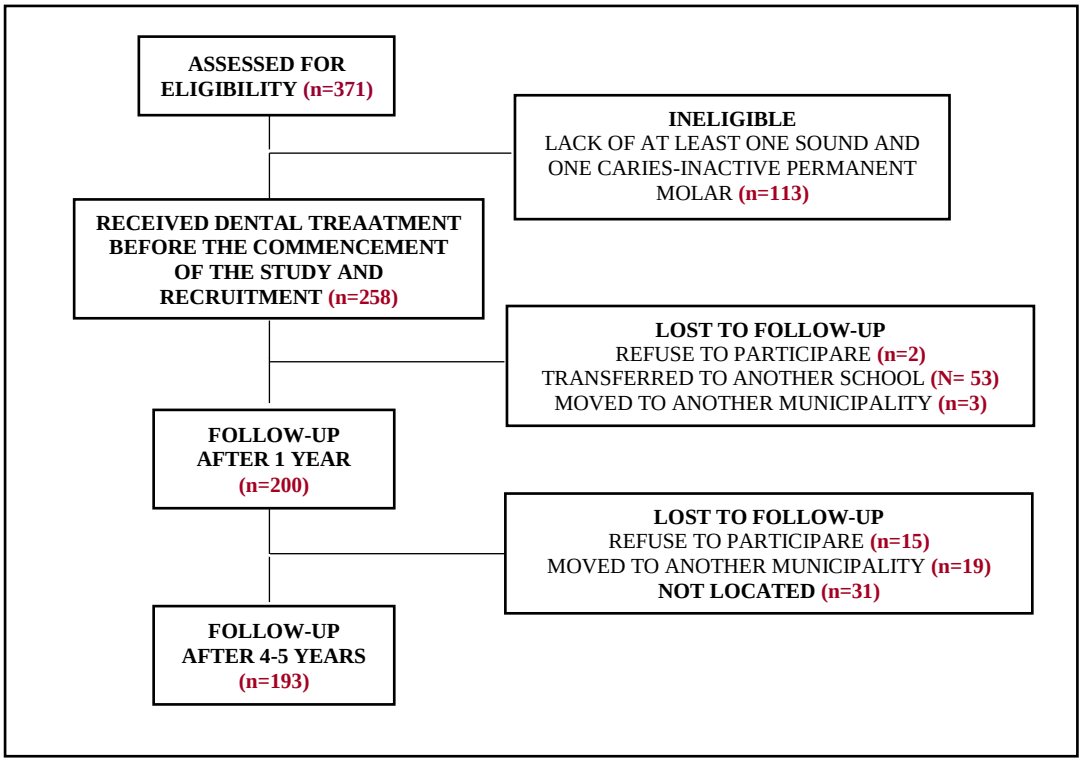

Table 1. Sample description at the site level. N=1,152.

	N (%)
Site status	
Sound	554 (48.1)
Inactive non-cavitated lesions	550 (47.7)
Inactive cavitated lesions*	48 (4.2)
Plaque	
No + hardly visible	886 (76.9)
Easily visible	266 (23.1)
Eruption	
Fully	956 (83)
Partially	196 (17)
Type of molar	
First	647 (56.2)
Second	505 (43.8)
Arch	
Upper	568 (49.3)
Lower	584 (50.7)
TOTAL	1,152

Table 2. Site status at the baseline and at the follow-up examination. N=1,152

Baseline	**Follow-up**									
	Sound	INC	ANC	IEC	AEC	IDC	ADC	Filling	Extracted	Total
Sound	212	294	11	17	2	3	4	11	0	554
Inactive non-cavitated	53	351	25	72	9	6	15	18	1	550
Inactive cavitated*	1	11	0	16	2	1	0	16	1	48
Total	266	692	36	105	13	10	19	45	2	1,152

INC = inactive non-cavitated lesion; ANC = active non-cavitated lesion, IEC = inactive enamel cavitated lesion; AEC: active enamel cavitated lesion, IDC = inactive dentine cavitated lesion, ADC = active cavitated lesion.

Table 3. Association between progression and the predictor variables (adjusted models).

	Activity		Severity	
	OR (95% CI)	p	OR (95% CI)	p
Site status				
Sound	1.00		1.00	
Inactive lesions	2.34 (1.51-3.62)	<0.001	2.69 (1.50-4.83)	0.001
Plaque				
No + hardly visible	1.00		1.00	
Easily visible	1.66 (0.99-2.76)	0.05	2.10 (1.16-3.79)	0.01
Eruption				
Fully	1.00		1.00	
Partially	1.26 (0.76-2.10)	0.37	0.73 (0.34-1.57)	0.42
Type of molar				
First	1.00		1.00	
Second	1.18 (0.75-1.87)	0.47	0.42 (0.24-0.74)	0.003
Arch				
Upper	1.00		1.00	
Lower	1.17 (0.76-1.80)	0.48	1.88 (1.18-3.00)	0.008

OR = odd ratio obtained in a logistic regression model based on generalized estimating equations; CI = confidence interval.

3 CONSIDERAÇÕES FINAIS

Esta dissertação avaliou a progressão de lesões de cárie inativas não cavitadas e minimamente cavitadas durante um período de 4-5 anos. O conhecimento do curso clínico da doença é importante para guiar as tomadas de decisão do tratamento da cárie dentária. Poucos estudos já haviam acompanhado longitudinalmente esta condição e ao comparar com estudos in situ mostraram resultados conflitantes.

Neste estudo, a maioria dos sítios diagnosticados como cárie-inativos (85-90%) não apresentou progressão ao longo do período observacional. Ainda assim, eles apresentaram taxas de progressão mais elevadas do que as superfícies oclusais hígidas. Os resultados apontam para a validade do controle clínico longitudinal de lesões cariosas incipientes inativas em superfícies oclusais de molares permanentes.

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APÊNDICE A – FICHA DE EXAME CLÍNICO

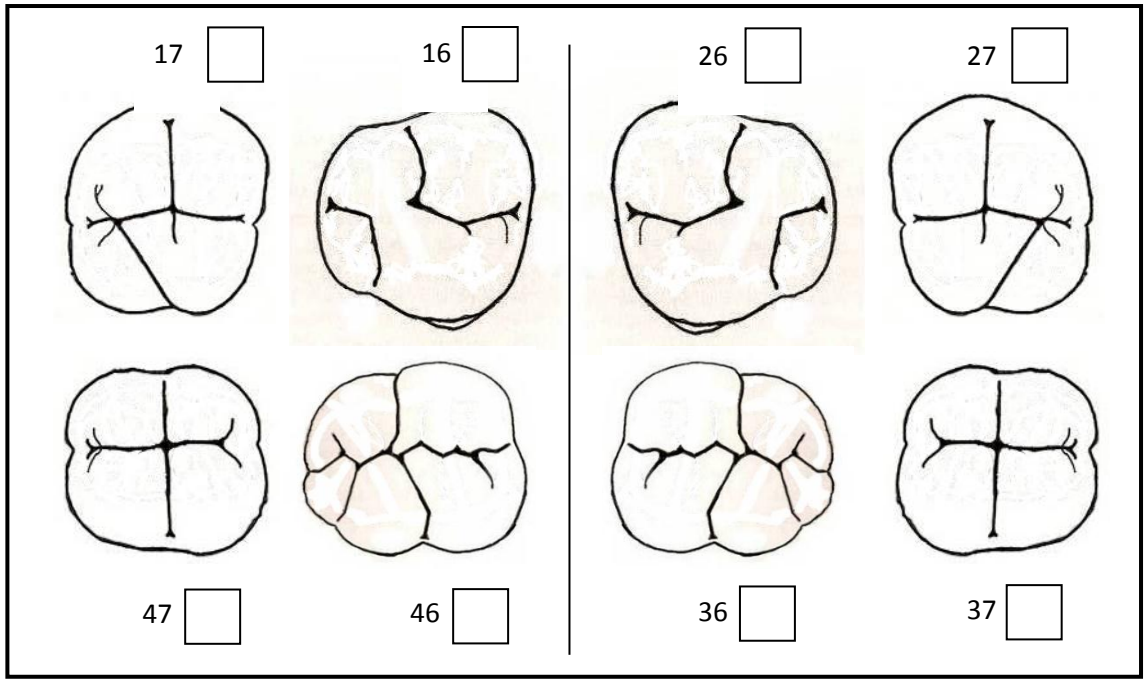
UNIVERSIDADE FEDERAL DE SANTA MARIA
DEPARTAMENTO DE ESTOMATOLOGIA
DISCIPLINA DE ODONTOLOGIA EM SAÚDE COLETIVA

EXAME CLÍNICO DO BIOFILME DENTÁRIO

PACIENTE Nº.: _____ DATA ____ / ____ / ____ EXAME: Inicial ☐ 12 meses ☐ 24 meses ☐ 36 meses ☐

NOME: _____ ENDEREÇO: _____ FONES: _____

PAIS / RESP: _____ OUTRO CONTATO:_____ FONES: _____



APÊNDICE A – FICHA DE EXAME CLÍNICO

UNIVERSIDADE FEDERAL DE SANTA MARIA
DEPARTAMENTO DE ESTOMATOLOGIA
DISCIPLINA DE ODONTOLOGIA EM SAÚDE COLETIVA

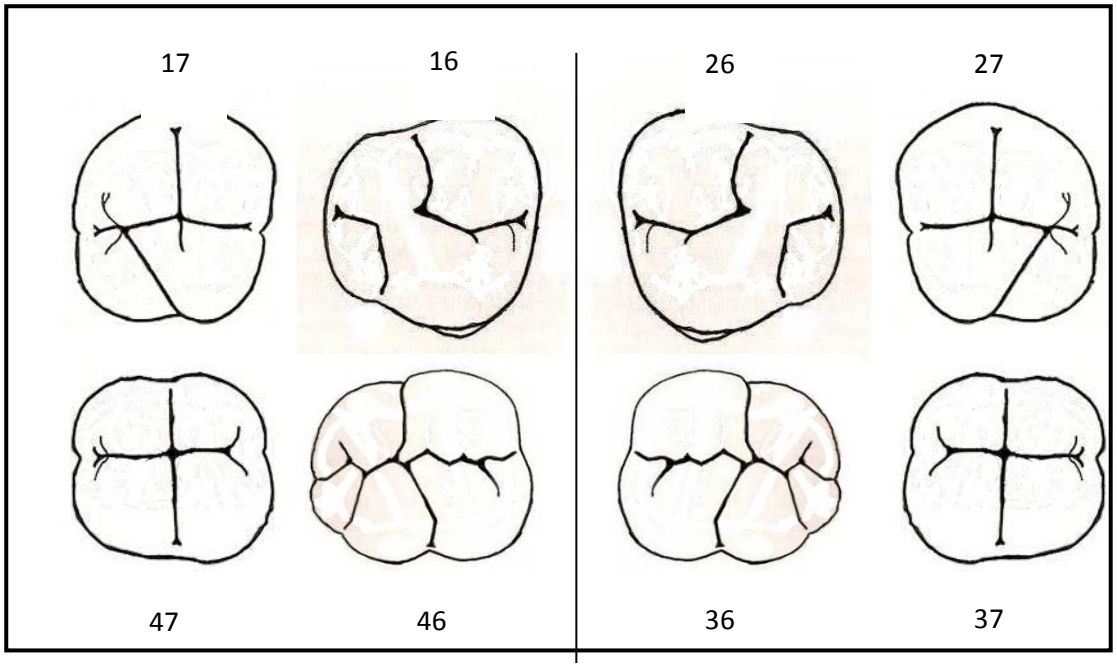
EXAMES CLÍNICO E RADIOGRÁFICO DAS LESÕES OCLUSAIS

PACIENTE Nº.: _____ DATA ____ / ____ / ____ EXAME: Inicial ☐ 12 meses ☐ 24 meses ☐ 36 meses ☐

NOME: _____ ENDEREÇO: _____ FONES: _____

PAIS / RESP: _____ OUTRO CONTATO:_____ FONES: _____

Dente	ICDAS	Ativ	Erup	Rx
17				
16				
27				
26				
37				
36				
47				
46				



APÊNDICE B – TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

UNIVERSIDADE FEDERAL DE SANTA MARIA
CCS - CURSO DE ODONTOLOGIA
DEPARTAMENTO DE ESTOMATOLOGIA
DISCIPLINA DE ODONTOLOGIA EM SAUDE COLETIVA

PROJETO DE PESQUISA:

Avaliação longitudinal do curso clínico de lesões de cárie inativas

TERMO DE CONSENTIMENTO LIVRE E ESCLARECIDO

Elaborado com base na Resolução 196/1996 do Conselho Nacional de saúde, publicada no DOU Nº 201, 1996.

O presente termo, elaborado pelo Professor Júlio Eduardo do Amaral Zenkner (Matr. SIAPE Nº 0379391) da Disciplina de Odontologia em Saúde Coletiva do Curso de Odontologia da UFSM, tem por objetivo estabelecer acordo mediante o qual a criança ou adolescente regularmente matriculado na Escola Estadual de Ensino Fundamental e Médio Irmão José Otão receberá por parte de seu (sua) responsável autorização para ser atendido (a) pelos Cirurgiões-dentistas e/ou acadêmicos integrantes do presente projeto com finalidade de tratamento conservador de lesões de cárie dentária. Os procedimentos clínicos serão executados no ambiente da clínica extramuros do Curso de Odontologia localizada na própria escola e poderão consistir em: preenchimento de fichas clínicas, radiografias intra-bucais, anestesia, isolamento absoluto, preparo cavitário com brocas odontológicas de alta e/ou baixa rotação e curetas de dentina para remoção parcial ou total da dentina cariada, restaurações dentárias com materiais restauradores utilizados de acordo com a recomendação dos fabricantes. A presente autorização deverá ser concedida com o pleno conhecimento do Sr. (da Srª) responsável sobre a natureza dos procedimentos a serem executados e seus objetivos, no uso de sua liberdade e sem sofrer qualquer tipo de coação ou pressão.

OBJETIVO: Por meio de exame clínico e radiográfico diagnosticar a presença de lesões ativas ou inativas de cárie em molares permanentes e restaurá-las com materiais odontológicos indicados para tal, ou mantê-las sob controle clínico e radiográfico ao longo do tempo, de modo a averiguar a inativação das lesões pelo tratamento com flúor, higienização periódica dos dentes pelos profissionais e orientação para adequada limpeza domiciliar. Após o tratamento, as avaliações clínicas e radiográficas dos dentes tratados serão feitas em uma periodicidade aproximadamente anual por um período de até 3 anos.

BENEFÍCIOS PREVISTOS PARA AS CRIANÇAS ENVOLVIDAS: Todos os pacientes receberão orientações para uma adequada higiene oral e quanto ao consumo correto de alimentos doces, de modo a tratar a atividade de cárie; restaurações dos dentes que tenham cavidades de cárie; além de outros procedimentos clínicos odontológicos necessários para sua saúde bucal, seus responsáveis receberão informações quanto ao andamento do tratamento e ao sucesso dos procedimentos executados.

RISCOS PREVISTOS PARA AS CRIANÇAS ENVOLVIDAS: Serão aqueles inerentes ao tratamento odontológico convencional, como desconforto em função da manipulação da boca

e do trabalho nos dentes, não existindo previsão de qualquer risco para a saúde do (da) menor atendido (a).

Eu,_____, RG Nº._____, responsável pelo(s) menor (es) _____ matriculados na(s) _____série(s) da Escola Estadual de Ensino Fundamental e Médio Irmão José Otão tendo lido o presente termo e estando devidamente esclarecido (a) e no uso de meu livre arbítrio autorizo-o(os) a participar(em) 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.
DATA: ____ / ____ / ____ ASSINATURA: _____
ENDEREÇO:_____TELEFONE: _____

Eu _____, aluno(a) da Escola Estadual de Ensino Fundamental e Médio Irmão José Otão concordo em ser atendido pelos cirurgiões-dentistas participantes deste Projeto, de acordo com o que foi explicado a mim e a meus responsáveis.
DATA: ____ / ____ / ____ ASSINATURA: _____

Em caso de dúvida contate o Comitê de Ética em Pesquisa da UFSM:
Avenida Roraima, 1000 - Prédio da Reitoria - 7º andar - Sala 702 Cidade Universitária - Bairro Camobi 97105-900 - Santa Maria - RS
FONE: (55) 3220 93 62.

ANEXO A – CARTA DE APROVAÇÃO DO COMITÉ DE ÉTICA EM PESQUISA.

MINISTÉRIO DA SAÚDE
Conselho Nacional de Saúde
Comissão Nacional de Ética em Pesquisa
(CONEP)

UNIVERSIDADE FEDERAL DE SANTA MARIA
Pró-Reitoria de Pós-Graduação e Pesquisa
Comitê de Ética em Pesquisa - CEP- UFSM
REGISTRO CONEP: 243

CARTA DE APROVAÇÃO

O Comitê de Ética em Pesquisa – UFSM, reconhecido pela Comissão Nacional de Ética em Pesquisa – (CONEP/MS) analisou o protocolo de pesquisa:

Título: Diagnóstico e tratamento não invasivo de lesões cariosas; avaliação longitudinal após validação de métodos de diagnóstico visuais
Número do processo: 23081.008528/2008-35
CAAE (Certificado de Apresentação para Apreciação Ética): 0097.0.243.000-08
Pesquisador Responsável: Julio Eduardo do Amaral Zenkner

Este projeto foi APROVADO em seus aspectos éticos e metodológicos de acordo com as Diretrizes estabelecidas na Resolução 196/96 e complementares do Conselho Nacional de Saúde. Toda e qualquer alteração do Projeto, assim como os eventos adversos graves, deverão ser comunicados imediatamente a este Comitê. O pesquisador deve apresentar ao CEP:

Abril/2009 **Relatório final**

Os membros do CEP-UFSM não participaram do processo de avaliação dos projetos onde constam como pesquisadores.

DATA DA REUNIÃO DE APROVAÇÃO: 12/08/2008

Santa Maria, 13 de Agosto de 2008.

Lissandra Dal Lago
Coordenadora do Comitê de Ética em Pesquisa – UFSM
Registro CONEP N. 243.