http://dx.doi.org/10.1590/1981-86372022002320200207

| ORIGINAL

Diagnostic methods for stained pits and fissures caries lesions on the occlusal surface

Métodos diagnósticos para lesões de cárie com sulcos pigmentados em superfície oclusal

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ABSTRACT

Objective: The aim of this study was to compare methods for in vitro diagnosis of pigmented pits and fissures on the occlusal surface. **Methods**: Forty-one human molars and premolars extracted with pigmentation in pits and fissures were used. The teeth were evaluated with artificial illumination for classification according to ICDAS, followed by fluorescent laser evaluation. For the radiographic evaluation, the teeth were positioned to obtain interproximal images, adopting the criterion of Rodrigues et al. 2008 for diagnosis of lesions. For histological evaluation, the teeth were sectioned in the mesiodistal direction in the occlusal sulcus region and evaluated in a 20-fold stereoscopic magnifying glass, using the criterion of Ekstrand et al. (1997) for evaluation. The methods were compared with the histological evaluation, obtaining values of accuracy, sensitivity and specificity regarding the response variables "presence / absence" of enamel caries. **Results**: When comparing visual inspection with histological analysis, 65.85% accuracy, 40% sensitivity and 90.48% specificity were observed with false positive and negative probability of 20% and 38.71%. When comparing the fluorescent laser with the histological analysis, the accuracy was 58.54%, sensitivity 70% and specificity 47.62%. Comparing the radiographic analysis with the histological analysis, it was obtained 53.66% accuracy, sensitivity of 42.11% and specificity of 73.68%. **Conclusion**: The ROC curve and the Yuden index showed that visual inspection presented the best combination of sensitivity and specificity than fluorescent laser and radiographic analysis for diagnosis, which represented the best method for detecting inactive carious lesions in enamel.

Indexing terms: Dental caries. Dental enamel. Diagnosis.

RESUMO

***Objetivo**: O objetivo deste estudo foi comparar métodos para diagnóstico in vitro de sulcos pigmentados em superfície oclusal. **Métodos**: Foram utilizados 41 molares e pré-molares humanos extraídos com pigmentação em sulcos e fissuras. Os dentes foram*

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How to cite this article

Meirelles JB, Carlos NR, Amaral FLB, França FMG, Turssi CP, Basting RT. Diagnostic methods for stained pits and fissures. RGO, Rev Gaúch Odontol. 2022;70:e20220023. http://dx.doi.org/10.1590/1981-86372022002320200207

avaliados com iluminação artificial para classificação quanto ao critério ICDAS, seguida por avaliação com laser fluorescente. Para a avaliação radiográfica, os dentes foram posicionados para obtenção de imagens interproximais, adotando-se o critério de Rodrigues et al. (2008) para diagnóstico. Para avaliação histológica, os dentes foram seccionados no sentido mésio-distal na região de sulco oclusal e avaliados em lupa estereoscópica com aumento de 20 vezes, adotando-se o critério de Ekstrand et al. (1997). Os métodos foram comparados com a avaliação histológica, obtendo-se valores de acurácia, sensibilidade e especificidade quanto às variáveis de resposta "presença/ausência" de lesão de cárie em esmalte. ***Resultados****: Ao comparar a inspeção visual com a análise histológica, observou-se acurácia de 65,85%, sensibilidade de 40% e especificidade de 90,48%. Ao comparar o laser fluorescente com a análise histológica, a acurácia foi de 58,54%, sensibilidade de 70% e especificidade de 47,62%. Na comparação da análise radiográfica com a histológica, obteve-se acurácia de 53,66%, sensibilidade de 42,11% e especificidade de 73,68%.* ***Conclusão****: A curva ROC mostrou que a inspeção visual apresentou a melhor combinação de sensibilidade e especificidade que o laser fluorescente e que a análise radiográfica para o diagnóstico, representando o melhor método para detecção de cárie em lesões com sulcos pigmentados em esmalte*

Termos de indexação: *Cárie dental. Esmalte dentário. Diagnóstico.*

INTRODUCTION

White spot lesions are the first clinical sign of caries lesions; however, due to the remineralization process, white lesions may incorporate exogenous pigments from food over time, resulting in a brownish or blackish color, manifesting as an inactive lesion with a stained pits and fissures, also being called "arrested lesion " [1]. This lesions can present clinical aspects that can confuse the professional when making the clinical decision regarding treatment, since they can be confined to the pits and fissures on the occlusal surface, but they can also be associated with microcavities and with darkening regions of the surrounding regions pits, indicating that the lesion may have progressed beyond the limits of the enamel substrate. Therefore, if the lesion is not diagnosed correctly, an incorrect treatment decision can lead to undertreatment or overtreatment of the problem [2].

The deep region of the pits and fissures can also show pigmentation due to the deposition of the biofilm, which can become mineralized, resulting in a condition that does not represent a pathological condition [3]. These pigmentations are called biological sealing [4], with less possibility of demineralization of the dental structure, not requiring invasive treatment, but also being confused with an inactive or arrested caries lesion that does not require restorative intervention. Thus, it is important to use accurate methods to detect caries lesions, aiming at the best treatment decisions in favor of benefits to patients [5].

The visual inspection is the most used exam in clinical dental practice, since it starts the diagnostic process and because it is a fast, low-cost and easy-to-perform method [6]. However, the difficulty that the occlusal surface represents in the diagnosis, other auxiliary methods have been developed to facilitate and contribute to the diagnosis, prognosis and therapeutic measures. The radiographic examination associated with visual inspection promotes an increased sensitivity in detecting proximal and occlusal caries lesions in dentin, in addition to promoting a better estimate of the depth of the lesion compared to the use of isolated visual inspection [7]. As the visual method performs well in relation to specificity, but with low sensitivity [6,8], radiographic examination would be recommended to increase sensitivity in detecting carious lesions, helping to reduce the use of additional diagnostic methods, with ionizing radiation, to avoid overdiagnosis and to determine the best preventive and operative dental care [9].

Laser fluorescence is another diagnostic method, based on the capture of fluorescence emitted by the tooth after the emission of a light from a diode laser. This fluorescence is higher in the carious tissue than in the healthy tissue. The device itself translates this fluorescence into a scale from 0 to 99, presented by the equipment, and the higher the value recorded by the device, the greater the depth of the lesion [10]. In an in vitro study it was found that it presents high specificity and sensitivity in the measurement of occlusal lesions [11]. Shix et al. [12] show that the diagnostic accuracy of fluorescent laser in the detection of enamel caries was lower than dentin caries, as well as seems to present better performance in superficial lesions [13].

All diagnostic methods are used to evaluate the presence of caries lesions, especially in early stages when the lesion is not yet cavitated; however, there are no studies to evaluate the efficacy of these methods, caries lesions with pigmented pits and fissures to diagnose the extent of the lesion (whether in enamel or dentin) and to define the need

for invasive restorative procedures, if necessary. Thus, caries diagnosis methods should accurately evaluate the clinical signs of caries progression, regardless of the degree of pigmentation, with the aim of monitoring lesions, especially when adopting non-invasive treatment strategies [14]. Thus, this in vitro study aims to compare the accuracy, sensitivity and specificity of methods of diagnosis of caries lesions with pigmented pits and fissures on the occlusal surface of human molars and premolars.

METHODS

Ethical aspects

The present study was approved by the Research Ethics Committee of São Leopoldo Mandic, with the number CAAE 88483118.1.0000.5374.

Selection and preparation of teeth

Sixty upper and lower premolar and premolar teeth were selected and extracted with darkened in the region of pits and fissures on the occlusal surface. As an inclusion criterion, the teeth should have the main pits and fissures with pigmentation and be classified using the ICDAS 1 or 2 index (table 1). Pigmentation could be due to an inactive enamel caries lesion (which showed pigmentation during the remineralization process with pigments from food) or a biological seal (from pigmentation of bacterium plaque products in the fissure region) leaving both with similar visual characteristics (darkened pits and fissure whose color can vary from brown to brownish. Exclusion criteria were: teeth with fractures or cracks in the coronary portion of the tooth, lesions cavitated in dentin, presence of active caries lesion (white spot) on the occlusal fissures, presence of restorations in the coronary portion, presence of hypoplastic stains or defects in dental formation.

The teeth were cleaned with periodontal curettes to remove the periodontal ligament, calculus, then prophylaxis was performed with pumice stone, rubber bowl and Robinson brush in low rotation. With clean and dry teeth, and using artificial lighting from a dental reflector, the exclusion criteria were applied again, obtaining a total of 41 teeth selected for the experiment.

The teeth were embedded in acrylic containers to allow the correct evaluation in the different diagnostic methods to be obtained. Thus, for visual inspection, by fluorescent laser and for radiographic evaluation, the root portion of the teeth was fixed with dense condensation silicone paste (Reflex, Yller, Pelotas, RS, Brazil), so that the long axis of the tooth remained perpendicular to the horizontal plane, keeping the coronary portion exposed.

The teeth were immersed in artificial saliva to promote hydration throughout the experiment and to allow adequate conditions for the different diagnostic methods, keeping them in a bacteriological oven at 37° C. The artificial saliva used was the one recommended by Featherstone et al. [15] and modified by Serra & Cury [16].

Diagnostic method by visual inspection

For evaluations through visual inspection, three examiners were previously trained in the evaluation criteria by the ICDAS index (International Caries Detection and Assessment System) (table 1). The group of examiners was formed by two teachers with experience in diagnosing caries lesions and the person responsible for the present study.

The evaluation of the teeth was performed in a dental office under the reflector light, with the score being consensually assigned by the three examiners, always deciding to assign a more optimistic score (of lesser extent of the lesion) in cases of doubt. The tooth to be examined was removed from the artificial saliva solution and dried for 10

seconds with the aid of compressed air from a triple syringe. After drying, the occlusal surface was observed, and the examiner attributed the ICDAS index score. Then, the tooth was again immersed in an artificial saliva solution.

Table 1. ICDAS Index score evaluation, radiographic evaluation, histological evaluation.

Scores	Rating criteria
	ICDAS Index
0	No evidence of changes in enamel translucency after prolonged drying (more than 5s).
1	No evidence of changes when the tooth is visualized moist, only after drying more than 5 seconds with an air jet, a change in opacity is visible. In dark lesions, only when it is restricted to the bottom of the fissures.
2	Visible opacity in the enamel with the damp tooth or darkened pigmentation extending beyond the walls of the crack.
3	Cavity located in opaque or pigmented enamel, without exposing the dentin.
4	Shading of darkened dentin visible through the apparently intact marginal ridge.
5	Opaque or pigmented enamel cavity with exposure of the underlying dentin involving less than half the surface.
6	Opaque or pigmented enamel cavity with exposure of the underlying dentin, involving more than half of the surface.
	Radiographic Evaluation Scores/ According to Rodrigues et al. (2008)
0	No visible radiolucency.
1	Visible radiolucency in enamel.
2	Radiolucency visible in dentin, but restricted to the external half of dentin.
3	Radiolucency involving the internal half of the dentin.
	Histological Evaluation Scores/ According to Ekstrand et al. (1997)
0	Absence of caries lesion.
1	Caries lesion limited to the outer layer of enamel.
2	Caries lesion extending into the inner layer of enamel and the outermost layer of dentin.
3	Caries lesion involving the middle third of the dentin
4	Caries lesion involving the deepest layer of dentin.

Fluorescent laser diagnostic method

For this analysis, only one examiner performed the evaluations, since the measurement is independent of the subjectivity of the examiner as it is a quantitative method. A laser fluorescence device was used (DiagnoDENT, Kavo, Biberich, Alemanha). For its use, the calibration protocol recommended by the manufacturer was followed. Tip "A" was used, which is indicated for the evaluation of pits and fissures. The tooth was removed from the artificial saliva solution and dried for 10 seconds with the aid of compressed air from a triple syringe, with two evaluations of each tooth being performed. For this, in a first measurement, the peak values of each evaluated occlusal surface were noted. The tip attached to the equipment covered all the occlusal fissure, touching the dental surface with light pressure. Then, the tooth was rehydrated in artificial saliva solution. After 30 minutes, the tooth was dried and the second evaluation was performed, in order to obtain greater precision of the values, obtaining the average of the values between the two evaluations.

Diagnostic method by radiographic evaluation

To obtain radiographic images, a digital X-ray device (Dabi Atlante, Ribeirão Preto, SP, Brazil) was used with 70 KVp and 7Ma. For this, the teeth were positioned on a phosphor plate for further scanning in a digital device of periapical radiographs (Vista Scan perio Plus, Bietigheim, Germany). The direction of the X-ray emitting cone maintained the parallelism to the proximal faces of the teeth as recommended in interproximal radiographs with a distance of 20 cm from

the cone to the tooth. The images were then scanned and archived on the computer. The evaluation was performed by the same examiners who participated in the diagnosis by visual inspection. They were trained according to the evaluation criteria adopted by Rodrigues et al. [17] (table 1). For the evaluation, the scores were assigned by the examiners in a consensual way, always deciding to assign more optimistic scores (of lesser extent of the lesion) in cases of doubt..

Diagnostic method by histological evaluation

For histological evaluation, the teeth were removed from plastic containers with silicone, fixed in acrylic plates with dimensions of 5 cm by 2 cm with useful wax and sectioned longitudinally in the mesio-distal direction, in the central region of the occlusal surface, in slices of approximately 1 mm thickA double-sided diamond disc mounted on a metallographic cutter was used (Isomet 1000, Buehler Ltda, Lake Buff, Illinois, EUA), with speed 350 rpm. On average, two to three slices from the central region of the main tooth occlusal fissure were obtained with sectioning. The slices were analyzed using a stereoscopic magnifying glass (Eikonal Equipamentos Óticos, São Paulo, SP, Brazil) with a 20-fold magnification. The slices were classified by a single examiner (responsible for the study) according to the criterion proposed by Ekstrand et al. [18] (table 1).

Statistical analysis

Comparisons between diagnostic methods and histological analysis were performed for accuracy, sensitivity and specificity, and area under the ROC (Receiver Operating Characteristic) curve with the respective 95% confidence interval. The cut-off point "0" of the histological analysis (absence of caries lesion) was considered to relate the diagnostic methods evaluated in relation to the absence of disease. All analyzes were performed using the R program (R Core Team, 2018).

RESULTS

Visual inspection X histological evaluation

Histological analysis, 21 teeth (51.2%) were diagnosed without caries, 9 (22.0%) with caries lesion limited to the outer layer of enamel and 11 (26.7%) with caries lesion extending into the layer enamel and the outermost layer of dentin. In the visual analysis, 46.3% of the teeth had a score of 1 by ICDAS and a score 0 by histological analysis, while 12.1% of teeth that had a score of 1 by ICDAS had a score of 2 by histological analysis (table 2).

Table 2. Frequency distribution of the results of the visual inspection (ICDAS criterion) in relation to the histological analysis.

Score ICDAS	Histological analysis		
	0	1	2
1	19 (46.3%)	7 (17.1%)	5 (12.1%)
2	2 (4.9%)	2 (4.9%)	6 (14.6%)

ICDAS: Score 1: no evidence of changes when the tooth is viewed moist, only after drying more than 5 seconds with an air jet, a change in opacity is visible. In dark lesions, only when it is restricted to the bottom of the fissures. Score 2: visible opacity in the enamel with a damp tooth or darkened discoloration exceeding the crack walls. Histological: (0) no caries, (1) caries lesion limited to the outer layer of enamel (2) caries lesion extending into the inner layer of enamel and the outermost layer of dentin.

Laser fluorescence X Histological analysis

The comparison between frequencies and percentages for laser fluorescence results in relation to histological analysis is shown in table 3. It can be seen that 19.5% of the teeth were diagnosed on visual inspection with score 2 (caries lesion extending in the internal enamel layer and the outermost layer of dentin) by histological analysis and with laser fluorescence values ≥ 20 (with caries lesion present in dentin). Histological analysis, 26.8% of teeth were diagnosed with a score of 0 (without caries) by histological analysis and with fluorescence values ≥ 20 (with caries lesion present in dentin) by fluorescent laser.

Table 3. Frequency distribution of laser fluorescenceresults in relation to histological analysis.

Laser fluorescence	Histological evaluation		
	0	1	2
<20	10 (24.4%)	3 (7.3%)	3 (7.3%)
≥20	11 (26.8%)	6 (14.6%)	8 (19.5%)

Laser fluorescence: values above 20 (inclusive) are teeth that have a carious lesion already present in dentin.

Histological: (0) no caries, (1) caries lesion limited to the outer layer of enamel (2) caries lesion extending into the inner layer of enamel and the outermost layer of dentin.

Radiographic analysis x Histological analysis

It is observed that 36.8% of the teeth were diagnosed without caries by histological analysis and score 1 (visible radiolucency in enamel) by radiographic analysis (table 4). In addition, 10.5% of the teeth were diagnosed with a score 2 (caries lesion extending to the inner layer of enamel and the outermost layer of dentin) by histological analysis and score 2 (radiolucency visible in dentin, but restricted to the outer half dentin) by radiographic analysis.

Table 4. Frequency distribution of radiographic analysis in relation to the histological analysis (mode of the two evaluations by the three evaluators).

Radiographic analysis	Histological Evaluation		
	0	1	2
0	0 (0.0%)	0 (0.0%)	0 (0.0%)
1	14 (36.8%)	6 (15.8%)	5 (13.2%)
2	4 (10.5%)	3 (7.9%)	4 (10.5%)
3	1 (2.6%)	0 (0.0%)	1 (2.6%)

Radiographic evaluation: (0) without visible radiolucency, (1) visible enamel radiolucency, (2) visible radiolucency in dentin, but restricted to the external half of the dentin, (3) radiolucency involving the internal half of the dentin.

Histological: (0) no caries, (1) caries lesion limited to the outer layer of enamel (2) caries lesion extending into the inner layer of enamel and the outermost layer of dentin, (3) caries involving the middle third of dentin, and (4) caries involving the deeper layer of dentin.

Analysis of all diagnostic methods

Table 5 shows the results of the comparison of all the diagnostic methods chosen. In the visual evaluation by the ICDAS criterion considering the cutoff point in the histological analysis (cutoff = 0 / without caries), accuracy of 65.85%, sensitivity of 40.0% and specificity of 90.48% are observed, verifying that the test showed greater specificity than sensitivity in the diagnosis.

The results of laser fluorescence in relation to the histological according to the cutoff point, shows that there is an accuracy of 58.54%, sensitivity of 70.0% and specificity of 47.62%. The evaluation by fluorescent laser showed greater sensitivity than specificity in the diagnosis.

For radiographic analysis, when compared with the cutoff of histological analysis, it is observed that the accuracy was 53.66%, sensitivity 42.11% and specificity 73.68%. Radiographic analysis showed greater specificity than sensitivity in the diagnosis.

Table 5 shows the general results of the three diagnostic methods, including the area under the ROC curve. The area represents the ability of the method to correctly classify the disease. A weak method for diagnosis is one with an area under the curve of 0.5, that is, the sensitivity is always equal to 1-specificity. The closer the curve gets to the upper left corner (larger area under the curve) (Figure 1), the better the quality of the method, that is, the further the curve moves away from the x = y curve, the better. The x = y curve is represented by the dotted line and corresponds to a

Table 5. Results of diagnoses of inactive caries lesions on the occlusal surface of human molars and premolars through visual inspection (ICDAS criterion), laser fluorescence and radiographic analysis compared to histological analysis.

Cut-off point for histological analysis	Measure	ICDAS	Laser fluorescence	Radiographic analysis
		1 × 2	<20 × ≥20	
0	Accuracy	65.85%	58.54%	53.66%
	Sensitivity	40.00%	70.00%	42.11%
	Specificity	90.48%	47.62%	73.68%
	Area under the ROC curve (95% CI)	0.65 (0.48 – 0.82)	0.59 (0.41 – 0.76)	0.58 (0.40 – 0.76)

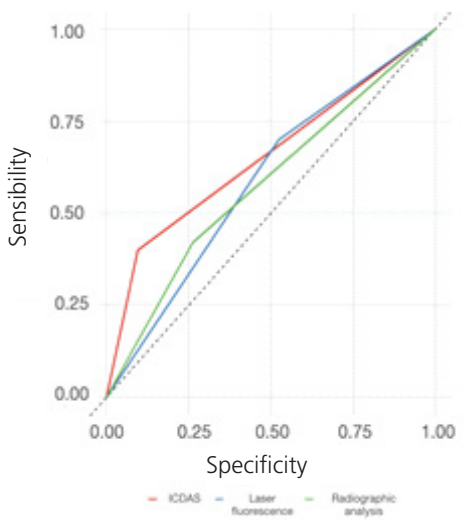

Figure 1. ROC curve (Receiver Operating Characteristic) for visual navigation (ICDAS), fluorescent laser (Diagnodent) and radiographic analysis at cut-off point 0 of the histological analysis.

method whose result is random. As the sample size is small, the confidence intervals overlap, that is, there is no significant difference between the areas under the curve, but observing the areas under the curves, the visual method (ICDAS) presents a better combination of sensitivity and specificity than the other two methods.

DISCUSSION

ICDAS was developed to be used as the best system for detecting caries, having been reported as the most reliable system for assessing lesions in the early stages [19]. A strong relationship has been observed between ICDAS scores and treatment decision, suggesting that clinical evaluation by ICDAS should be the first criterion used to assess the occlusal face of the tooth before a treatment decision is made [20]. In the present study, it was observed that lesions diagnosed by the ICDAS method classified as scores 1 and 2, which would correspond to lesions present in non-cavitated enamel (in which no invasive procedures for removal of carious tissue would be indicated), were limited to inner layers of enamel or outer layers of dentin (Table 2), by visual analysis 46.3% of the teeth were classified as score 1 of ICDAS and 0 in histological analysis. Although clinically there is no diagnostic precision as to the extent of the lesion, there would be an adequate indication as to the treatment of the lesion, considering that invasive treatment is unnecessary in these cases [21].

By histological analysis, 21 teeth (51.2%) were diagnosed without caries, 9 (22.0%) with caries lesion limited to the outer layer of enamel and 11 (26.7%) with caries lesion extending into the layer enamel and the outermost layer of dentin. Even teeth that possibly had involvement of the outermost layer of dentin (classified as score 3), it should be considered that the current criteria for the indication of minimally invasive procedures do not indicate the restoration of cavities with little dentinal involvement and non-invasive options, Minimally invasive or microinvasive interventions should be a focus of modern cariology in order to preserve mineralized dental tissues. In this regard, strategies for applying sealants have been suggested [21].

When comparing the ICDAS results in relation to the cutoff point in the histological analysis (table 5), an increase in the accuracy and sensitivity values and a decrease in the specificity value was observed. The ICDAS showed high specificity at the cutoff point. High sensitivity is usually obtained to the detriment of reduced specificity, a situation that could lead to an increase in the number of false-positive caries diagnoses, which in turn could lead to excessive treatment of a generally slow-evolving disease. Downer [22] reported that it is more appropriate for a method of detecting caries to have high specificity, even at the expense of a small reduction in sensitivity. This was observed for visual inspection in a systematic review, since they found a tendency of grouped specificity being greater than the grouped sensitivity in most analyzes [8]. However, currently the ideal is that the method has high specificity and sensitivity, without the expense of detriment to one or the other.

Other studies also show that the ICDAS for the evaluation of occlusal surfaces presents greater specificity and less sensitivity when compared to other methods, such as fluorescent laser, and having the histological exam as the gold standard [23,24], as was also seen in this study where specificity had an index of 90.48%. that training for the correct application of ICDAS increases the sensitivity of visual inspection in detecting initial lesions on occlusal surfaces [25]. However, of the total number of examined teeth, 11 teeth would need some treatment (even if non-invasive) to control the carious lesion present in dentin.

Thus, interproximal radiographs have been used as an auxiliary resource for clinical visual examination, which provide a considerable amount of valuable diagnostic information [13]. However, it can be limited when considering the examination of occlusal surfaces, as they may not increase sensitivity, but only confirm the findings previously found in the visual examination [9].

It can be considered that in cases of occlusal lesions, radiography is useful for assessing the depth of dentin lesions, but not for detecting them when they are enameled or uncapitalized [26]. The radiological evaluation showed a specificity value greater than that of sensitivity, at the cut-off point equal to 0 (without caries) there was greater accuracy,

greater specificity and less sensitivity, which is related to the value of 0 - it represents absence of disease. Despite the high specificity identified, radiography can positively assist in the correct diagnosis of injuries when associated with other methods. The high specificity probably occurred because the radiographic method tends to underestimate the real mineral loss, in addition to the difficulty in assessing the presence of cavities, which can result in a high number of false negatives.

However, the advantage of the radiographic method would be to detect lesions before they become cavitated so that non-invasive procedures are applied and to avoid restorative treatment [27]. In the present study, however, the high specificity of the radiological diagnostic method was observed. The percentage of 36.8% (that is, 14 teeth) with a score equal to 1 (visible radiolucency in enamel) had a score of 0 on the histological examination, which can be justified by the difference in contrast in the images in the region of the amelodentinary junction. Only 10.5% of the teeth had compatible histological and radiographic scores equal to 2 for histological (caries lesion extending to the outer half of the dentin) and 2 for radiological (translucency in the innermost enamel and outermost dentin), reinforcing the difficulty of true positive or true negative diagnoses with radiological examination. To detect enamel lesions, more sensitive methods can be considered in populations at high risk and prevalence of caries.

To improve the accuracy of detecting non-cavitated occlusal caries, laser fluorescence diagnosis can favor the diagnosis, as well as monitor the control of non-invasive treatments applied to these lesions [28]. Laser fluorescence has shown greater sensitivity for detecting initial lesions [29]. In the present study, the sensitivity was greater than the specificity for fluorescence, in which 25 teeth had a score greater than 20 (caries lesion already present in dentin); however, only 8 actually presented dentin lesions by histological examination, and 11 didn't present caries lesions, suggesting that the sensitivity of the fluorescent laser may be influenced by factors such as the presence of pigments in the lesion, such as that observed in inactive lesions. Changes in the color of the dental substrate associated with the progression of the carious process are reflected in an increase in the amount of fluorescent light [30]. This trend of greater sensitivity and less specificity was observed, but with results slightly lower than those obtained by radiographic examination. This increase is expected, since the complementary methods have shown higher values of sensitivity in the detection of more advanced lesions [8].

Achilleos et al. [28] found lower sensitivity values (0.66 to 0.75) compared to other methods studied (such as ICDAS) due to the fact that they evaluated enamel lesions. This study showed high sensitivity for the fluorescent laser, as well as high specificity. When compared with the histological examination, 10 teeth had values <20 by fluorescent laser and had a rating of 0 on histological, and only 6 teeth had a rating of 1 or 2 on histological (which indicates the presence of caries disease) with a value of <20 by laser; however, 11 teeth (26.8%) had a score> 20 and histological classification equal to zero. Thus, the method was less accurate (58.54%) when compared to the visual examination by ICDAS.

According to the analysis of the ROC curve, considering the cut-off point 0, a better performance of the ICDAS visual method for the diagnosis of inactive lesions was observed, in which the specificity was greater than the sensitivity when compared to the fluorescent laser and radiographic examination . Since there were no significant differences in accuracy between the methods, it can be seen that the visual analysis by ICDAS presented the best combination of sensitivity and specificity than the other methods, even that the objective has been to detect lesions restricted to the enamel on the occlusal surface, and bearing in mind that an ideal diagnostic method should have high specificity and high sensitivity [26]. Clinically, this result represents the indication of the visual method as a diagnostic method for pigmented pits on the occlusal surface; however, the association with other methods such as radiography can be indicated, especially in cases of doubt.

CONCLUSION

There were no differences regarding the accuracy, sensitivity and specificity of diagnostic methods for inactive lesions in pigmented fissure on the occlusal surface of human molars and premolars when using cut-off point 0 in the

histological analysis; For sensitivity, there was a higher percentage value (72.73%) for fluorescent laser at the cutoff point when compared to other methods. ICDAS and interproximal radiographic evaluations showed lower results for sensitivity at cut-off point 0; For specificity, the three methods showed significant differences between them, with the ICDAS being more specific and the fluorescent laser of less specificity. In general, visual assessment by ICDAS represented the best method for detecting inactive caries lesions of pigmented enamel pits and fissures.

Collaborators

JB MEIRELLES: Responsible for the experimental phase and writing of the article; NR CARLOS: Contributor of the experimental phase and text review; FLB AMARAL: Contributor of the experimental phase and text review; FMG FRANÇA: Contributor of the experimental phase and text review; CP TURSSI: Collaborator in text review; RT BASTING: Work supervisor, collaborator of the experimental phase and text review.

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Received on: 21/11/2020
Approved on: 19/2/2021

Assistent editor: Marcelo Sperandio