Assessment of Different Techniques to Detect Recurrent Carious Lesion Around Amalgam Filling

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Abstract

Background: This in-vitro study was to evaluated bitewing radiograph and tactile examination for detection secondary caries adjacent to amalgam restorations.
Material and method: Sixty primary extracted molars with class I and class II amalgam restorations were selected from children, and examined by bitewing radiographs were taken by using film holders and interpreted on a backlit screen without magnification. Then, we used tactile examination with blunt probe.
Result: The result of this study showed that the best cut-off points for the sample were found by a Receiver Operator Characteristic (ROC) analysis, and the area under the ROC curve and the sensitivity, specificity and accuracy of the techniques were calculated for enamel (D1) and dentine (D2) thresholds. These parameters were found for each techniques and then compared by the Cochran's Q test. The tactile examination presented the fair techniques for detecting secondary caries at enamel thresholds for both occlusal and proximal surfaces, While, bitewing radiograph presented good techniques at dentin thresholds.
Conclusion: Tactile examination represented the best performance for detecting enamel secondary caries. While, bitewing radiograph represented the best performance for detecting dentin secondary caries.
Keywords: Secondary caries, Amalgam restorations, Bitewing radiograph, Tactile examination. **(J Bagh Coll Dentistry 2017; 29(1): 193-198)**

INTRODUCTIO

Amalgam is a restorative material essentially accurate for classes I and II restorations in teeth that encounter heavy chewing forces[1,2]. Secondary caries is a disease that occurs on the tooth after the dental restoration has been in place for a period of time [3]. It was the major cause most frequently reported in relation to failure and replacement of restorations [4, 5,6, 7].

Secondary caries is responsible for 60% of all replacement restorations in the typical dental practice [8].

The diagnosis of secondary caries is still a challenging topic. So, early detection of these kinds of caries can be helpful to use preventive procedures and control caries development [9,10,11]. As a result, the accurate detection of secondary caries lesions is extremely important.

The conventional techniques commonly used for this purpose have been radiographic and tactile examination are the most common techniques applied for detecting secondary caries lesions [12,13].

Furthermore, radiographic and tactile examination perform better at detecting advanced caries lesions than non cavitated lesions [14,15,16].

MATERIAL AND METHODS

This study was carried out on sixty primary extracted molars with class I and class II amalgam restorations were selected from children.

One, two or three surfaces were selected adjacent to the restorations (n = 120) for examination. The specimens were cleaned with a toothbrush with pumice/water slurry and stored in saline solution until the examinations.

Caries detection techniques

1. Bitewing radiograph

Each two teeth are fixed in cast by wax to the level of CEJ which pouring on simple articulator. For standardized conditions the bitewing radiographs were taken a Kodak ultras-speed film**,** all of the same batch number was used. And using film holding system with same x-ray machine at the same exposure factors (70 Kvp, 8mA with exposure time 0.50 sec).After exposure the film was developed in automatic processor in which the temperature of the developer and developing time were kept rigidly constant. The radiographs was examine on a backlit screen, without magnification**.**

The evaluation was according to the following criteria [17]:

Sound radiolucency restricted to the outer half of the enamel.

Radiolucency in the inner half of the enamel or at maximum to the outer third of the dentine.

Radiolucency reaching the middle third of the dentin.

Radiolucency in the inner third of the dentin.

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2. Tactile examination

The tactile examination was perform by probing gently the suspected surfaces with a blunt explorer probe to avoid damage to the dental tissues.

Additionally, this examination was the last one to be performed in order to avoid interference in the results of the other techniques in case of any damage. The evaluation was regarding the presence of ditches and presence of softened dental tissue, using the following scores [18]:

0. No ditches.
1. Ditches hardly visible.
2. ditches visible (< 0.2 mm).
3. ditches visible (> 0.2 mm).

Statistical analysis

ROC curves: A Receiver Operator Characteristic (ROC) is a graphical plot that illustrates the performance of a binary classifier system as its discrimination threshold is varied. The curve is created by plotting the true positive rate (sensitivity) against the false positive rate (1 - specificity) at various threshold settings. For the analyses, occlusal and proximal surfaces were dichotomized into sound and decay, and performed for enamel (D1) and dentine (D2) thresholds, and the area under the ROC curve and the best cut-off points were obtained. Using these cut-off points for sensitivity (ability to recognize secondary caries in teeth with/without cavitations), specificity (correct recognition of sound tooth structure), and accuracy (percentage of correct diagnosis in sound and decayed teeth) of each techniques were calculated at each threshold. Accuracy is measured by the area under the ROC curve which interpreted as follow: 90-1 = excellent, 80-.90 = good, 70-.80 = fair, 60-.70 = poor,50-.60 = fail.

Results

The area under the ROC curve for the tactile examination at enamel threshold better than bitewing radiograph. while almost bitewing radiograph was good for detection secondary caries at dentin for occlusal surfaces.

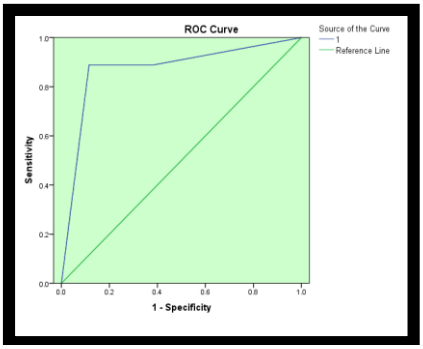

Figure 1: Receiver operator characteristic ROC plot: Bitewing radiograph at enamel threshold for occlusal surfaces

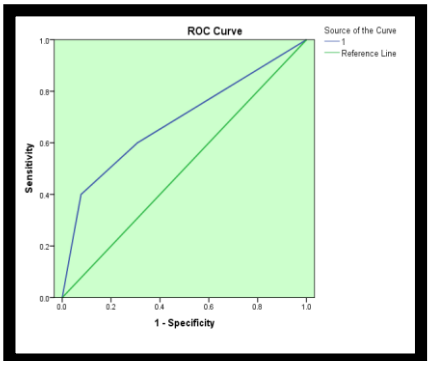

Figure 2: Receiver operator characteristic ROC plot: Bitewing radiograph at dentin threshold for occlusal surfaces

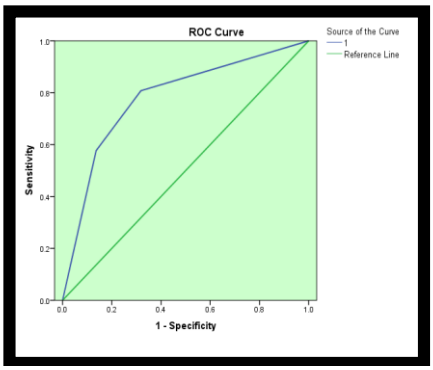

Figure 3: Receiver operator characteristic ROC plot: Tactile examination at enamel threshold for occlusal surface

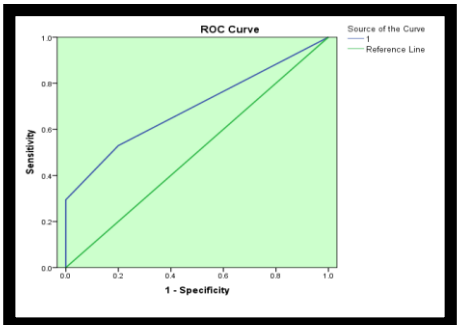

Figure 4: Receiver operator characteristic ROC plot: Tactile examination at dentin threshold for occlusal surface

Table 1: The sensitivity, specificity, accuracy and p-value for diagnostic techniques to detect secondary caries at enamel (D1) and dentin (D2) threshold in occlusal surface in primary molars teeth.

Techniques		Sensitivity	Specificity	Accuracy	P-value
Bitewing radiograph	D1	0.600	0.308	0.685	0.077 (NS)
	D2	0.889	0.335	0.872	0.000 *
Tactile examination	D1	0.808	0.318	0.781	0.001 *
	D2	0.529	0.200	0.694	0.062 (NS)

NS: non-significant difference (p≥ 0.05)
*highly significant difference (p≤ 0.001)

The area under the ROC curve for the tactile examination at enamel threshold better than bitewing radiograph. while almost bitewing radiograph was good for detection secondary caries at dentin for proximal surfaces.

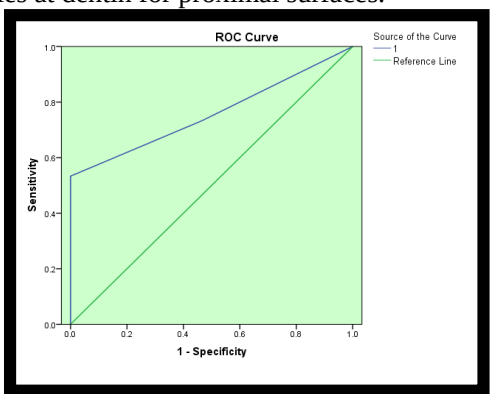

Figure 5: Receiver operating characteristic ROC plot: Bitewing radiograph at enamel threshold for proximal surfaces

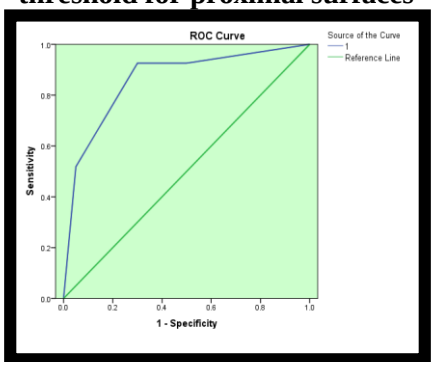

Figure 6: Receiver operating characteristic ROC plot: Bitewing radiograph at dentin threshold for proximal surfaces

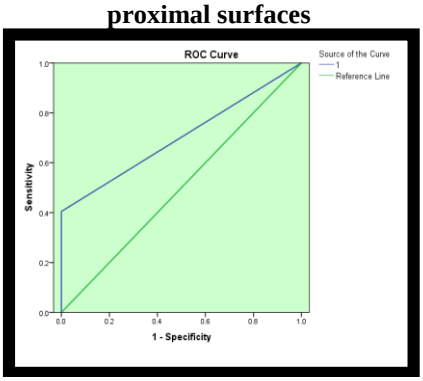

Figure 7: Receiver operating characteristic ROC plot: Tactile examination at enamel threshold for proximal surfaces

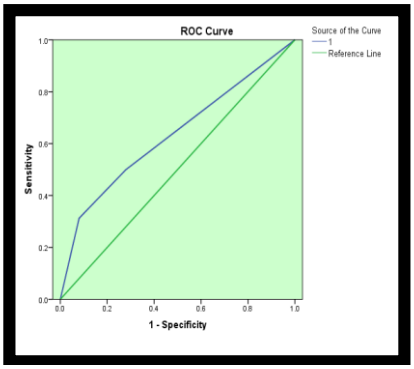

Figure 8: Receiver operating characteristic ROC plot: Tactile examination at dentin threshold for proximal surfaces

Table 2: The sensitivity, specificity, accuracy and p-value for diagnostic techniques to detect secondary caries adjacent toamalgam restoration at enamel (D1) and dentin threshold (D2) in proximal surfaces for primary molars teeth.

Techniques		Sensitivity	Specificity	Accuracy	P-value
Bitewing radiograph	D1	0.789	0.545	0.672	0.121 (NS)
	D2	0.926	0.500	0.860	0.000 **
Tactile examination	D1	0.612	0.200	0.702	0.048*
	D2	0.500	0.280	0.634	0.153 (NS)

NS: non-significant difference ($p \geq 0.05$)
* significant difference ($p \leq 0.05$)
**highly significant difference ($p \leq 0.001$)

Result of percentile value of sound, enamel caries and dentin caries of each techniques in occlusal and proximal surface of primary molars in groups A,B,C,D

Tactile examination had higher percentage value in sound surface followed by enamel caries and lower percentage at dentin caries.

Whereas, bitewing radiograph had high percentile values at dentin caries followed by sound then enamel caries.

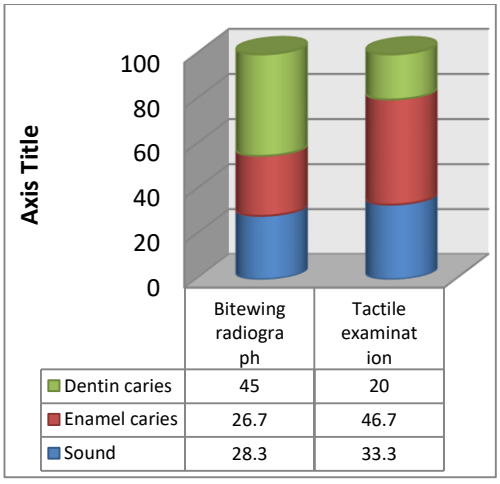

Figure9: Illustrated percentile value of different threshold of each techniques at occlusal surface

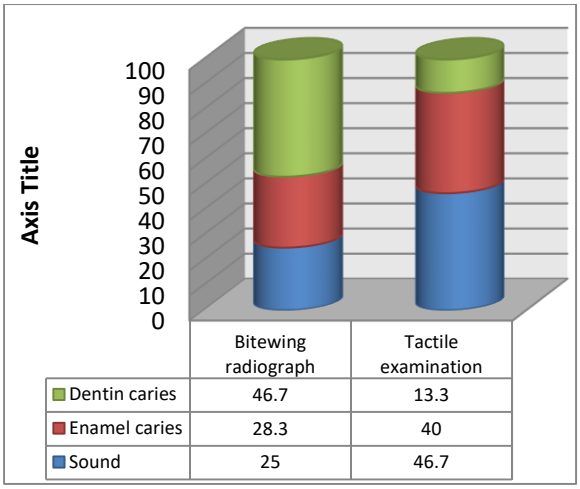

Figure 2: Illustrated percentile value of different threshold of each techniques at proximal surface

DISCUSSION:

The diagnosis of secondary caries is still a challenging topic. Therefore early detection of these kinds of caries can be helpful to use preventive procedures [9,10] and caries control [11].

Bitewing radiograph and tactile examination are the basic and most commonly used techniques for caries detection. But these techniques are subjective, with a low reproducibility [19].

The present study evaluate Bitewing radiograph and tactile examination for detection secondary caries adjacent to amalgam restoration for primary molars teeth in vitro.

Bitewing radiograph was good sensitivity and accuracy for detection demineralize dentin at occlusal and proximal surfaces but poor at enamel threshold, as a result many existing lesions are not detected. A small amount of demineralization at one site may be masked by the radiodensity of the surrounding sound enamel [20].

Therefore, bitewing radiograph do not recommend for detection of non-evident occlusal and proximal caries in primary molars. This agreed with [21 -36].

Hence, tactile examination was fair sensitivity and accuracy at enamel threshold for occlusal surfaces but poor at dentin threshold.

Accordingly, The result of this study confirm tactile examination alone fails to detect a number of occlusal and proximal caries lesions and inadequate for detection caries in deciduous teeth in children. This result agreed with other studies [23,31,33,37,38 - 42].

CONCLUSION

Bitewing radiograph presented the best performance in detecting dentin secondary caries at occlusal and proximal surfaces in primary teeth restored with amalgam, and at proximal surfaces better than occlusal surfaces.

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الخلاصة

الهدف من هذه الدراسة كان لتقييم تقنية الفحص باستخدام الأشعة التشخيصية والفحص عن طريق اللمس في الكشف عن التسوس الثانوي الذي يظهر حول حشوه الأملغم.

استخدمت في هذه الدراسة ستين من الأسنان اللبنية المقلوعة وتم الفحص باستخدام الأشعة التشخيصية واستعمال حامل الفلم وقرأتها على الشاشة بدون تكبير , وبعدها بواسطة الفحص عن طريق اللمس باستخدام المسبار.

بينت نتائج هذه الدراسة أن أفضل نقطة تقاطع للعينة تم العثور عليها من قبل (ROC) ، وحساب المنطقة تحت منحنى ROC والحساسية والنوعية والدقة في طبقة المينا (D1) والعاج (D2). وبعد أيجاد هذه المعلومات لكل تقنية, تتم المقارنة فيما بينها باستخدام اختبار كوكران كيو. أظهرت تقنية الفحص عن طريق اللمس بأنها تقنية جيدة للكشف عن التسوس الثانوي عند طبقة المينا لكل من أسطح الإطباق والأسطح الجانبية من الفحص شعاعي. في حين، كان الفحص شعاعي جيد وأفضل في طبقة العاج من الفحص عن طريق اللمس.
اظهر الفحص عن طريق اللمس أفضل نتائج للكشف عن التسوس الثانوي في طبقة المينا.في حين أظهر الفحص الشعاعي على أفضل نتيجة للكشف عن تسوس الثانوي في طبقة العاج.