Evaluation of Four Methods of Occlusal Caries Detection at Discoloured Fissures in vivo - Preliminary Data.

Language: English

Authors: Dr. med. Thomas Klinke[1], Prof. Dr. med. habil. Wolfgang Klimm[1], Samira Zraiki[2], Prof. Dr. med. habil. Gisela Hetzer[2], Dipl.-Math. Eberhard Kuhlisch[3], PD Dr. med. habil. Michael Gente[4]
[1]Clinic of Conservative Dentistry
[2]Department of Pediatric Dentistry
[3]Institute of Informatics and Biometrics, Technical University of Dresden, Germany
[4]School of Dental Medicine, University of Marburg, Germany

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Introduction

Teeth with non-cavitated occlusal surfaces but markedly discoloured fissures are a diagnostic challenge for the dentist.
A number of modern devices are used to produce objective values, which help to diagnose occlusal dentine caries that need to be excavated.
The present investigation deals with the ability of three diagnostic tools, based on electric conductive measurement and laser fluorescence, to facilitate the dentist's decision for or against an (minimally-) invasive treatment. The detection of invisible ("hidden") caries below fissures which appear sound, was not an objective of this study.

Materials and Method

A total of 352 sites on 190 occlusal surfaces were examined in vivo by two dentists using four diagnostic methods:

1. visual inspection using magnifying glasses (x2,5),
2. laser fluorescence measurement with KaVo DIAGNOdent device,
3. electric conductive measurement with ECM III,
4. electric conductive measurement with Cariometer CRM 800 (Gente 1999).

Before examination the teeth were cleaned with a rotating bristle brush and polishing paste.
Diagnostic criteria are shown in the following table:

Diagnostic method	Diagnostic criteria	
	Enamel caries	**Dentine caries**
Visual assessment Magnifiying glasses x2.5 (Fig. 1)	Discolouration of the fissure	Greyish opacity at the fissure wall or diffuse discolouration/shadow beneath the fissure
DIAGNOdent (Fig. 2)	16 - 30	> 30
ECM III (Fig. 3)	3 - 6 (6.55 - 1.78 MΩ)	> 6 (< 1.78 MΩ)
Cariometer CRM 800 *Gente* 1999 (Fig. 4)	4 - 7 (1.142 - 0.266 MΩ)	> 7 (< 0.266 MΩ)

Abb. 1: Magnifying glasses x2.5

Abb. 2: DIAGNOdent, a laser fluorescence device from KaVo, Biberach, Germany

Abb. 3: ECM III, an electric conductive measurement device from Lode Diagnostics, Groningen, The Netherlands
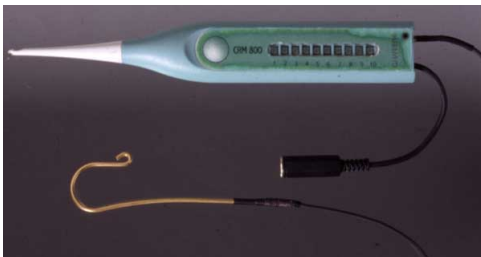

Abb. 4: Cariometer CRM 800, an amperage-controlled electric conductive measurement device Prototype, Gente 1999

If two or more methods indicated dentinal caries, a minimally invasive opening of this site was performed. The preparation was extended along the fissure until no caries remained.

During stepwise preparation into dentine, lesion depth was determined visually (magnifying glasses x2,5) and caries activity was assessed with a dental probe (presence of softened dentin indicated active caries) to create a gold standard for each of the examined locations within the fissure.

This way data were collected at 67 sites that were opened in the fissures of 38 teeth from 27 patients aged 5 to 30 years (mean 17,7 years).

Diagnostic performance for occlusal dentine caries detection was evaluated for each of the diagnostic methods using the parameters sensitivity and specificity as well as area under the ROC curve. Inter-examiner reproducibility was estimated by Kohen´s Kappa.

Results

The inter-examiner reproducibility for dentine caries diagnostics is shown in the following table:

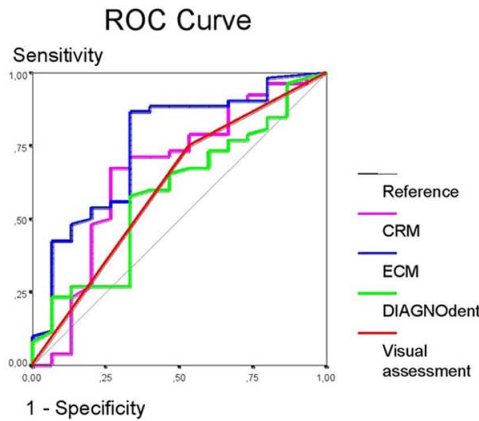Inter-examiner reproducibility (dentine caries)

Diagnostic method	Cohen's kappa
Visual assessment	0,62
DIAGNOdent	0,78
ECM	0,93
CRM	0,69

Only ECM gave acceptable and significant results in detecting dentine caries (shaded green in table 1, 2, 4 and 5). The diagnostics of soft dentine, classified as active dentine caries that requires invasive intervention, was distinctly more difficult.
DIAGNOdent failed in age group 1 (shaded red in table 2 and 4) and ECM failed to meet expectations in the second age group (shaded red in table 3 and 6). Cariometer gave better results than ECM in age group 2 with respect to active caries (table 6), but it had a more moderate performance in general.

Active + inactive dentinal caries   **Active dentinal caries**
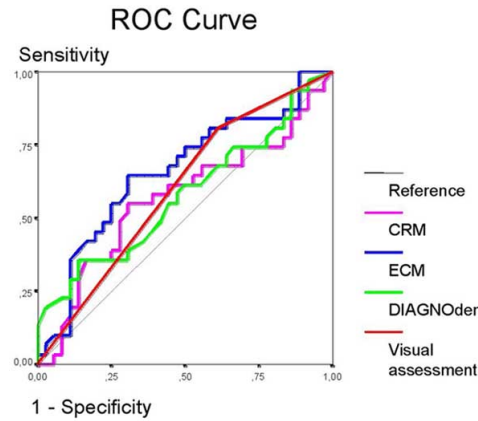
Overall sample

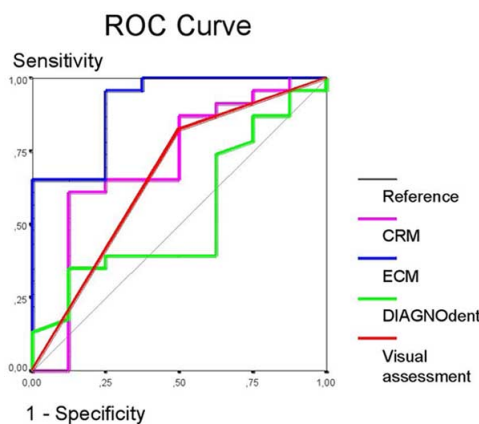| Diagnostic method	Area under ROC curve	Asymptotic significance	Asymptotic 95% confidence interval		Suitable cut-off	Sensitivity for D3 lesion	Specificity for D3 lesion
Visual ass.	0.61	0.204	0.440	0.777		0.75	0.47
DIAGNOdent	0.58	0.325	0.421	0.747	40/41	0.58	0.67
ECM	0.75	0.003	0.608	0.899	2.06 MΩ	0.86	0.67
CRM	0.66	0.058	0.489	0.834	0.72 MΩ	0.71	0.67

Diagnostic method	Area under ROC curve	Asymptotic significance	Asymptotic 95% confidence interval		Suitable cut-off	Sensitivity for D3 lesion	Specificity for D3 lesion
Visual ass.	0.60	0.170	0.462	0.734		0.81	0.39
DIAGNOdent	0.57	0.258	0.436	0.716	31/32	0.39	0.69
ECM	0.66	0.028	0.523	0.791	0.69 MΩ	0.64	0.69
CRM	0.57	0.073	0.424	0.708	0.59 MΩ	0.55	0.69

Table/Graph 1: Dentine caries diagnostics of age group 1+2, all dentinal caries

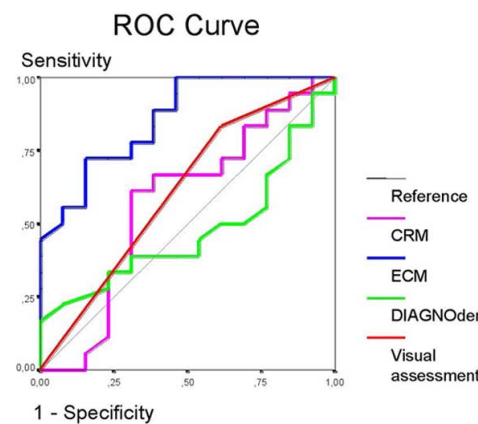Table/Graph 4: Dentine caries diagnostics of age group 1+2, active dentinal caries

Age group 1

Diagnostic method	Area under ROC curve	Asymptotic significance	Asymptotic 95% confidence interval		Suitable cut-off	Sensitivity for D3 lesion	Specificity for D3 lesion
Visual ass.	0.63	0.176	0.428	0.898		0.83	0.50
DIAGNOdent	0.53	0.118	0.301	0.764	25/26	0.39	0.75
ECM	0.91	0.001	0.788	1.027	2.06 MΩ	0.96	0.75
CRM	0.71	0.121	0.473	0.940	0.70 MΩ	0.65	0.75

Diagnostic method	Area under ROC curve	Asymptotic significance	Asymptotic 95% confidence interval		Suitable cut-off	Sensitivity for D3 lesion	Specificity for D3 lesion
Visual ass.	0.61	0.307	0.402	0.816		0.83	0.38
DIAGNOdent	0.47	0.810	0.267	0.682	25/26	0.39	0.69
ECM	0.86	0.001	0.727	0.987	0.69 MΩ	0.72	0.85
CRM	0.57	0.112	0.352	0.789	0.69 MΩ	0.61	0.69

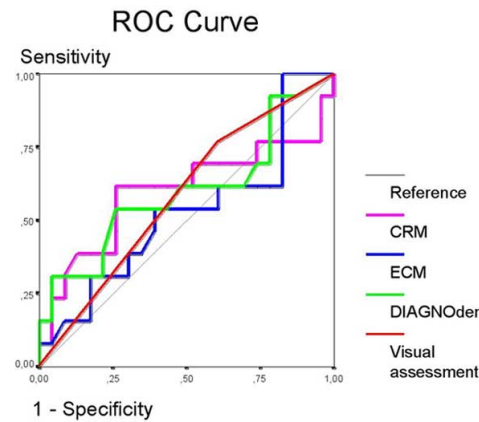Table/Graph 2: Table/Graph 1: Dentine caries diagnostics of age group 1, all dentinal caries
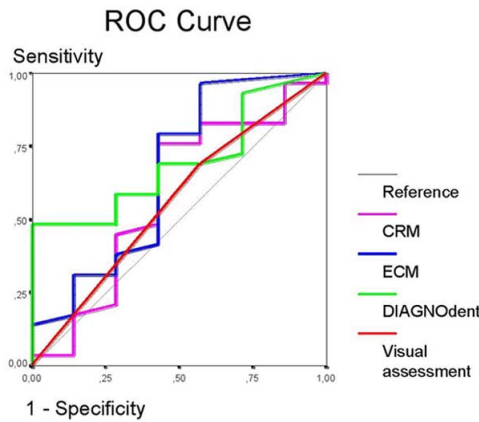

Table/Graph 5: Dentine caries diagnostics of age group 1+2, active dentinal caries

Age group 2

Diagnostic method	Area under ROC curve	Asymptotic significance	Asymptotic 95% confidence interval		Suitable cut-off	Sensitivity for D3 lesion	Specificity for D3 lesion
Visual ass.	0.56	0.631	0.315	0.803		0.69	0.43
DIAGNOdent	0.70	0.110	0.510	0.884	46/47	0.59	0.71
ECM	0.66	0.201	0.397	0.919	2.06 MΩ	0.79	0.57
CRM	0.58	0.510	0.317	0.845	0.72 MΩ	0.76	0.57

Diagnostic method	Area under ROC curve	Asymptotic significance	Asymptotic 95% confidence interval		Suitable cut-off	Sensitivity for D3 lesion	Specificity for D3 lesion
Visual ass.	0.58	0.429	0.387	0.773		0.77	0.39
DIAGNOdent	0.60	0.340	0.388	0.806	38/39	0.54	0.74
ECM	0.52	0.830	0.316	0.727	0.63 MΩ	0.54	0.61
CRM	0.60	0.340	0.379	0.815	0.58 MΩ	0.62	0.74

ROC Curve

Sensitivity

Reference
CRM
ECM
DIAGNOdent
Visual assessment

1 - Specificity

Table/Graph 3: Dentine caries diagnostics of age group 2, all dentinal caries

ROC Curve

Sensitivity

Reference
CRM
ECM
DIAGNOdent
Visual assessment

1 - Specificity

Table/Graph 6: Dentine caries diagnostics of age group 2, active dentinal caries

Discussion and Conclusions

The aim of the study was to judge caries below non-cavitated, yet discoloured fissures.

Clinical studies of occlusal caries detection are rare, because the validation of negative findings is limited by ethical principles. In this investigation, a fissure was opened only if at least two of the four diagnostic methods used indicated that dentine caries were present at one or more sites of the fissure. The preparation was then extended until no dentine or enamel caries could be seen at the cavity walls. In this manner, within a fissure, some sites with only enamel caries were opened that were also not judged as carious with respect to dentine, producing true negative data. The other negative validated findings, however, corresponded to false positive diagnostic results. Therefore specificities, like expected, were mainly at a low level at cut-off points proposed by the manufacturers, and the overall predictive power was partially disappointing. Because of limited cases, validation of D1 and D2 lesions (which is commonly easier than those of D3 lesions) was not included in the ROC statistics.

As a result of this study higher cut-off-points for the DIAGNOdent device can be recommended for caries diagnostics in adults. The most suitable cut-off for the ECM was between 6 and 7 at the simplified ECM III scale; with respect to active dentine caries, however, the appropriate cut-off was lower, about 0.60-0.70 megaohm, which is whithin 9 at the simplified scale. CRM cut-offs were constant at a level of 0.60 to 0.70 megaohm.

Further data have to be collected to confirm the results and to achieve significant differences between the several devices used for caries diagnostics.

This poster was submitted by Dr. H. Thomas Klinke.

Correspondence address:
Dr. H. Thomas Klinke
Technische Universität Dresden
Medizinische Fakultät "Carl Gustav Carus"
Zentrum für Zahn- Mund- und Kieferheilkunde
Poliklinik für Zahnerhaltung
Fetscherstr. 74
D-01307 Dresden
GERMANY

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Th. Klinke[a*], S. Zraiki[b], W. Klimm[a], G. Hetzer[b], E. Kuhlisch[c], M. Gente[d]
[a]Clinic of Conservative Dentistry, [b]Department of Pediatric Dentistry and
[c]Institute of Informatics and Biometrics, Technical University of Dresden, Germany,
[d]School of Dental Medicine, University of Marburg, Germany

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Teeth with non-cavitated occlusal surfaces but markedly discoloured fissures are a diagnostic challenge for the dentist. A number of modern devices are used to produce objective values, which help to diagnose occlusal dentine caries that need to be excavated. The present investigation deals with the ability of three diagnostic tools, based on electric conductive measurement and laser fluorescence, to facilitate the dentist's decision for or against an (minimally-) invasive treatment. The detection of invisible ("hidden") caries below fissures which appear sound, was not an objective of this study.

Materials and Method

Whole sample: 352 sites in discoloured fissures of 190 molars and premolars

Diagnostic methods and criteria:

Tooth cleansing: Rotating bristle brush and polishing paste

Caries validation:
- Minimally-invasive opening if two or more diagnostic methods indicated dentinal caries
- Visual determination of lesion depth during stepwise preparation into dentine (magnifying glasses x2.5)
- Estimation of caries activity using a dental probe (presence of softened dentin indicated active caries)
- Extension of the preparation along the fissure until no caries remained

Validated sample:
Overall: 27 patients aged 5 to 30 years (mean 17.7); 67 sites on 38 teeth
Age group 1: 12 patients aged 5 to 16 years (mean 12.1); 31 sites on 20 teeth
Age group 2: 15 patients aged 17 to 30 years (mean 22.2); 36 sites on 18 teeth

Statistical methods: Inter-examiner reproducibility: Cohen's Kappa
Diagnostic outcome: Area under the ROC curve; Sensitivity and specificity: Suitable cut-off points were selected

Inter-examiner reproducibility study (2 examiners):
46 sites in the fissures of extracted teeth (premolars and molars) with discoloured fissures were judged visually and measured with two similar DIAGNOdent appliances and with the same ECM and CRM devices

Results

Only ECM gave acceptable and significant results in detecting dentine caries (shaded green in table 1, 2, 4 and 5). The diagnostics of soft dentine, classified as active dentine caries that requires invasive intervention, was distinctly more difficult. DIAGNOdent failed in age group 1 (shaded red in table 2 and 4) and ECM failed to meet expectations in the second age group (shaded red in table 3 and 6). Canometer gave better results than ECM in age group 2 with respect to active caries (table 6), but it had a more moderate performance in general.

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Further data have to be collected to confirm the results and to achieve significant differences between the several devices used for caries diagnostics.