International Poster Journal IPJ of Dentistry and Oral Medicine

Int Poster J Dent Oral Med 2006, Vol 8 No 01, Poster 309

Caries Detection at Discoloured Occlusal Sites: A Comparison of Four Methods Within Two Age Groups.

Language: English

Authors:
Dr. med. Thomas Klinke, Clinic of Conservative Dentistry,
Samire Zraiki, Department of Pediatric Dentistry,
Prof. Dr. H. Wolfgang Klimm, Clinic of Conservative Dentistry,
Dr. Gabriele Viergutz, Department of Pediatric Dentistry,
Dipl.-Math. Eberhard Kuhlisch, Institute of Informatics and Biometrics,
University of Technology, Faculty of Medicine Carl Gustav Carus, Dresden, Germany
Prof. Dr. Michael Gente, School of Dental Medicine, University of Marburg, Germany

Date/Event/Venue:
30th June - 3rd July 2004
51st ORCA Congress
Marburg, Germany

Introduction

Used as a decision aid for occlusal caries diagnostics, modern devices are applied after clinically examining teeth for which visual caries assessment is problematic. That mainly applies to teeth with non-cavitated, but discoloured occlusal surfaces.

Objectives

The aim of this study was therefore to assess the suitability of the four methods visual examination, DIAGNOdent, ECM and Cariometer, a new device based on electrical conductive measurement, for diagnosing occlusal dentine caries on a sample of such teeth.

Material and Methods

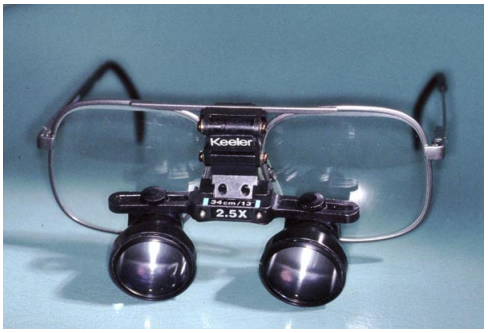


Fig. 1 Magnifying glasses (x2.5)

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

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

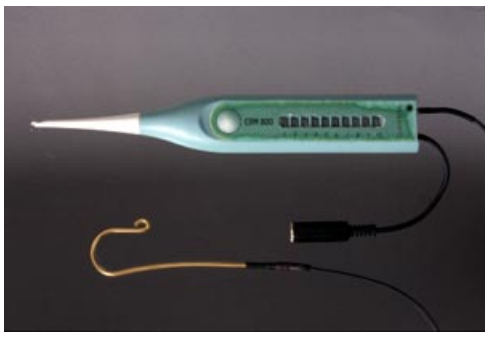


Fig. 4 Cariometer, an amperage-controlled, electric conductive measurement device; Prototype, Gente 1999

Age Group	Age (years)	Patients	Drilled teeth	Opened sites
1	6 - 16	21	41	72

2	17 - 30	16	19	36
Total	6 - 30	37	60	108

Table 1: Numbers of validated sites, teeth and patients divided into age groups

Whole Sample:
550 sites in discoloured fissures and pits of 260 molars and premolars

Dentine Caries Detection:
Visual assessment (Magnifying glasses): Modified Ekstrand criteria
Cut-offs: DIAGNOdent 31,ECM score 7 (1.5 MΩ), Cariometer score 8 (266 kΩ)

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)
- Estimation of caries activity using a dental probe (presence of softened dentine indicated active caries)
- Extension of the preparation along the fissure until no caries remained

Inter-examiner reproducibility study (2 Examiners):
70 occlusal sites at molars and premolars of 15 patients were judged visually and measured with the three diagnostic devices

Statistical methods:
Inter-examiner reproducibility: Cohen's kappa and weighted kappa
Diagnostic outcome:

- Area under the ROC curve
- Sensitivity and specificity, Youden's index

Comparison of hit rates:

- McNemar χ^2 test, Bonferroni adjustment procedure

Combination of methods:

- Binary logistic regression models (uni- and multivariate approaches)

Results

- ECM proved to be the most accurate method, followed by Cariometer and DIAGNOdent.
- Combination of methods did not improve the results.
- Performance of ECM and Cariometer was lower ($p \leq 0.05$) when only active caries was jugded to be a positive result.
- In older patients (17 - 30 year olds) all diagnostic methods performed at a far lower level.
- Optimal cut-offs, expressed by Youden's index, are shown in figures 5 to 7

Fig. 5. Performance of dentine caries detection at different cut-offs utilizing DIAGNOdent in age group 1

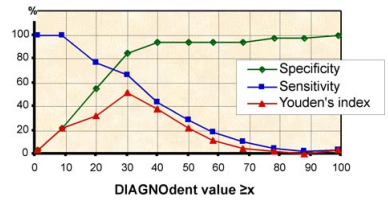


Fig. 6. Performance of dentine caries detection at different cut-offs utilizing ECM in age group 1

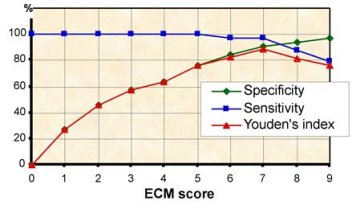
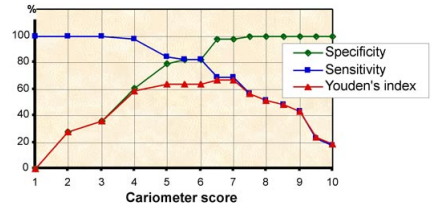


Fig. 7. Performance of dentine caries detection at different cut-offs utilizing Cariometer in age group 1



Diagnostic method	Coefficient	Value	95%-CI
Visual	Cohen's kappa	0.4943	(0.3170,0.6716)
DIAGNOdent	Weighted kappa	0.8328	(0.7557,0.9099)
ECM	Weighted kappa	0.9346	(0.8599,1.0000)
Cariometer	Weighted kappa	0.6619	(0.5079,0.8158)

Table 2: Inter-examiner reproducibility of diagnostic methods

Diagnostic method (n = 72)	**All** dentine caries lesions			**Soft** dentine caries lesions		
	area ROC (SE; significance)	sensitivity	specificity	area ROC (SE; significance)	sensitivity	specificity
Visual	0.653 (0.066; p>0.05)	82.1	48.5	0.615 (0.067; p>0.05)	82.1	40.9
DIAGNOdent positive test cut-off 31	0.781 (0.056; p>0.003)	66.7	84.8	0.784 (0.063; p>0.006)	71.4	75.0
ECM positive test cut-off 7	0.972 (0.021; p>0.003)	97.4	90.9	0.880 (0.040; p>0.003)	96.4	68.2
Cariometer positive test cut-off 6	0.927 (0.028; p>0.003)	82.1	81.8	0.825 (0.049; p>0.003)	82.1	65.9

Table 3. Age group 1 (6 to 16 years): Area under the ROC curve, sensitivity and specificity of the detection of dentine caries lesions at discoloured occlusal sites

Diagnostic method (n = 72)	**All** dentine caries lesions			**Soft** dentine caries lesions		
	area ROC (SE; significance)	sensitivity	specificity	area ROC (SE; significance)	sensitivity	specificity
Visual	0.512 (0.122; p>0.05)	69.0	28.6*	0.542 (0.102; p>0.05)	75.0	33.3
DIAGNOdent positive test cut-off 31	0.559 (0.121; p>0.05)	72.4	14.3*	0.497 (0.108; p>0.05)	75.0	25.0
ECM positive test cut-off 7	0.660 (0.138; p>0.05)	75.9	57.1*	0.481 (0.105; p>0.05)	66.7	29.2
Cariometer positive test cut-off 6	0.534 (0.125; p>0.05)	69.0	42.9*	0.622 (0.119; p>0.05)	66.7	33.3

Table 4. Age group 2 (17 to 30 years): Area under the ROC curve, sensitivity and specificity of the detection of dentine caries lesions at discoloured occlusal sites

Conclusions

The performance of diagnostic methods for the detection of occlusal caries is significantly dependent on the properties of the teeth forming the sample. It could be expected that the exclusive preselection of teeth with discoloured occlusal surfaces would lead to a superiority of electroconductive methods compared to optical ones, since discolourations alter the optical properties but not the conductivity of dental hard tissues.
Surprisingly excellent results were obtained with ECM in age group 1. The somewhat lower performance of Cariometer is probably due to a less reproducible degree of dryness of the enamel during measurement which is achieved with the ECM by a defined air-stream. However, despite lower reproducibility of results the new instrument is convenient in practice: It is small (15x3x2cm), battery-powered and comparatively inexpensive.
It is remarkable that in age group 2 (17-30 year olds) all diagnostic methods performed at a far lower level. Therefore the instruments should be used for young patients only.

Electrical conductance measurement proved to be the most suitable method for detecting dentine caries underneath discoloured fissures and pits. Acceptable results are provided for young patients only. When evaluating the results from in vitro studies, the age of the patients whose teeth have been used should be known.

This Poster was submitted by Dr. med. Thomas Klinke.

Correspondence address:
Dr. med. Thomas Klinke
Clinic of Conservative Dentistry, University of Technology, Faculty of Medicine Carl Gustav Carus, Dresden
Zentrum für Zahn- Mund- und Kieferheilkunde
Poliklinik für Zahnerhaltung
Medizinische Fakultät "Carl Gustav Carus"
Technische Universität Dresden
Fetscherstr. 74
D-01307 Dresden
GERMANY

Poster Faksimile:

Caries Detection at Discoloured Occlusal Sites: A Comparison of Four Methods Within Two Age Groups

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;
Dresden University of Technology, Dresden, Germany; [d]School of Dental Medicine, University of Marburg, Germany

Introduction

Used as a decision aid for occlusal caries diagnostics, modern devices are applied after clinically examining teeth for which visual caries assessment is problematic. That mainly applies to teeth with non-cavitated, but discoloured occlusal surfaces. The aim of this study was therefore to assess the suitability of the four methods (visual examination, DIAGNOdent, ECM and Cariometer, a new device based on electrical conductive measurement) for diagnosing occlusal dentine caries on a sample of such teeth.

Material and Methods

Whole Sample:
550 sites in discoloured fissures and pits of 260 molars and premolars

Dentine Caries Detection:
Visual assessment (magnifying glasses): Modified *Ekstrand* criteria
Cut-offs: DIAGNOdent 31, ECM III score 7 (1.5 MΩ), Cariometer score 8 (266 kΩ)

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)
- Estimation of caries activity using a dental probe (presence of softened dentine indicated active caries)
- Extension of the preparation along the fissure until no caries remained

Inter-Examiner Reproducibility Study (2 Examiners):
70 occlusal sites at molars and premolars of 15 patients were judged visually and measured with the three diagnostic devices

Statistical Methods:
Inter-examiner reproducibility: Cohen's kappa and weighted kappa
Diagnostic outcome:
- Area under the ROC curve
- Sensitivity and specificity, Youden´s index

Comparison of hit rates:
- McNemar's χ^2 test, Bonferroni adjustment procedure

Combination of methods:
- Binary logistic regression models (uni- and multivariate approaches)


Fig. 1 Magnifying glasses (x 2.5)


Fig. 2 DIAGNOdent, a laser fluorescence device from Kavo, Biberach, Germany

Age group	Age (years)	Patients	Drilled teeth	Opened sites
1	6 - 16	21	41	72
2	17 - 30	16	19	36
Total	6 - 30	37	60	108

Table 1. Numbers of validated sites, teeth and patients divided into age groups


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


Fig. 4 Cariometer, an amperage-controlled electric conduction measurement device, Prototype, Gerdis 1999

Results

- ECM proved to be the most accurate method, followed by Cariometer and DIAGNOdent
- Combination of methods did not improve the results
- Performance of ECM and Cariometer was lower ($p \leq 0.05$) when only active caries was jugded to be a positive result (tables 3 and 4)
- In older patients (17 – 30 year olds) all diagnostic methods performed at a far lower level
- Optimal cut-offs, expressed by Youden's index, are shown in figures 5 to 7

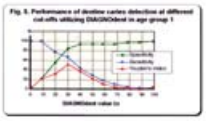


Fig. 5. Performance of dentine caries detection at different cut-offs utilizing DIAGNOdent in age group 1

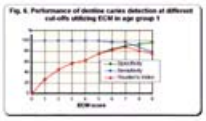


Fig. 6. Performance of dentine caries detection at different cut-offs utilizing ECM in age group 1

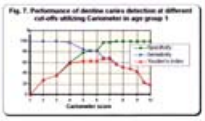


Fig. 7. Performance of dentine caries detection at different cut-offs utilizing Cariometer in age group 1

Table 2. Inter examiner reproducibility of diagnostic methods.

Diagnostic method	Coefficient	Value	95%-CI
Visual	Cohen's kappa	0.6943	(0.3173, 0.8714)
DIAGNOdent	Weighted kappa	0.8328	(0.7337, 0.9099)
ECM	Weighted kappa	0.9346	(0.8599, 1.0000)
Cariometer	Weighted kappa	0.8618	(0.3678, 0.8159)

Table 3. Age group 1 (6 to 16 years): Area under the ROC curve, sensitivity and specificity of the detection of dentine caries lesions at discoloured occlusal sites.

Diagnostic method (n = 75)	≥D dentine caries lesions: area ROC (SE,significance)	≥D: sensitivity	≥D: specificity	≥xD dentine caries lesions: area ROC (SE, significance)	≥xD: sensitivity	≥xD: specificity
Visual	0.652 (0.066, p=0.05)	83.1	48.5	0.615 (0.067, p=0.15)	83.1	44.9
DIAGNOdent positive test cut-off 31	0.791 (0.058,p=0.002)	66.7	84.8	0.764 (0.063, p=0.004)	71.4	75.0
ECM positive test cut-off 7	0.872 (0.031 , p=0.000)	87.4	85.9	0.880 (0.046, p=0.000)	88.4	85.2
Cariometer positive test cut-off 8	0.827 (0.039, p=0.000)	82.1	81.8	0.825 (0.048, p=0.000)	82.1	85.8

Table 4. Age group 2 (17 to 30 years): Area under the ROC curve, sensitivity and specificity of the detection of dentine caries lesions at discoloured occlusal sites.

Diagnostic method (n = 98)	≥D dentine caries lesions: area ROC (SE,significance)	≥D: sensitivity	≥D: specificity	≥xD dentine caries lesions: area ROC (SE, significance)	≥xD: sensitivity	≥xD: specificity
Visual	0.512 (0.122, p=0.05)	66.0	28.6*	0.542 (0.102, p=0.05)	75.0	33.3
DIAGNOdent positive test cut-off 31	0.559 (0.131,p=0.05)	73.4	14.3*	0.667 (0.109, p=0.05)	75.0	28.6
ECM positive test cut-off 7	0.582 (0.130, p=0.05)	75.8	57.1*	0.661 (0.109, p=0.05)	66.7	28.2
Cariometer positive test cut-off	0.534 (0.125, p=0.05)	66.0	42.9*	0.622 (0.114, p=0.05)	66.7	33.3

*Values are to be treated with caution because of low accuracy due to a small number of cases (n=7)

Discussion

The performance of diagnostic methods for the detection of occlusal caries is significantly dependent on the attributes of teeth forming the sample. It could be expected that the exclusive preselection of teeth with discoloured occlusal surfaces would lead to a superiority of electroconductive compared to optical methods, since discolourations alter the optical properties but not the conductivity of dental hard tissues. Surprisingly excellent results were obtained with ECM in age group 1. The somewhat lower performance of Cariometer is probably due to a less reproducible degree of dryness of the enamel during measurement which is achieved for ECM by a defined air-stream. However, despite lower reproducibility of the results the new instrument is convenient in practice: It is small (15x3x2cm), battery-powered and comparatively inexpensive. It is remarkable that in age group 2 (17-30 year olds) all diagnostic methods performed at a far lower level. Therefore the instruments should be used in young patients only.

Conclusions

Electrical conductance measurement proved to be the most suitable method for detecting dentine caries underneath discoloured fissures and pits. Acceptable results are provided for young patients only. When evaluating the results from in vitro studies, the age of the patients whose teeth have been used should be known.