

Comparison of different DIAGNOdent cut-offs for in vivo detection of occlusal caries

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Objectives

Dental practitioners who use the DIAGNOdent device (KaVo, Biberach, Germany) were confronted with different clinical guidelines of the manufacturer as well as cut-offs from clinical and laboratory studies (Tab. 1). Therefore this in vivo study aimed to test recently recommended cut-off limits for the laser fluorescence measurement for occlusal caries detection.

No	Study	Sound	Enamel lesion	Dentin lesion	
		D0	D1-2	D3	D4
	Cut-offs recommended from clinical studies				
I	Lussi & others (1999b)	0-15	16-25	> 25	
II	Verdonschot, Abdo & Frankenmolen (1999)	-	> 19	> 19	
III	Lussi (2000)	0-14	15-20	> 20	
IV	Lussi & others (2001)	0-13	14-20	> 20	
	Cut-offs proposed by the manufacturer				
V	Clinical Guidelines, KaVo (1998a)	0-4	5-10	11-20	> 20
VI	Clinical Guidelines, KaVo (1998b)	0-4	5-10	11-24	> 24 or 30
VII	Clinical Guidelines, KaVo (1999 and 2002)	0-4	5-25	26-34	> 34
VIII	Clinical Guidelines, KaVo (2001)	0-9	10-17	> 17	
	Cut-offs reported from laboratory studies				
IX	Lussi & others	0-4	5-10	11-18	> 18
X	Shi, Welander & Angmar-Månsson (2002)	0-7	8-21	> 21	
XI	Pereira, Verdonschot & Huysman (2001)	-	> 10	> 10	

Table 1: Recommended cut-offs for the use of the DIAGNOdent (KaVo) to detect different stages of occlusal lesion extension.

Material and Methods

Study population

- 248 permanent molars of 94 patients (mean age 19.2 yrs) of a general dental practice were included.

Laser fluorescence examination

- After professional tooth cleaning and cotton roll isolation the teeth were examined by the DIAGNOdent device (probe A).
- The maximum DIAGNOdent reading (0 to 99) obtained from the whole fissure pattern was recorded.

Validation by fissure opening

- The extent of occlusal lesions (gold standard) was determined after minimal operative intervention with a fissurotomy bur (SS White, USA).
- To quantify the lesion extent a probe with a 2-mm-graduation (P 2-12 YX, Hilite/ American Eagle, USA) was used for measuring the distance between the cavity floor and the outer enamel margin of the cavity. Validation ratings were obtained according to the greatest extent of the lesion on a scale from D0 to D4.
- All cavities were restored with a composite material.

Results

- Upon fissure opening 24 teeth had an enamel caries and 224 teeth revealed dentin caries of which 58 and 166 were up to half or beyond half the dentin.
- The comparison with DIAGNOdent cut-offs revealed considerable variations of the performance (Table 2 and 3). Recommended cut-offs between 17 to 21 for superficial dentin lesions were in the same order of magnitude ($\kappa = 0.48 - 0.51$). On the D4 level only the manufacturers cut-off of > 34 achieved the best performance ($\kappa = 0.51$).

Lesion extent D1-2 versus D3-4

No	Cut-off	SE	SP	% correctly diagnosed lesions	κ
I, VII	> 25	89	63	87	0,40
II	> 19	94	58	90	0,48
III, IV	> 20	93	63	90	0,49
V,VI	> 10	99	17	91	0,24
VIII	> 17	96	54	91	0,51
IX, XI (in vitro)	> 10	99	13	92	0,18
X (in vitro)	> 21	93	63	90	0,49
Optimal cut-off in this study	> 18	95	58	91	0,51

Table 2: Performance of the different DIAGNOdent (KaVo) cut-off limits for detecting superficial dentin lesions (D3 level)

Lesion extent D1-3 versus D4

No	Cut-off	SE	SP	% correctly diagnosed lesions	κ
V	> 20	95	28	73	0,28
VI	> 24	93	33	73	0,30
VII	> 34	85	66	79	0,51
IX (in vitro)	> 18	98	27	74	0,30
Optimal cut-off in this study	> 37	84	70	79	0,54

Table 3: Performance of the different DIAGNOdent (KaVo) cut-off limits for detecting deep dentin lesions (D4 level)

- The optimal cut-off limits based on the highest κ -values were > 18 for superficial dentinal caries and > 37 for deep dentinal caries (Figure 1 and 2).

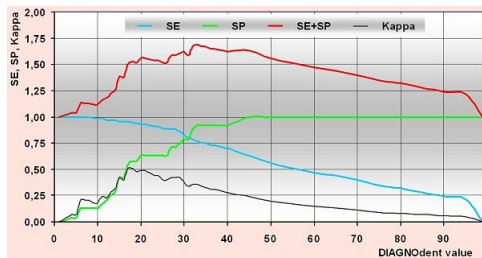


Figure 1: Sensitivity, Specificity, sum of Sensitivity and Specificity and Kappa of different DIAGNOdent values for superficial dentin lesions.

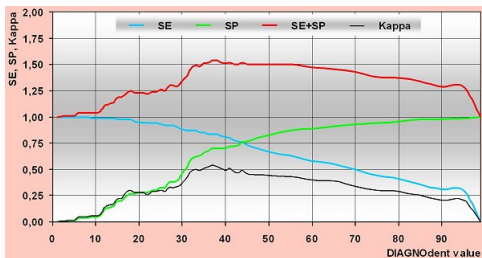


Figure 2: Sensitivity, Specificity, sum of Sensitivity and Specificity and Kappa of different DIAGNOdent values for deep dentin lesions.

- According to the κ -values and the area under the ROC curves (Figure 3) the agreement between validated caries extent and laser fluorescence value is still unsatisfactory.

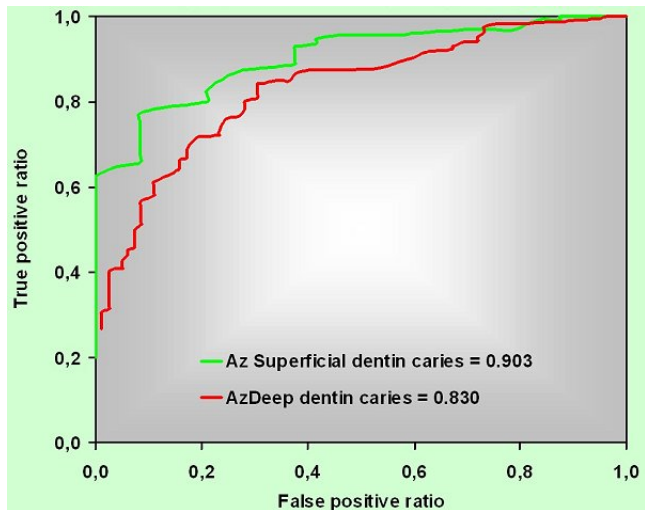


Figure 3: ROC-Curves of superficial (D3-4) and deep dentin lesions (D4) for DIAGNOdent (KaVo) readings.

Conclusions

Regarding the limited data base cut-off values for the clinical use of DIAGNOdent should be interpreted cautiously until more in vivo studies are available.

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Comparison of different DIAGNOdent cut-offs for in vivo detection of occlusal caries

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AIM

Dental practitioners who use the DIAGNOdent device (KaVo, Biberach, Germany) were confronted with different clinical guidelines of the manufacturer as well as cut-offs from clinical and laboratory studies (Tab. 1). Therefore this in vivo study aimed to test recently recommended cut-off limits for the laser fluorescence measurement for occlusal caries detection.

No.	Study	Sound	Enamel lesion	Dentine lesion
		D0	D1-2	D3-4
Cut-offs recommended from clinical studies				
1	Liese & others (1997b)	0-10	10-20	>20
2	Vindmeijnd, Akse & Broukema (1995)	-	10	>10
3	Liese (2002)	0-14	14-20	>20
4	KaVo (2002)	0-10	14-20	>20
Cut-offs proposed by the manufacturer				
V	Clinical Guidelines, KaVo (1996a)	0-4	5-10	11-20
VI	Clinical Guidelines, KaVo (1996b)	0-4	5-10	11-24
VII	Clinical Guidelines, KaVo (1999)	0-4	5-25	26-34
VIII	Clinical Guidelines, KaVo (2001)	0-9	10-17	>17
Cut-offs reported from laboratory studies				
9	Liese & others (1997a)	0-4	5-10	11-18
10	St. Willebrand & Argman-Silberstein (2002)	0-7	8-21	>21
11	Peters, Vindmeijnd & Popert (2001)	-	>10	>10

STUDY POPULATION and METHODS

- 248 permanent molars of 94 patients (mean age 19.2 yrs) of a general dental practice were included.

Laser fluorescence examination

- After professional tooth cleaning and cotton roll isolation the teeth were examined by the DIAGNOdent device (probe A).
- The maximum DIAGNOdent reading (0 to 99) obtained from the whole fissure pattern was recorded.

Validation by fissure opening

- The extent of occlusal lesions (gold standard) was determined after minimal operative intervention with a fissurotomy bur (SS White, USA).
- To quantify the lesion extent a probe with a 2-mm-graduation (P 2-12 YX, Hiltner American Eagle, USA) was used for measuring the distance between the cavity floor and the outer enamel margin of the cavity. Validation ratings were obtained according to the greatest extent of the lesion on a scale from D0 to D4.
- All cavities were restored with a composite material.

RESULTS

- Upon fissure opening 24 teeth had an enamel caries and 224 teeth revealed dentin caries of which 58 and 165 were up to half or beyond half the dentin.
- The comparison with DIAGNOdent cut-offs revealed considerable variations of the performance (Table 2 and 3). Recommended cut-offs between 17 to 21 for superficial dentin lesions were in the same order of magnitude ($\kappa = 0.48 - 0.51$). On the D4 level only the manufacturer cut-off of >34 achieved the best performance ($\kappa = 0.51$).

- The optimal cut-off limits based on the highest κ -values were >18 for superficial dentin caries and >37 for deep dentin caries (Figure 1 and 2).
- According to the κ -values and the area under the ROC curves (Figure 3) the agreement between validated caries extent and laser fluorescence value is still unsatisfactory.

Table 2: Performance of the different DIAGNOdent (KaVo) cut-off limits for detecting superficial dentin lesions (D3 level)

No.	Cut-off	Lesion extent D1-2 versus D3-4			
		SE	SP	% correctly diagnosed lesions	κ
L VII	> 20	89	63	87	0.40
8	> 19	94	59	90	0.48
8L, IV	> 20	93	92	92	0.48
V, VI	> 10	99	17	81	0.24
VII	> 17	99	54	91	0.51
IX, X (in vitro)	> 10	99	13	82	0.18
X (in vitro)	> 21	93	83	90	0.48
Optimal cut-off in this study	> 18	95	55	81	0.51

Figure 1: Sensitivity, Specificity, sum of Sensitivity and Specificity and Kappa of different DIAGNOdent values for superficial dentin lesions

Table 3: Performance of the different DIAGNOdent (KaVo) cut-off limits for detecting deep dentin lesions (D4 level)

No.	Cut-off	Lesion extent D1-3 versus D4			
		SE	SP	% correctly diagnosed lesions	κ
V	> 20	85	28	73	0.28
VI	> 24	93	33	73	0.30
VI	> 34	93	66	79	0.51
D (in vivo)	> 15	90	27	74	0.30
Optimal cut-off in this study	> 37	94	70	79	0.54

Figure 2: Sensitivity, Specificity, sum of Sensitivity and Specificity and Kappa of different DIAGNOdent values for deep dentin lesions

Figure 3: ROC-Curves of superficial (D3-4) and deep dentin lesions (D4) for DIAGNOdent (KaVo) readings.

CONCLUSION

Regarding the limited data base cut-off values for the clinical use of DIAGNOdent should be interpreted cautiously until more in vivo studies are available.