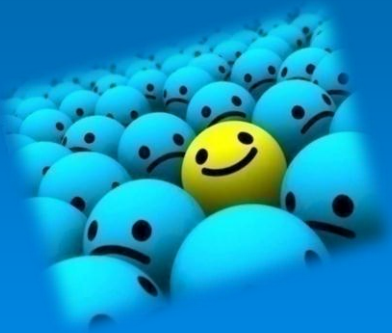


Evaluating and Comparing Visual & Fluorescence imaging methods in assessing the severity of Occlusal caries- A clinical study.

Neeraj Gugnani, IK Pandit, Nikhil Srivastava, Monika Gupta, Shalini Gugnani, Iain Pretty, Roger.P. Ellwood

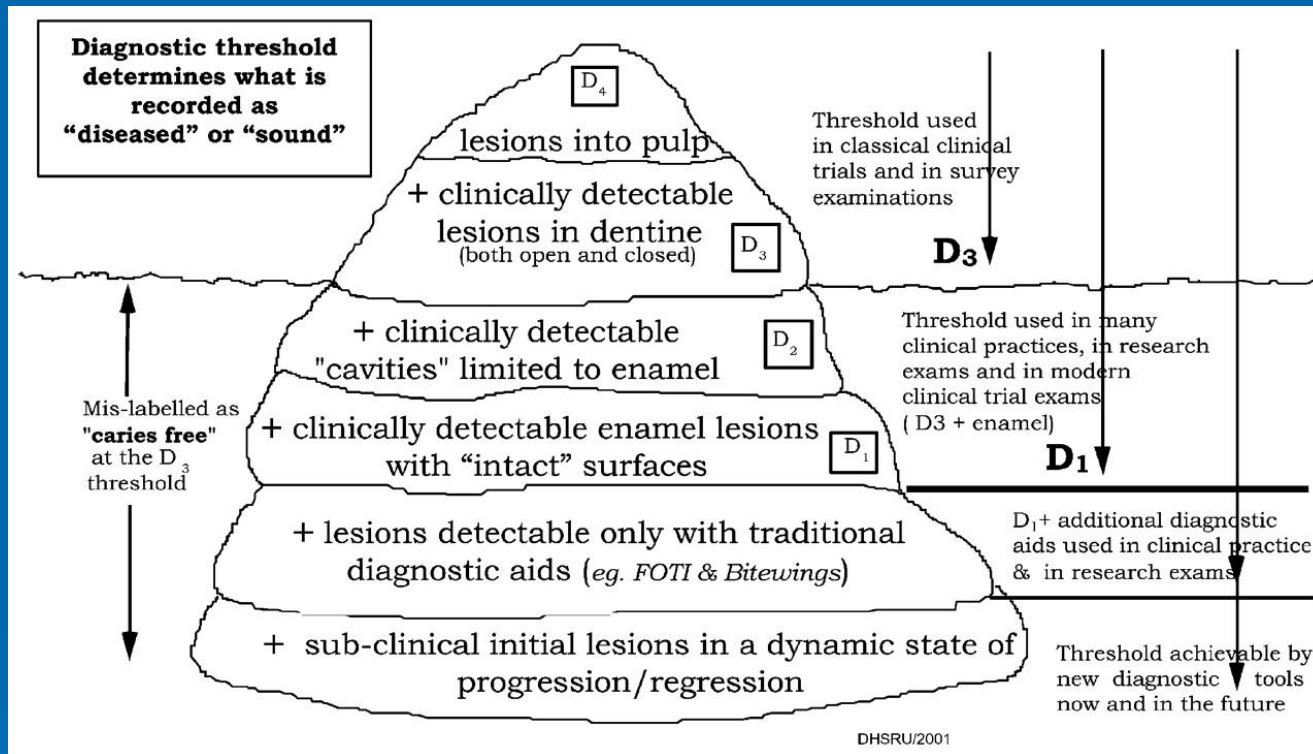


D.A.V (C) Dental College & Hospital



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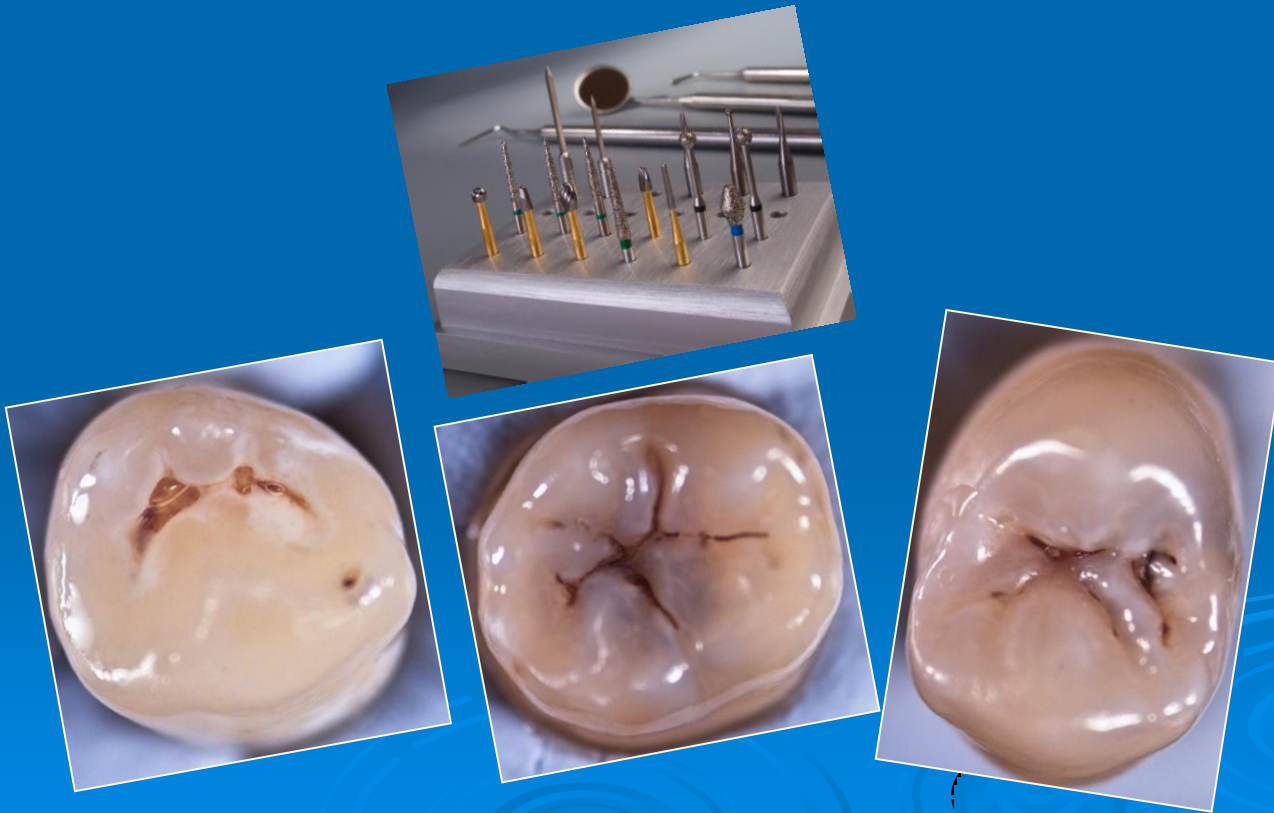
Caries is recorded at various thresholds in clinical and research settings.



The management is dependent on the 'threshold of its recording'.

Traditionally, caries is detected at the Cavitated stage, the only treatment option left is to restore the lesion....

“Surgical Approach for caries management”.



Today..Focus is towards detection of carious lesions at Noncavitated stage of the disease.



The management strategy of these Non Caviated lesions aims upon “Remineralization of the lesions” along with other prevention strategies.

.....
Medical Management of Dental Caries.

Various methods of caries detection:

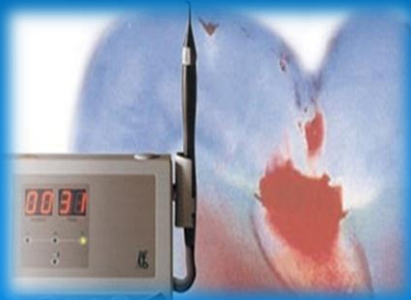
1. Visuo- tactile

2. Radiography {Conventional & Digital}

3. Subtraction radiography

4. Novel Detection aids

- a. FOTI
- b. DIFOTI
- c. ECM
- d. QLF
- e. OCT
- f. SOPROLIFE



International Caries Detection & Assessment System (ICDAS) : New Concept

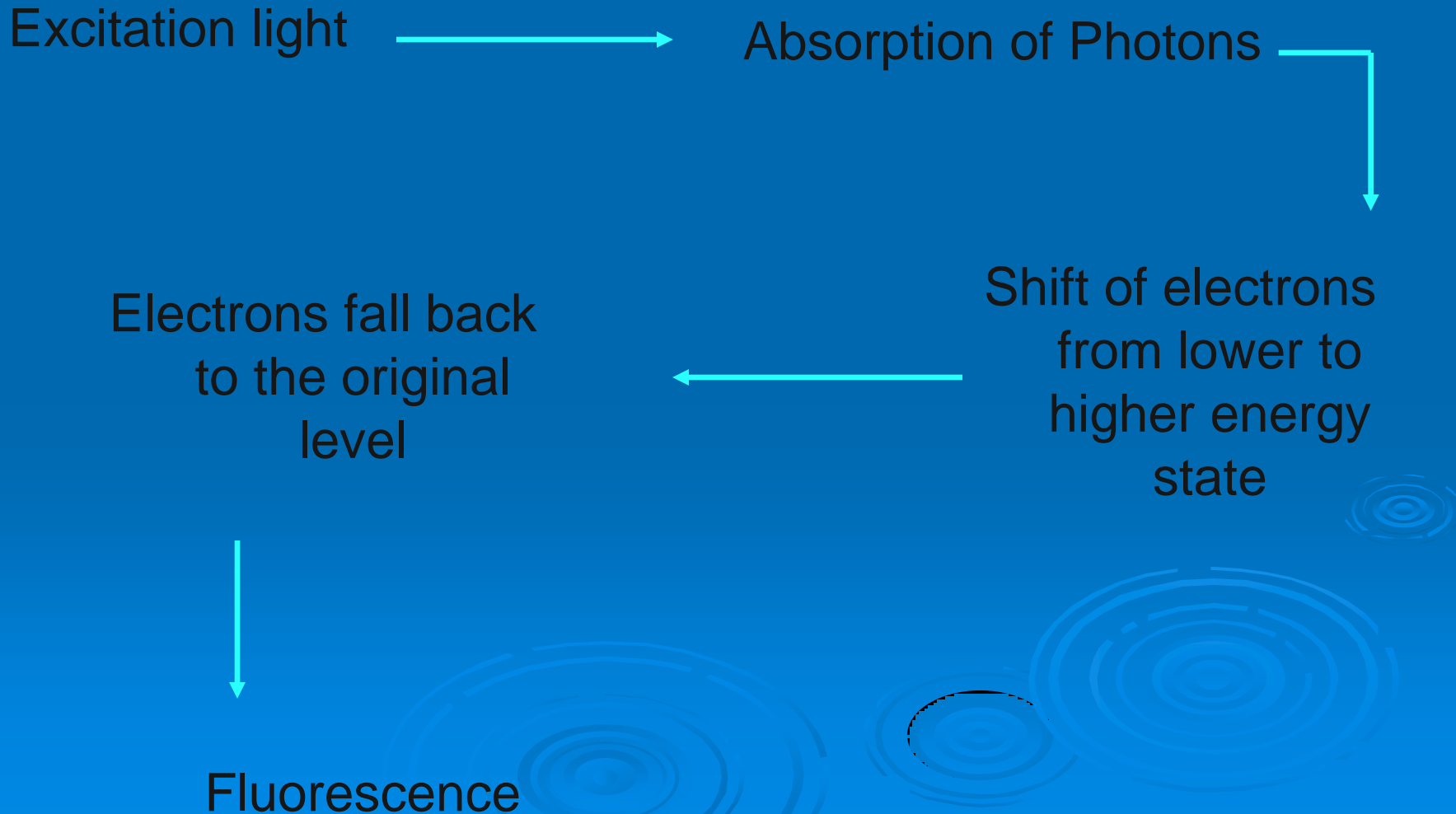
- Records Caries in Continuum.
- The scale helps differentiating the treatment needs from remineralization Vs restoration.

ICDAS II

- Code 0 – Sound; may have a stained fissure
- Code 1 – White opacity only when dried
- Code 2 – White opacity when wet
- Code 3 – Enamel breakdown without visible dentine
- Code 4 – Dentine discoloration through intact enamel
- Code 5 – *Cavitation*
- Code 6 – *Extensive cavitation involving at least ½ of surface*

Fluorescence....

.....based on the interaction of light with dental hard tissues.



How Caries affects dental fluorescence..?

Lesion acts as a barrier for the excitation light



Light scatters within the lesion.

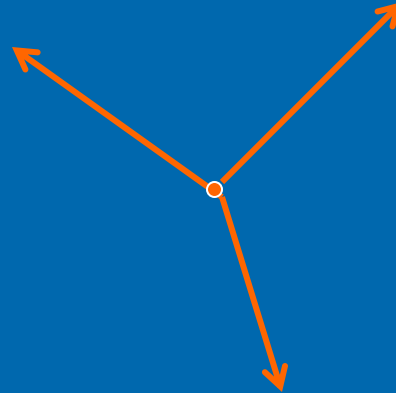




Diagnodent and
Dpen



QLF Clin pro



SoproLife



Our Study:

DAV Dental College, INDIA

DHU, Manchester, UK

Assessing the Severity of Occlusal Caries in 12 year old urban and rural children of Yamuna Nagar district (India) using ICDAS II Visual criteria and two fluorescence imaging methods.

Materials and Methods

Ethical Approval: Ethical committee of DAV .C. Dental College YamunaNagar, Kurukshetra University, India.

Subjects : The study involved 557 male and female school children, who were 11-12 years of age.

Selection of Schools & Children: From both urban and rural areas of YamunaNagar district, India based upon cluster sampling such that students were selected from all the socioeconomic groups of the society. Children in the age groups 11- 12 years were selected, on the basis of simple random sampling.

Consent : Informed Written consent from School Principals, Parents and Children.

Screening : To check for inclusion/ Exclusion criteria for finally Including in the study.

Following clinical examinations were done :

1. ICDAS visual II scoring
2. QLF images of Permanent first molars
3. SoproLife Images of Permanent first molars

{The SoproLife images were captured as Mesio-and Disto occlusal }

- i. Day Light Mode*
- ii. Diagnostic Mode*
- iii. Treatment Mode*

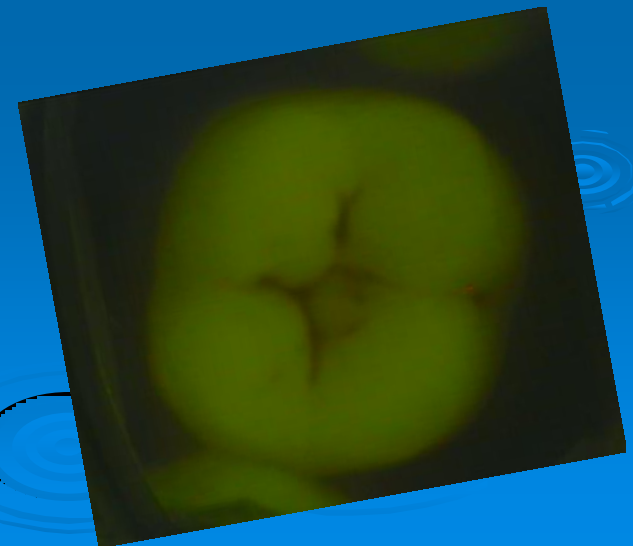
✓ ICDAS scores were recorded in the standardized ICDAS scoring sheets.

✓ Image analysis:

➤ QLF images:..... Inspektor Software.

➤ SoproLIFE images:..... MATLAB based software.

percent fluorescence loss (ΔF),
area of fluorescence loss
 ΔQ ($\Delta F \times \text{area}$).



QLF – image analysis

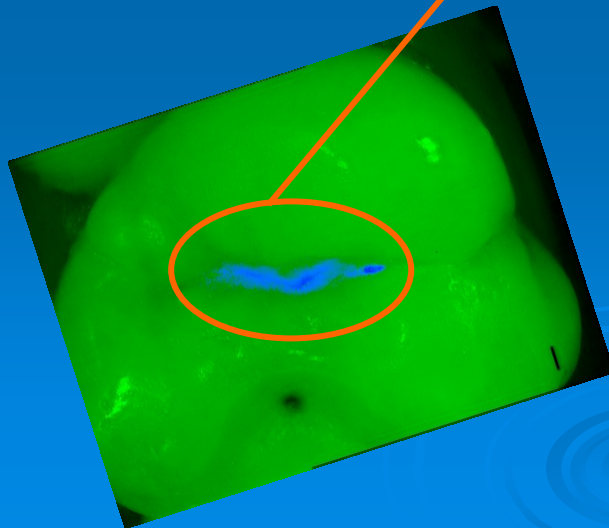
- Was done using the Inspektor software and the outcome was recorded as area, % ΔF , ΔQ .



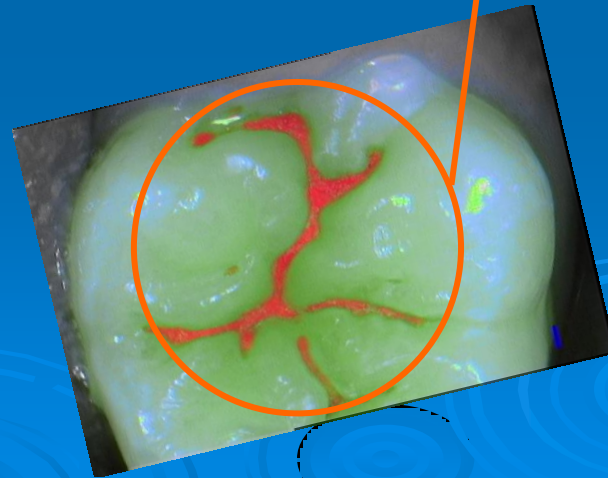
SoproLife Image analysis (similar to the Inspektor software)

using a custom software, based on MATLAB^(R) works. Outcomes were designated as

ΔF^{sg} ,
 $area^{sg}$
 ΔQ^{sg} .



ΔF^{sr}
 $Area^{sr}$
 ΔQ^{sr}



Hypothesis

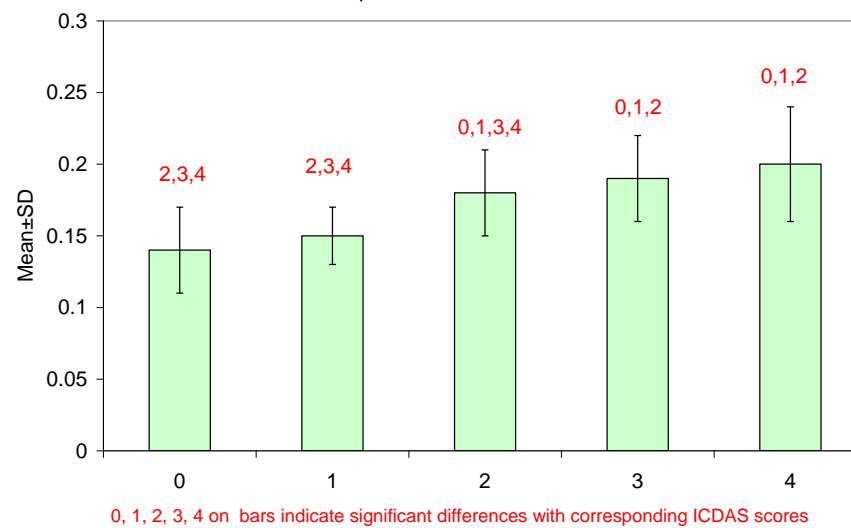
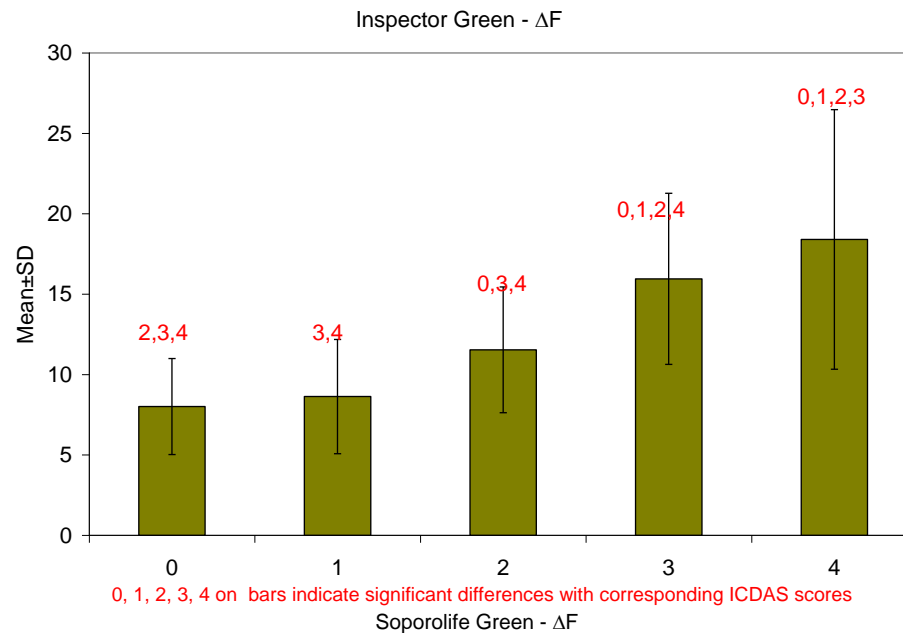
- ✓ Loss of fluorescence is indicative of dental caries ?
- ✓ The fluorescence loss increases with increasing severity of caries?
- ✓ Any variation if exists among the Urban and Rural Populations.

Results: Mean Fluorescence values for different ICDAS scores

ICDAS Scores	N	Inspektor Green Fluorescence			SoproLife Green fluorescence			SoproLife red Fluorescence		
		Area	ΔF	ΔQ	Area ^{sg}	ΔF^{sg}	ΔQ^{sg}	Sopr Area	Sopr dF	Sopr dq
0	68	1.07 ± 1.78	-8.01 ± 2.99	-12.84 ± 41.72	4177.31 ± 4517.32	0.14 ± 0.03	686.47 ± 864.85	208.65 ± 647.98	0.12 ± 0.25	155.01 ± 558.66
1	28	1.38 ± 1.26	-8.63 ± 3.55	-14.72 ± 20.72	4998.46 ± 3834.79	0.15 ± 0.02	797.05 ± 650.22	52.18 ± 151.90	0.12 ± 0.20	33.90 ± 139.24
2	377	2.12 ± 1.75	-11.54 ± 3.91	-28.67 ± 31.50	12578.66 ± 10854.57	0.18 ± 0.03	2403.08 ± 2343.14	719.11 ± 1653.50	0.34 ± 0.31	571.51 ± 1610.61
3	103	3.69 ± 1.97	-15.95 ± 5.32	-63.32 ± 44.08	21428 ± 15661.29	0.19 ± 0.03	4396.28 ± 4119.73	886.26 ± 1521.87	0.38 ± 0.30	642.66 ± 1415.14
4+	26	5.35 ± 2.98	- 18.40 ± 8.07	-107.83 ± 69.94	22793.77 ± 14911.25	0.20 ± 0.04	4977.54 ± 3765.26	382.38 ± 675.44	0.26 ± 0.25	181.24 ± 332.92

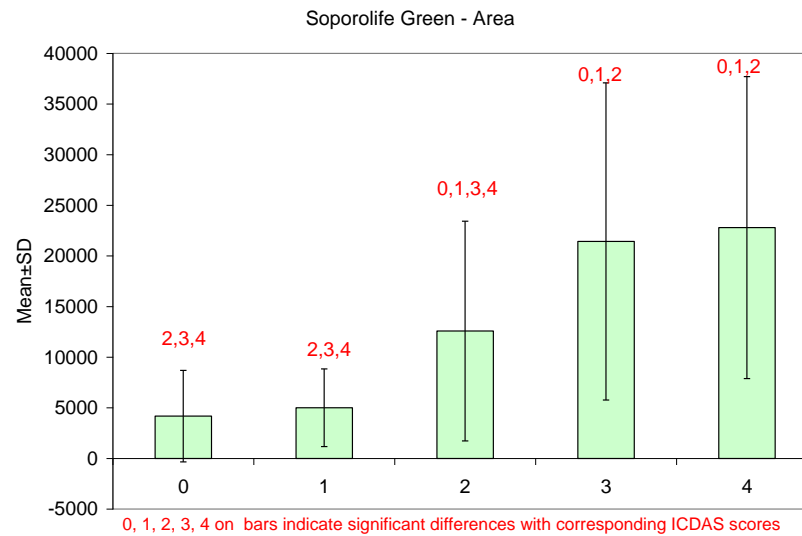
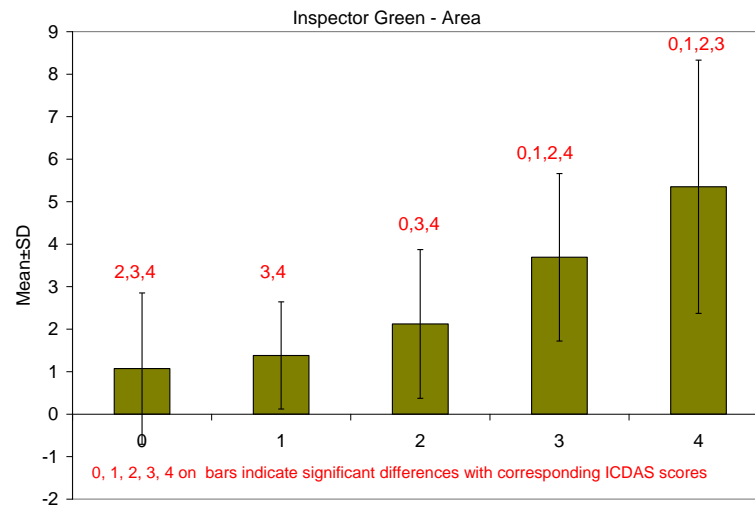
QLF & Soprolife Vs ICDAS ΔF

ΔF



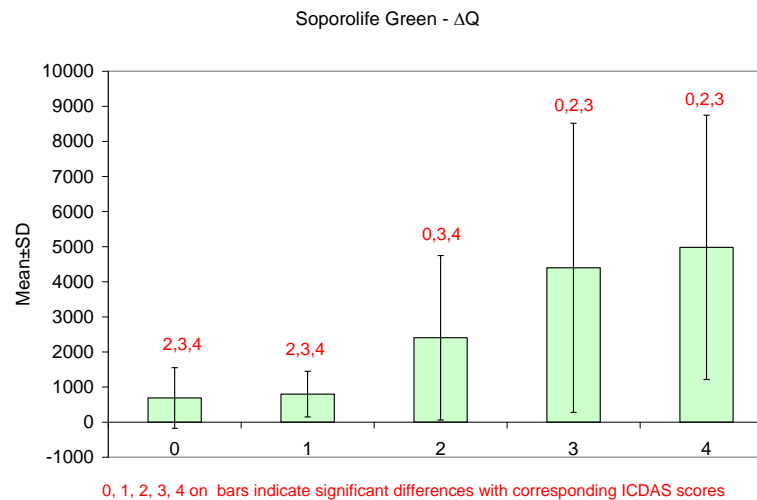
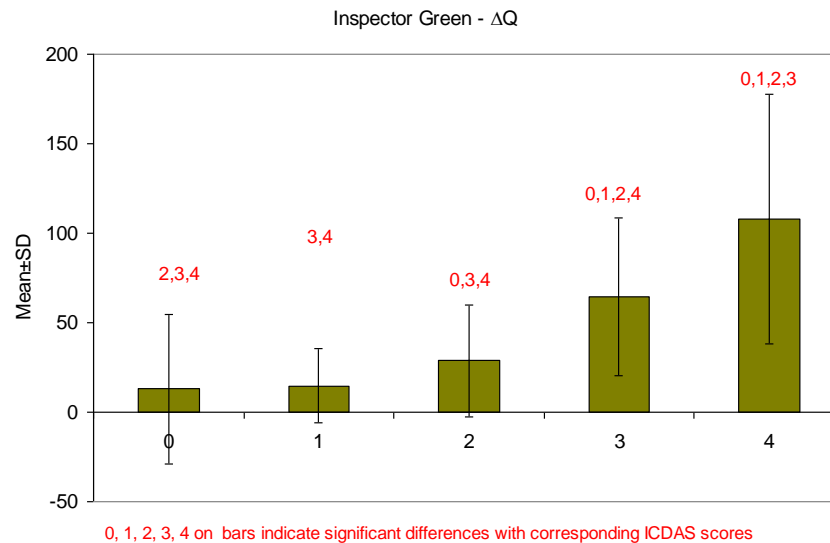
QLF & Soprolife Vs ICDAS Area

Area



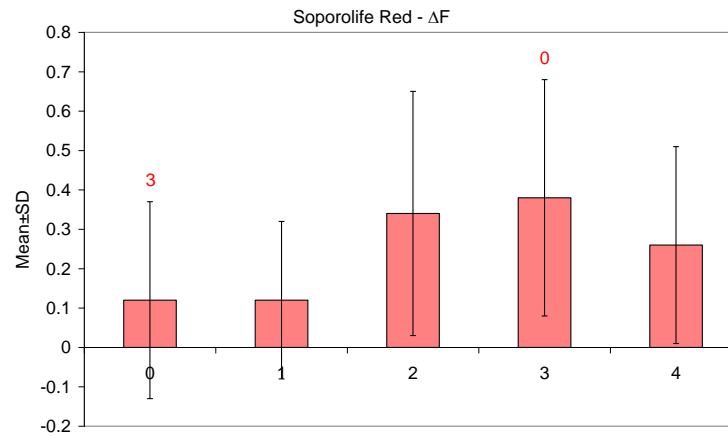
QLF & Soprolife Vs ICDAS ΔQ

ΔQ



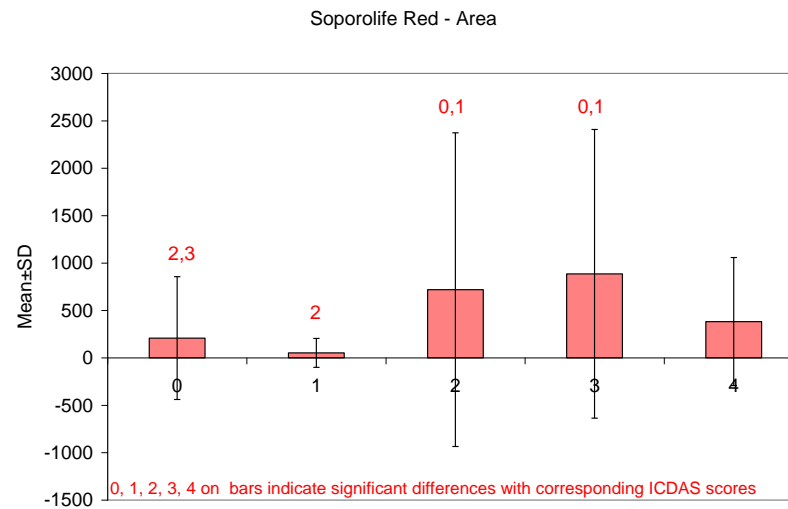
SoproLife Red

ΔF



0, 1, 2, 3, 4 on bars indicate significant differences with corresponding ICDAS scores

Area



0, 1, 2, 3, 4 on bars indicate significant differences with corresponding ICDAS scores

Independent Sample t Test; comparing Mean Fluorescence values for different ICDAS scores

Comparison among groups.	Inspektor Green Fluorescence			Soprolife Green fluorescence			Soprolife Red fluorescence		
	Area	dF	dQ	dF	Area	dQ	dF	Area	dQ
	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
ICDAS 0 * ICDAS 1	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
ICDAS 0 * ICDAS 2	P<0.01	P<0.01	P < 0.05	P<0.01	P<0.01	P < 0.05	P<0.05	0.09	0.26
ICDAS 0 * ICDAS 3	P<0.01	P<0.01	P < 0.05	P<0.01	P<0.01	P < 0.05	P<0.05	0.03	0.28
ICDAS 0 * ICDAS 4+	P<0.01	P<0.01	P < 0.05	P<0.01	P<0.01	P < 0.05	.42	1.00	1.00
ICDAS 1 * ICDAS 2	0.40	0.007	0.53	P<0.01	P<0.01	P = 0.02	P<0.05	0.21	0.53
ICDAS 1 * ICDAS 3	P<0.01	P<0.01	P < 0.05	P<0.01	P<0.01	P < 0.05	0.06	0.08	0.44
ICDAS 1 * ICDAS 4	P<0.01	P<0.01	P < 0.05	P<0.01	P<0.01	P < 0.05	0.08	1.00	1.00
ICDAS 2 * ICDAS 3	P<0.01	P<0.01	P < 0.05	0.02	P<0.01	P < 0.05	1.00	1.00	1.00
ICDAS 2 * ICDAS 4	P<0.01	P<0.01	P < 0.05	0.04	P<0.01	P < 0.05	1.00	1.00	1.00
ICDAS 3 * ICDAS 4	P<0.01	0.10	P < 0.05	1.00	1.00	1.00	0.68	1.00	1.00

Discussion:



✓ Consistent increase in the loss of fluorescence (both for QLF & SoproLIFE) with increased ICDAS scores.

($p < 0.005$, ANOVA ANALYSIS)

➤ QLF works on the principle of auto fluorescence and Demineralization of enamel results in reduction in the fluorescence (Pretty 2006)

➤ This loss in fluorescence has been shown to correlate with actual mineral loss (van der Veen and de Josselin de Jong 2000)

➤ Shi et al (2001) showed that mean fluorescence loss as analyzed in QLF images exhibit a linear relationship with lesion depth

➤ SoproLIFE camera also works on the principle of auto fluorescence

➤ Carious lesion or diseased tissue would be detected by variation in the auto fluorescence of its tissues in relation to a healthy area of the same tooth.

✓ Loss of fluorescence has been shown as an indicator of caries (Terrer et al. 2009).

✓ “Hence, the loss of fluorescence might have shown increased values with increased severity of caries.”



Intergroup Comparisons

- ✓ All Intergroup comparisons >>> Significant differences, except
- ✓ When the mean values were compared for patients with ICDAS score 0 Vs 1
Non significant differences ($p=1.00$).
- ✓ Common finding for both QLF and SoproLIFE.
- ✓ ICDAS visual examination typically excludes all the non-carious opacities and all such lesions are scored as 0 while QLF actually detects stain or any non carious hypocalcified area such as dental fluorosis(Stookey 2004). And same might be the case with SoproLIFE.



Urban population Vs rural population

Fluorescence parameters: Urban Vs Rural Populations.

Parameter	Mean of subject level QLF parameters.			Mean of subject level SOPG parameters		P value
	Urban (N= 95)	Rural(N= 60)	p value	Urban (N= 95)	Rural(N= 60)	
	Mean \pm SD	Mean \pm SD		Mean \pm SD	Mean \pm SD	
Area	2.71 \pm 1.55	1.91 \pm 1.24	0.001	14899.45 \pm 87	10268.66 \pm 93	0.002
df	-12.93 \pm 4.25	-10.78 \pm 3.54	0.001	0.18 \pm 0.02	0.16 \pm 0.03	<0.001
Dq	-42.42 \pm 33.4	-25.97 \pm 24.47	0.001	2931.81 \pm 19	1975.50 \pm 22	0.006

Urban Vs Rural populations: ICDAS Scores, QLF & SoprLIFE

Mean ICDAS score for urban population was significantly higher than the rural population.

{Hiroko Miura et al: Prevalence of dental caries in developing countries increases with the degree of urbanization(1997).}

Similarly for QLF and SoproLIFE output parameters, significant differences were observed when urban and rural populations were compared.

Conclusions



- The loss in fluorescence with both QLF and SoproLife can be predictably used as an indicator of caries.
- The loss/ alteration in green fluorescence is predictive of quantitative mineral loss.
- The diagnostic tools are able to distinguish between the Urban & Rural population and thus can be used as tools for Epidemiological research in “Early Caries detection studies”.