結果

結果を表１に示した。CPP はQLF から得られるパラメーターに対応したものとしてΔB（健常部位からの輝度の増加率）、ΔW（ΔB×ホワイトスポットの面積）、WS（ホワイトスポットの面積）を用いた。

	QLF			CPP		
No.	⊿F%	⊿Q%*mm2	WSmm2	⊿B%*	⊿W%*mm^2*	WSmm2
1	−9.17	−6.33	0.69	11.8	3.90	0.33
2	−9.12	−5.61	0.61	14.5	9.31	0.64
3	−6.49	−0.37	0.06	12.0	0.72	0.06
4	−7.87	−7.63	0.97	18.1	24.31	1.34
5	−9.26	−4.42	0.48	26.9	49.25	1.83
6	−8.18	−1.17	0.14	20.3	17.09	0.84
7	−8.94	−9.94	1.11	27.6	69.92	2.53
8	−11.30	−19.00	1.68	22.9	60.05	2.62
9	−8.75	−6.69	0.76	20.3	48.54	2.39
10	−8.63	−10.80	1.25	18.6	49.77	2.67
11	−11.90	−31.70	2.66	21.5	86.26	4.01
12	−11.60	−56.50	4.85	26.5	158.96	5.99

*⊿B=WS value÷Sound value×100−100

*⊿W=⊿B×WS area

表１　QLF 及びCPP から得られた各パラメーター

考察

QLF とCPP の各パラメーターの相関関係を図２，３，４に示す。脱灰部位の深度を表すΔF とΔB の相関が低いことから、CPP は深度方向の情報を得ることが困難である可能性が示唆された。今回は最も光の散乱の影響を受けやすいB チャンネルの画像を用いたため、他のチャンネルやグレー画像を用いての検討や照明の条件を変えてみると違う結果が得られる可能性があると考えられる。

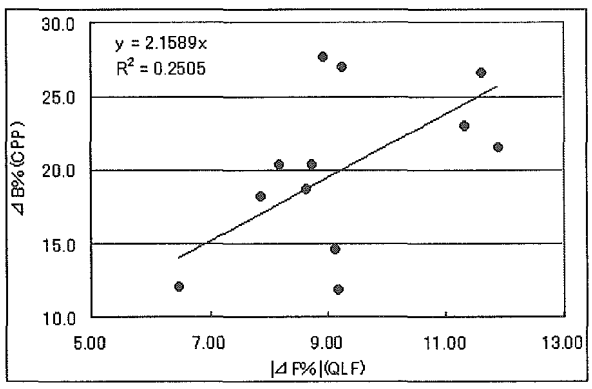

図２　ΔF（QLF）とΔB（CPP）の関係

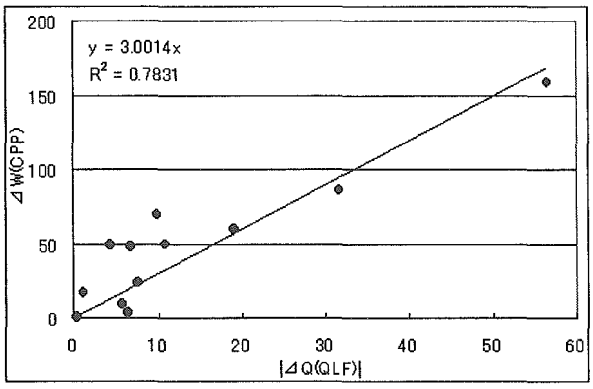

図３　ΔQ（QLF）とΔW（CPP）の関係

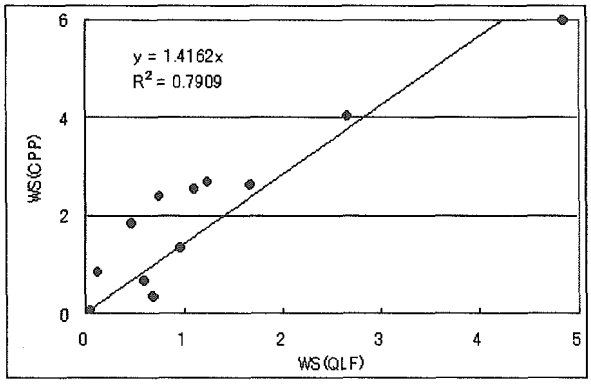

図4　WS（QLF）とWS（CPP）の関係

一方、ΔQとΔW、WSの相関は高かった。このことからΔQとΔWはホワイトスポットの面積に大きく影響を受けていることが分かる。主に解析ソフトウエアの性質によるものと考えられるが、QLFとCPPでは検出感度が初期う蝕の大きさや部位の湾曲度により異なった傾向を示すことが認められた。しかしながら、この点に関してはサンプル数が少ないため定量的な考察はできなかった。

CPPは初期う蝕部位で散乱される光の量を検出するため、内部からの蛍光の遮蔽度を検出するQLFとは原理が異なる。その結果、深さ方向の情報を今回の条件で得ることは困難であった。しかしながら、面積の情報はQLFと高い相関で得られることが明らかになった。従って、それぞれの特徴を活かした使用方法を考えて活用していくべきだと考えられる。

ＱＬＦの特徴

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1．QLF 待望論の背景

QLF の臨床応用への待望論には、疾患は早期に介入すればするほど最小の努力で最大の効果を挙げられるとの科学的認識が背景にある。最小の努力とは脱灰抑制と再石灰化促進を可能にするフッ化物による化学的介入であり、最大の効果とは歯質ミネラルの回復による健全歯への回帰、最善が望めない場合でも耐酸性獲得による病変の進行停止である。初期う蝕にともなうこれら可逆現象が、初期う蝕は reversible caries であるいわれる理由でもある。2000 年に提唱された必要最小限の侵襲を意図した歯科医療[1)]（MI Dentistry；表１）として取り上げられた治療ステップの１つに初期う蝕の再石灰化処置が位置づけられているのも初期う蝕は reversible caries であるという事実を受けてのことである。

表１　MI Dentistry の治療ステップ

1. Remineralisation of early lesions
(初期齲蝕の再石灰化処置)

2. Reduction in cariogenic bacteria, in order to eliminate the risk of further demineralisation and cavitation
(脱灰進行と齲窩形成のリスク除去のための齲蝕原因菌の削減処置)

3. Minimum surgical intervention of cavitated lesions
(齲窩形成のある齲蝕に対する必要最小限の切削処置)

4. Repair rather than replacement of defective restorations
(再修復でない修理的修復処置)

5. Disease control
(初発ならびに再発の予防処置)

Int Dent J, 50;1-12,2000.

しかしながら、これらの期待も、その前提となる疾患の早期発見の可能性なくしては机上の空論である。早期発見すべき疾患は可逆的反応の可能性を有する疾患の検出である。これまでの多くの *in vitro* 研究からは、初発の脱灰性病変は再石灰化によってそのミネラルを回復することが知られている。ヒトが視診で確認できる前に、いかに早期にこれまでの視診・触診を中心とした主観的な方法にとって変わる光学的科学機器による検出法が切望されていた。光学的科学的である必要は、レーザ光や可視光であれば再石灰化を可能にしている表層の歯質を破壊してはならないこと、ミネラルの変化を定量的に高い再現性をもって計測できなければ可逆的変化を評価できないからである。

価格が高価なこと、操作性には熟練が必要、使用には規格化した条件を準備しなければならない諸点を除けば、画像があり、初期う蝕の数値データを得ることができることは、初期う蝕の客観的な評価を可能にした点で特筆すべき機器である（表２）。これまでに検討されてきた報告を総合すると、脱灰－再石灰化現象の可逆的反応を評価することは、欠点を含むその機器の特徴を合わせて理解しておくことで可能となる。

表２　QLF 機器の特徴

Devices for detection	What is obtained	Clinical application
QLF	1. Tooth image for patient or later analysis 2. Fluorescence loss (Mean/Max.) 3. The area of lesion (mm^2)	1. Cost of the device 2. Skill of the operator 3. Standardized conditions for hydration
DIFOTI	・Tooth image for patient	・ not interpret the images in the same manner of radiography
DIAGNOdent	・the amount of fluorescence numeric readout (0-99)	1. Cost of the device 2. Simple to operate 3. Cleaned and dried

２．初期う蝕と QLF 値の関連

光学的科学機器 QLF の特徴は、歯質の有する蛍光強度が健全歯と初期う蝕部では異なることを原理に各種パラメータ（蛍光減少度；デルタ F、面積、脱灰量デルタ Q）を用いて初期う蝕を定量評価する点にある[2, 3]。これまでに報告されてきた研究結果から、QLF の最大の特徴は蛍光減少度がう蝕の脱灰深度と高い相関関係にある点である。両者に関係があるという事実だけが拡大解釈されるとあらゆる深さにおいても関係があると誤解される懸念がある。正確には、*in vitro* の結果からは浅い場合は 10 μm の脱灰から検出可能[4]であるが、*in vivo* で形成された隣接面う蝕を調査した結果からは深い場合は約 800 μm の脱灰まではう蝕の脱灰深度と高い相関関係（図１）にあることが明らかにされている[5]。しかしながら、800 μm を超える脱灰の場合は、両者はけして直線関係にない。実際には深い脱灰深度を示すう蝕は多いが、注意を要する点である。

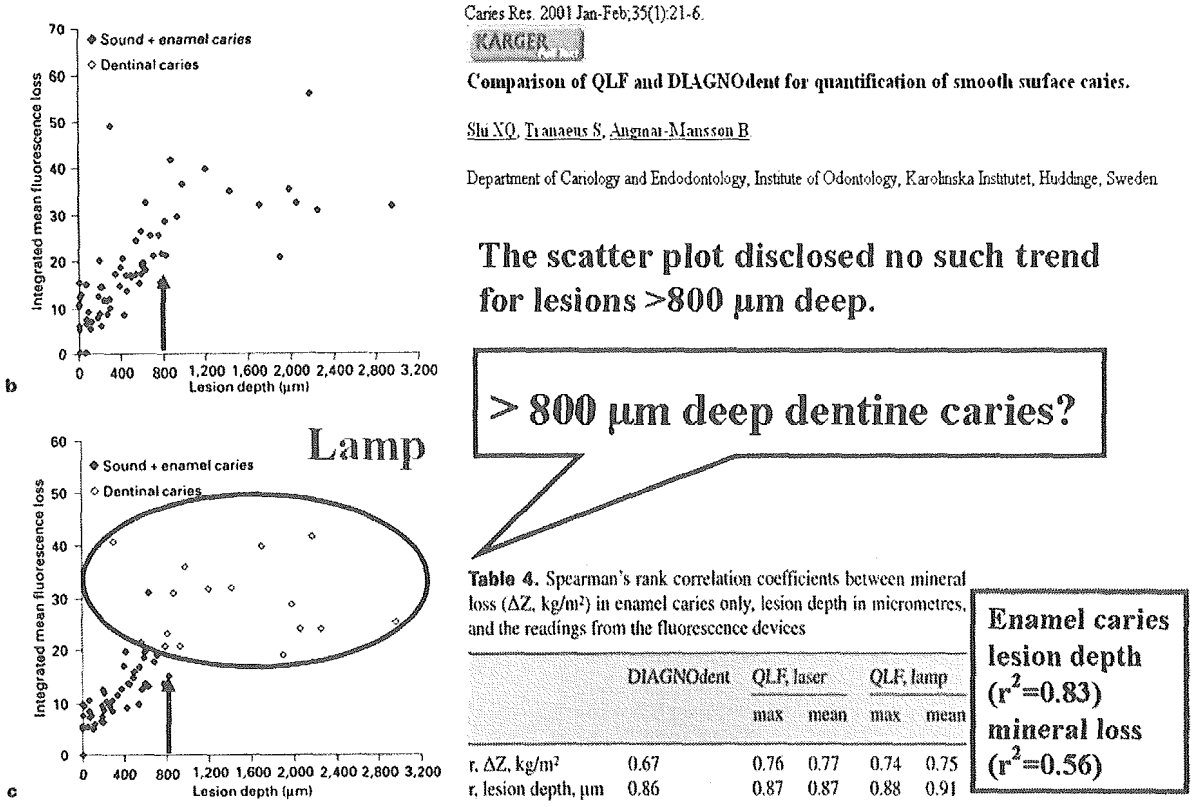

Table 4. Spearman's rank correlation coefficients between mineral loss (ΔZ, kg/m²) in enamel caries only, lesion depth in micrometres, and the readings from the fluorescence devices

	DIAGNOdent	QLF, laser		QLF, lamp	
		max	mean	max	mean
r, ΔZ, kg/m²	0.67	0.76	0.77	0.74	0.75
r, lesion depth, µm	0.86	0.87	0.87	0.88	0.91

Fig. 2. a–c The relationships between TMR, lesion depth in micrometres, and the readings from DIAGNOdent, QLF (laser), and QLF (lamp + filter), respectively.

図１　QLF 測定値と脱灰病変の深さとの関連

最新のう蝕検出機器に期待するのは、う蝕プロセスの早期病変を単に視診よりも確実に早期発見することだけではない。前述したように早期発見すべき疾患は可逆的反応の可能性を有する疾患の検出である。果たして検出した初期う蝕が再石灰化処置によってすべて可逆的変化を示す可能性があることを保証するものではない。

最善の歯質ミネラルの回復による健全歯への回帰、あるいは次善の耐酸性獲得による病変の進行停止を決定する要因(主にプロフェッショナルケアの内容と頻度、期間やセルフケアの内容と頻度、期間との関連、発酵性糖質の摂取頻度等の因子)は、多変量解析を中心とする研究の進展によって解明される事柄である。現在までのところ、可逆的変化を検出できる機器は存在していない。過剰な期待は禁物である。

3．QLF 機器の上手な使い方－計測条件の規格化－

QLF 機器は基本的には歯質の有する蛍光強度を計測している。QLF 機器からの光は計測部位に垂直に入射し、背後にある象牙質からの蛍光強度を計測し、パラメータを算出する。その歯質本来の蛍光強度はエナメル質よりも象牙質で強く、エナメル質/象牙境で最も強い傾向を有する[6]。したがって、計測部位の裏面に象牙質の存在が期待できない場合は、十分な蛍光強度が得られないため計測には不向きとなる。特にエナメル質に限局する隣接面の初期う蝕を頬舌面、あるいは咬合面方向から計測することはこのような理由から、残念ながら適応外である。現在までのところ最大の適応症は、平滑面の初期う蝕検出である。その場合でも計測には規格化が必要である（表３）。

表３　QLF 機器計測にあたって規格化の必要性

1. 歯面清掃の必要性-計測前に歯垢を除去
2. 乾燥の必要性-計測前に十分な乾燥を行う
3. 温度管理の必要性-乾燥に影響する温度管理を行う
4. ダークルーム環境の必要性-室内では蛍光灯の影響を排除しつつ計測を行う
5. 一定距離の必要性-特にモニタリングの場合は、機器と計測部位までの距離は初回と等距離・同じ方向から計測を行う

歯質蛍光強度の計測に影響を与える要因は、計測部位と機器との距離である。モニタリングの場合は、同じ方向から同じスケールで計測したパラメータを比較する必要がある。計測部位の乾燥条件は蛍光強度の変化に影響を与える。口腔内は常に唾液に濡れやすい環境下にあり、デルタ Q は湿潤状態では減少し乾燥に伴って増加する[7]。特に *in vivo* で形成された脱灰病変の場合、脱灰深度は *in vitro* の脱灰深さよりも深く、しかも均質でないことを考慮すると十分な乾燥条件下で計測する必要がある。圧縮空気での乾燥では１５秒という目安が示唆されている[7]が、どの深さに対する時間であるかが記載されていない。十分な乾燥時間は脱灰病変の深さ依存性の要因である。乾燥に関連し計測する環境条件の内、室温は口腔内からの乾燥に影響を与える重要な要因である。特にフィールド調査の場合、温度を考慮した十二分な乾燥条件が必要になる。また、光学機器である QLF は他の光の影響を受ける。室内では蛍光灯の影響を排除した、ダークルームで計測する必要がある。さらに、歯面上に歯垢が存在することは、その代謝産物ポルフィリンが蛍光強度に影響を与える要因である[8]。計測前には規格化された歯面清掃が必要となる。

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Rationale and Evidence for the International Caries Detection and Assessment System (ICDAS II)

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The International Caries Detection and Assessment System (ICDAS) presents a new paradigm for the measurement of dental caries that was developed based upon the insights gained from a systematic review of the literature on clinical caries detection system [Ismail, 2004a] and other sources [Chesters et al., 2002 ;Ekstrand et al., 1997; Fyffe et al., 2000; Ekstrand et al., 2001; Ekstrand et al., 2005; Ricketts et al., 2002]. That review found that while new caries detection criteria measured different stages of the caries process, there were inconsistencies in how the caries process was measured. The review also found that there is a gulf between European and American systems for caries detection and there were inconsistencies among the research criteria for measuring dental caries. By and large, especially in the USA, dental caries has been synonymous with presence of cavitation. In Europe, at least among the research community, the understanding of dental caries appears to be more advanced than the dichotomous approach used in the American criteria for measuring caries in that the clinical stages of the disease process which precede cavitation are acknowledged and often recorded.

The future of research, practice, and education in cariology requires the development of an integrated definition of dental caries and uniform systems for measuring the caries process. The systematic review concluded that there is an urgent need to address the answers to the following questions: 1) what stage of the caries process should be measured; 2) what are the definitions for each selected stage; 3) what is the best clinical approach to detect each stage on different tooth surfaces; and 4) what protocols of examiners' training can provide the highest degree of examiner reliability? These were the initial questions that initiated the discussion of the ICDAS process.

In this paper, we will describe the philosophy of the ICDAS system, how the ICDAS answers each of the four questions, and whether ICDAS can serve as a basis and benchmark for clinical and epidemiological research and inform dental undergraduate and postgraduate teaching in cariology. At the outset it is important to define an important guiding principle of ICDAS. Members of the coordinating committee have attempted several times to include the largest input of the cariology community in the process of developing integrated criteria. The ICDAS committee was expanded to include a larger group of participants. Invitations were mailed to cariologists from Europe and the USA. The following document summarizes the discussions that took place during the Baltimore ICDAS II workshop which was held in March 2005. It should also be understood that the ICDAS committee explicitly acknowledges that the ICDAS approach is built on a foundation of evidence which dates back over the last hundred years to G.V. Black in the US and to many of the founding fathers of ORCA (the European Organisation for Caries Research) in Europe.

Historical Perspectives and the Need for an Integrated System

Developments in epidemiological caries measures

More than a decade ago concern was expressed about how the quality and comparability of caries data could best be safeguarded in order to achieve valid assessments of disease status at a time when significant service developments were accompanied by changes in both the pattern and distribution of dental caries [Pitts, 1993]. These issues are even more relevant today. There is a danger that key information and concepts are not being disseminated sufficiently well [Pitts, 1994], and many of the clear and established issues and challenges in this area are still not recognized in dental public health. There is, therefore, a need to continue work to bring together

the evidence base from research in the field of "cariology" (which is very robust in some areas, but more deficient in others) on the one hand and the national and international dental epidemiology, dental public health, and dental practice communities on the other.

Many of the concepts debated at least since the 1980s in cariology are still seen as "new" or as radical by many working in other fields. There are, however, some encouraging signs in the UK [Drugan, 2004], the European Association for Dental Public Health (EADPH), the American Dental Association (which supported the Baltimore workshop), and the Federation Dentaire Internationale. The new emphasis on caries measurement and management may indicate that the dental community worldwide has started to recognize that we need new approaches in caries detection, assessment, and management.

The ICDAS coordinating committee has been guided by the model depicted in Figure 1 which illustrates graphically the type of updated caries terminology now being recommended. This allows more clarity for lay and non-dental audiences as well as continuity with traditional measures, while also reflecting the current research evidence from cariology. Key changes are to carefully avoid the use of the misleading and widely misunderstood term "caries free" and to explicitly acknowledge whether or not initial lesions clinically confined to the enamel are included or excluded in examinations.

Developments in caries measures for clinical research

There have been several conferences held during the last five years that focus on caries detection and assessment. A recent issue of *Caries Research* reporting the peer reviewed proceedings of

the 50th Anniversary European Organisation for Caries Research (ORCA) Congress on *Cariology in the 21st Century* is a good start [Nyvad et al., 2004]. The series of published proceedings from the "Indiana Conferences on Early Detection of Dental Caries" organised by Professor George Stookey and published by Indiana University also contain a wealth of detail of work in this area [Stookey, 1996; 2000; 2004]. In the field of randomized clinical trials of caries preventive agents, it has now been shown that by using clinical visual diagnostic criteria that include enamel lesions, it is possible to detect differences in treatment effect over a shorter period than using criteria relying only on the later stage caries changes extending into the dentin [Chesters et al., 2002].

An International Consensus Workshop on Caries Clinical Trials (ICW-CCT) was held with in 2002 involving 95 participants from 23 countries. The final Consensus Statements represent international agreement on where the evidence leads in the field of caries clinical trials [Pitts and Stamm, 2004]. The final agreed text includes:

- "There is some confusion with the terminology employed in the literature around *caries diagnosis* (which should imply a human professional summation of all available data), *lesion detection* (which implies some objective method of determining whether or not disease is present) and *lesion assessment* (which aims to characterise or monitor a lesion, once it has been detected)".
- "The understanding of the caries process has progressed far beyond the point of restricting the evidence for dental caries to the D2 (caries in enamel only) or D3 (caries in enamel and dentin) levels of cavitation".

- "For future clinical trials, recording only cavitated lesions as an outcome measure is becoming outmoded".
- The workshop participants also recommended that "in light of the evidence reviewed, both here and elsewhere, pertaining to modern caries definitions and measurement concepts – the participants supported a statement recommending that in future controlled clinical trials, caries measurement methods are employed which:
    1. Are capable of accurately capturing at any given point in time the manifestations of the caries process in dental hard tissues (enamel and dentin).
    2. When applied sequentially, can monitor definitive changes in manifestations of the caries process over time, over and above any background "noise" from normal levels of de- and re- mineralization, or from variations attributable to the caries detection system(s) employed.
    3. When applied sequentially, can differentiate actual product effects in terms of group differences in lesion initiation and lesion behavior (progression, arrest and/or regression)".

Immediately following the ICW-CCT workshop (April 2002), the ad hoc ICDAS coordinating committee was formed by Drs. Pitts and Ismail. The goal of that committee has been to develop an integrated clinical detection and assessment system of dental caries for research and clinical practice. The development of new technologies and applications has the potential to supplement clinical caries detection, but these assessments will have to be clinically meaningful by providing measurements over and above the noise of arrested initial and sub-clinical lesions (Pitts and Stamm, 2004]. A major challenge in synthesising the developing evidence in the partially overlapping fields of caries epidemiology, clinical caries

research and clinical caries management is the incompatibility of the terminology, criteria and grading systems currently used across these three fields. This challenge, together with a number of the recommendations of the NIH Consensus Development Conference (2001) and the ICW meeting on Clinical Caries Trials, led an ad hoc group to start the development of the International Caries Detection and Assessment System – ICDAS.

ICDAS: The Committee – The ICDAS activities have been carried out under the supervision of and on behalf of an informal, unfunded, ad hoc and voluntary committee which was assembled in an attempt to advance some of the key recommendations in the area of caries detection and assessment criteria. After the first meeting in Dundee, Scotland, an invitation was mailed to cariologists from Europe and USA to attend a development workshop in Ann Arbor, Michigan. No attempt was made to exclude any researcher or individual. The founding committee comprised: from the Dental Health Services Research Unit, University of Dundee (DHSRU): Nigel Pitts, Christopher Longbottom, Gail Topping, David Ricketts; from the University of Michigan: Amid Ismail; from Indiana University: Domenick Zero; from Copenhagen University: Kim Ekstrand; from the International Dental Federation (FDI) Elmar Reich and from NIH/NIDCR: Rob Selwitz. At the first meeting there was helpful input from Andrew Forgie (Dundee) and Chris Deery (now Edinburgh). From the second meeting the Committee was joined by David Banting (Ontario), Hafsteinn Eggertsson (Indiana) and Woosung Sohn (Michigan) and the third meeting onwards the committee was joined by Andréa Ferreira Zandoná (Indiana). To this group an additional 10 individuals participated in the Ann Arbor workshop. This group comprised the ICDAS development committee in 2002.

ICDAS: Philosophy – the philosophy on which this truly collaborative initiative is based is one where the methodology from caries epidemiology meets that from caries clinical trials and practice and the whole is conducted according to the values of evidence based dentistry (EBD). There have been many systems devised over the years for grading dental caries which have been visually based and included non-cavitated lesions in enamel and all are fully acknowledged. The driving principles of the ICDAS committee are: integration, scientific validation, and utility of the criteria in different research and practice settings.

ICDAS: Development Meetings – Before the ICDAS II workshop, four development meetings were held - Dundee, Scotland in April 2002; Ann Arbor, Michigan in August 2002, where the ICDAS I criteria were developed; Indianapolis, Indiana in May 2003; and Bornholm, Denmark in April 2004. The ICDAS II workshop was held in Baltimore, MD, USA, to share the progress in the ICDAS criteria and seek the input of a wider international expertise. Invitations were mailed to large group of experts and those who accepted the invitation convened to review, revise as necessary, and agree on the ICDAS II version of the criteria. The invitations were mailed to over 60 cariologists and researchers in the field.

ICDAS: Concepts – The use of a standardized system based on best evidence should lead to better quality information to inform decisions about appropriate diagnosis, prognosis and clinical management of dental caries at both the individual and public health levels. A "wardrobe" of validated tools should allow users to select the best criteria and conventions for a specific use. Adoption of the system should, in the longer term, also facilitate the work of those who subsequently seek to systematically review published evidence in the three fields referred to

above. The concept is that the system will be an open one maintained on the World Wide Web and subject to peer review. Users of the system will have to: 1) specifically acknowledge the version of the system they employ and 2) specify which parts of the "ICDAS wardrobe" is being used.

Figure 2 summarises the following key features of ICDAS:

- The **ICDAS caries detection criteria** have been piloted in various guises in Dundee, Detroit, Indiana, Copenhagen, Columbia, Mexico and Iceland. They are now ready for wider use and have been further peer reviewed in 2005.
- The **ICDAS caries activity criteria** are still part of an expanding research agenda. Preliminary caries activity assessment criteria have been developed using the ICDAS approach of relying on visual assessment and the use of the WHO/PSR probe. Further research is planned to validate the proposed criteria.
- The **ICDAS caries system** provides a vital step forward in giving a coherent framework of comparison against which the potential benefits and performance of existing and new aids to caries detection and diagnosis can be assessed against the optimised clinical visual method. Previous systematic reviews and consensus conferences have found considerable difficulty with the heterogeneous methodology and reporting in this area.

Caries diagnosis is an important part of the dentist's daily work. Caries diagnosis is a process, which can be considered as a three-step procedure: detection of the lesion, followed by an assessment of the severity of the lesion, which again is followed by an assessment of the activity

of the lesion [Ekstrand et al., 2001]. Caries risk assessment on the other hand is the assessment of the risk of getting new lesions in the near future [Bratthall et al., 1997].

Early in the discussions of the ICDAS coordinating committee it was recognised that lesion detection without assessment was of little clinical relevance. However, in reviewing the literature, it was found that there was insufficient current replicated evidence on the visual signs and symptoms of lesion activity to present an evidence-based system within the ICDAS criteria for lesion assessment. The limited evidence available, and previous criteria systems, were synthesised and used to develop draft criteria for assessing caries activity and during the ICDAS II workshop participants reviewed and modified these. These proposed criteria will be investigated and further revised if necessary.

Coronal Primary Caries Detection Criteria

Principles used to develop the criteria for Coronal Primary Caries

Dental caries is a dynamic process with cycles of demineralization followed by remineralization. The balance between the two cycles determines the stage of the disease as depicted in Figure 1. It is hard to categorize a complex disease like dental caries into a scale because the process is continuous and could be measured, if feasible, as stages representing minute loss of tooth structure that is currently not detectable using the current technology available for in vivo use. Clinically, we rely on visual signs (change in color, cavitation) which represent manifestations of a relatively advanced caries process.

To understand the measurement of caries it is important to review basic concepts. Sound enamel is translucent and microporous. After repeated demineralization challenges, microporosity of the

subsurface enamel increases. The increase in microporosity leads to a change in the refractive index of enamel. The first sign of carious change, hence, is a change in translucency and light refraction of enamel after it is dried for a short period. If demineralization continues and enamel microporosity and surface loss increases, further reduction occurs in the refractive index of enamel. As a result, early carious lesions are seen even when the surface is covered with saliva. This is a more advanced stage of dental caries.

Ekstrand et al. [1995] has correlated between the severity of carious lesions and their histological depth. White spot lesions, which require air-drying, are most likely to be limited to the outer ½ of the enamel. The depth of a white or brown spot lesion which is obvious without air-drying is located some place between the inner 1/2 of the enamel and the outer 1/3 of the dentin. Localized enamel breakdown due to caries, with no visible dentin, indicates that the lesion extends to the middle 1/3 of the dentin. In addition, a greyish, brownish or bluish shadow of the dentin shining up through apparently intact enamel also indicates a lesion extending to the middle 1/3 of dentin. Frank cavities with visible dentin indicate that a lesion has been extended to inner 1/3 of dentin.

The ICDAS I and II criteria (Appendix) incorporate concepts from the research conducted by Ekstrand et al. [1995, 1997] and other caries detection systems described in the systematic review conducted by Ismail [2004]. These systems indicate that measurement of non-cavitated carious lesions in enamel or dentin can be based on visual topography at the surface level. While such systems are not perfectly accurate; they have both content and correlational validity with histological depth of carious lesions.

As stated before, the ICDAS was developed to provide an international system for caries detection that would allow for comparison of data collected in different locations as well as at different points of time. The ICDAS system was developed to bring forward the current understanding of the process of initiation and progression of dental caries to the fields of epidemiological and clinical research. The coordinating committee also took into consideration developing a system that has wider utility for dental practitioners. If dental caries is classified using agreed upon criteria and systems, then comparison of findings by epidemiologists and clinicians from different countries would be feasible.

The ICDAS measures the surface changes and potential histological depth of carious lesions by relying on surface characteristics. The coordinating committees have discussed at extensive length the concept of measuring caries activity and have tested different clinical criteria systems [Ekstrand et al. 2005]. At the ICDAS II workshop in Baltimore existing activity criteria were modified to fit with the ICDAS approach for clinical detection of dental caries. The proposed caries activity system will be evaluated in future research projects.

The primary requirement for applying the ICDAS system is the examination of clean and dry teeth. The ICDAS examination is visual aided by a ball-ended explorer that is used to remove any remaining plaque and debris and to check for surface contour, minor cavitation or sealants. It is highly advisable that the teeth are cleaned with a toothbrush or a prophylaxis head/cup before the examination. The use of a sharp explorer is not necessary because it does not add to accuracy of the detection and it may damage the enamel surface covering early carious lesions (Ekstrand et al. 1987; Bergmen and Lindén, 1969).

The ICDAS criteria for coronal caries are described in the criteria document attached to this paper.

Caries Adjacent to Restorations and Sealants (CARS)

Rational and terminology

When a restoration is placed in a tooth, the adjacent tooth tissue, which is vulnerable to caries, can be considered in two planes. There is the surface enamel and the enamel and dentin of the cavity wall. Secondary caries has classically been described as occurring in two ways: an "outer lesion" and a "wall lesion". The chemical and histological processes involved in "outer lesions" are the same as primary caries and it has been suggested they occur as the result of a new, primary, attack on the surface of the tooth adjacent to the restoration. A number of researchers have suggested that secondary caries is quite likely to be primary caries adjacent to restorations [Ozer, 1997; Kidd and Beighton, 1996].

Additionally, however, given the appropriate conditions, a "wall lesion" may start on the wall of a cavity in the presence of leakage or micro-leakage. Thus these lesions only occur secondary to the presence of a restoration. The definitions given to caries found in association with a restoration, or on a restored tooth, vary greatly in the literature. "Secondary caries", "recurrent caries" and "residual caries" are some of the terms commonly used. However, the same terms are used to describe different conditions by different investigators. Many of the definitions focus on the spread of caries at the enamel-dentin junction (EDJ) in a restored tooth. Other definitions include the failure to remove all diseased tissues in the deep part and/or at the margin of cavity