Daily clinical applications from non-invasive to invasive dentistry

Pr Tassery

acteon

Introduction

It is now established that adjunct devices (eg. loupes, microscopes, intro-oral camera,.. etc) can make lesion detection more accurate, especially for early white spot and approximal lesions, where visual examination is least valid.

These technologies may not only help lesion detection but also inform on caries activity, appropriate carious tissue removal to leathery dentine level, and on-going lesion monitoring. It is important to also have the capacity to monitor lesions and keep specific, appropriate and accurate pictures and videos records, especially when using minimally invasive strategies.

Among the new detection tools, the new C50 camera is a new performing diagnosis aid tool combining HD pictures with 2 daylight modes (classic and boosted) and 2 specific fluorescent modes, one for caries diagnosis and caries activity detection and second for periodontal mode.

The caries mode and periodontal mode putatively revealed AGEs produced from Maillard[1] reactions and the clinical applications of the images are based on the LIFEDT concept (Light-Induced Fluorescence Evaluator for Diagnosis and Treatment)[2,3].

The tooth and periodontal tissues can be observed in HD daylight and daylight + and fluorescence modes with a high level of magnification (30X) according the preliminary steps.

Any modification of the reflected light from dentine or enamel and periodontal tissues, in comparison to a healthy lesion can be detected. Clinical decisions are not simplistically linked to numerical values (avoiding the pitfalls of cut-off values,) and the system improves visual inspection and informs about clinical decision making.

The objective learning of this booklet is to shift the line of the academic cariologic engrams and proposed new treatment flow charts from non invasive to invasive restorative techniques, using the new performing intra oral C50 camera.

LIFEDT concept is built on five principles:

1 - Depending on the diagnostic aids used, non-invasive, micro-invasive and invasive activities can be involved.

2 - Lesion activity, accessibility and presence of surface cavitation are the main factors for intervention choice for carious lesions.

3 - Cleaning the deepest part of the pits and fissures without damaging the enamel is mandatory to allow visualisation.

4 - Fluorescence variations help to evaluate carious lesion activity and inform on the end point of the carious dentine tissue excavation. This point focus on the Bioactive Dental Concept which recommend the use of ions released biomaterials in case of high caries risk patient, caries activity and little bondable enamel in proximal lesion.

5 - Burs or drilling tools have to be smaller than the width of the cavity. If not, sealing is preferable.

About the author

Pr. Hervé Tassery has received his PhD in biomaterials from Aix Marseille University 2001. Currently, he is full time Professor and past head of the Restorative and Preventive Department of Marseille Dental School at Aix-Marseille University.

His major fields of interest are in cariology, fluorescence devices, minimally invasive dentistry, and clinical research. Working in the Laboratory of bio-nanotechnology of Montpellier 1 University, (EA 4203), past head of the Team Biophotonic and Dental Diagnosis, his actual research interest, lies in improving the links between fundamental researches, clinical researches and clinical applications.

Promoting, in clinical practice, the use of high level of magnification, thanks to intraoral cameras combined with photonic signals, he created 2 clinical concepts:

1- the LIFEDT concept which enhanced the use of fluorescent signals in caries diagnosis and treatments

2- the Bioactive Dental Concept[4] which promote the use of ions released biomaterials.

He published more than 80 peer review publications and 2 book chapters.

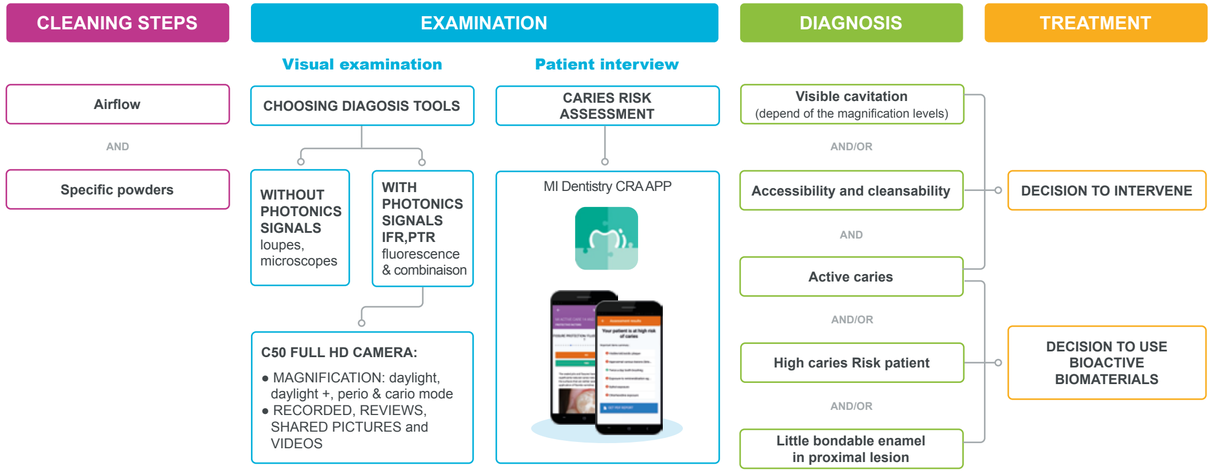
For more details, please links to :
https://www.researchgate.net/profile/Herve_Tassery/

Table of contents

Innovative caries detection workflow

Diagnosis tools can be divided into different groups according to the use of photonic signals, the possibility to record or not pictures or videos. The C50 camera gathers the use of variable magnification, photonic signal and possibility to retrieve pictures and videos.

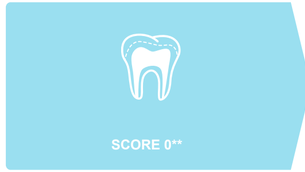
Caries risk assessment is an essential examination step and should be integrated into every protocols. To realized a rational and personalized management of carious disease we recommend to use MI Dentistry CRA application which was made by a group of academics, researchers and general practitioners specialising in MI dentistry. This app. encompasses all the age periods and specific patients like elder people and disabled patients and help to identify caries risk factors and support patient practitioner communication.



Recommended treatment according to caries score

Following the initial development of the International Caries Detection and Assessment System (ICDAS™)[5] in 2004, the International Caries Classification and Management System (ICCMS™)[6] was then developed in 2015, providing both the ability to classify the severity of carries, this time in 4 categories (built on the ICDAS score), but also to personalize patient management by taking « patient risk » into consideration.[7]

In preventive approach*



Overall, the management of proximal and occlusal lesions should be provided under the tenet of a preventive-oriented approach (dietary counselling, oral hygiene motivation). Managing a patient's caries risk/susceptibility will also help support managing specific proximal and occlusal lesions and assist in the prevention of new lesions on other, non-affected surfaces if accessible.

For initial lesions*

For non-cavitated lesions, non-invasive measures (e.g. interdental cleaning, topical fluoride application, sonic tooth brush) could be applied to arrest the lesions. This may be sufficient for lesion arrest in low caries risk/susceptible individuals and for lesions radiographically confined to enamel. In case of complex fissure shape application of Glass Ionomer Cement (press finger technic) after airflow (erythritol or soft Na bicarbonate) cleaning could be recommended.

The decision between sealing and resin infiltration should be guided by individual considerations, including applicability, clinical experience or costs and more by the accessibility of the lesion.

For moderate lesions*

Restorative strategies will often be needed. For restoring lesions, adhesive direct restorations allow minimally invasive, tooth-preserving preparations, are tooth-colored and hence are already the material of choice in many cases.
Use of Ion released biomaterials like HV-Glass Ionomer Cement or mineral enriched composites in case of HCR, active caries and little bondable enamel is highly recommended as rebuilding or dentine substitute materials.

For lesions in high-risk/susceptible individuals and for lesions extending radiographically into dentine, micro-invasive strategies should additionally be considered if using magnification and photonic signal.

For extensive lesions*

In structurally compromised teeth, especially when endodontically treated, indirect cuspal coverage restorations may be indicated. CAO Indirect restorations should recommend as it is much easier to practice.

* ICCMS™ criteria
** ICDAS™ criteria

Non-invasive protocol for initial lesions

This first protocol concerns caries score from SCORE 1 to SCORE 2. The main issue is to don't miss any incipient caries. The C50 camera allows us to ensure a fast and reliable diagnosis regardless the tooth surface involved and regardless of the advanced stage of caries.
It is also essential to take into consideration the patient's profile (caries risk) to take the necessary precautions.

Conventionnal protocol

EXAMINATION

CONVENTIONNAL TOOLS

Caries lesions not always detected.

DIAGNOSIS

INITIAL LESIONS

TREATMENT

MONITORING

5% NaF varnish

1,23% AFP
(2/3 per year)

0,2% NaF mouth rinse
(once per week)

Recommended protocol

EXAMINATION

VISUAL EXAMINATION + PATIENT INTERVIEW

C50 CAMERA

Clear and fast detection of caries in its early stages

CARIES RISK ASSESSMENT

MI Dentistry CRA App

DIAGNOSIS

INITIAL LESIONS	LOW CARIES RISK	HIGH CARIES RISK

TREATMENT

Initial lesions

PROXIMAL	**Common preventive treatment:** • Monitoring, 5% NaF varnish 1,23% AFP, (2/3 per year) 0,2% NaF mouth rinse (once per week) • Or if necessary Silver Diamine Fluoride, Curodont	• Monitoring • Silver diammine fluorid[8,9] • Curodont or Infiltrant resin
OCCLUSAL	• Monitoring • Resin sealant if necessary	**Resin sealants** **The key point is moisture control:** • If yes= resin • If not = Glass Ionomer Cement • If we can put the rubber dam, no need to distinguish HCR from LCR • If you use mineral enriched composite combined it with adhesive system

* Rounded prob

Tips & tricks: For a more accurate diagnose we recommend to clean before examination with airflow + Erythritol or Na bicarbonate powders.

Benefits: treatments adapted the patient caries risk.

NON INVASIVE CLINICAL CASE

Patient: male, 24 years old
Reason for consultation: dental sensitivity

VISUAL EXAMINATION

Magnification tools: C50 camera, Reflect mirror.

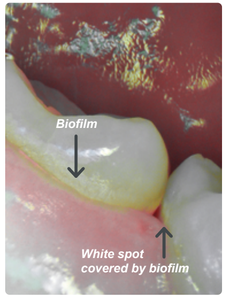


Fig. 1: *Enamel white spot between 36-37*

Daylight mode **Daylight+ mode** **Perio mode**

DIAGNOSIS

Active proximal enamel caries.

Caries score: ICDAS 1 / 2 inital lesions with Low Caries Risk.

Diagnosis positive of an enamel white spot between teeth 36-37 thanks to the combination of daylight, daylight + and Periomode. No cavitation visible despite the huge magnification.

TREATMENT

The recommended treatment is to apply silver diamine fluorid varnish (step 1 and 2) and monitor the lesion for the long term.

Dye plaque, Airflow with erythritol, application of Step 1 and 2 Acqua Silver Diamine Fluoride, application of fluorid varnish.

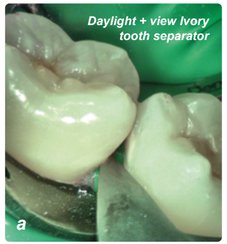


Fig 2 a: *C50 view, Ivory separator*

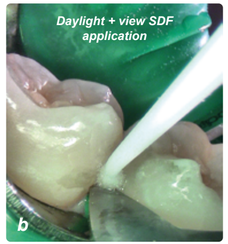


Fig 2 b: *C50 view Silver Diamine Fluoride (SDF) application*

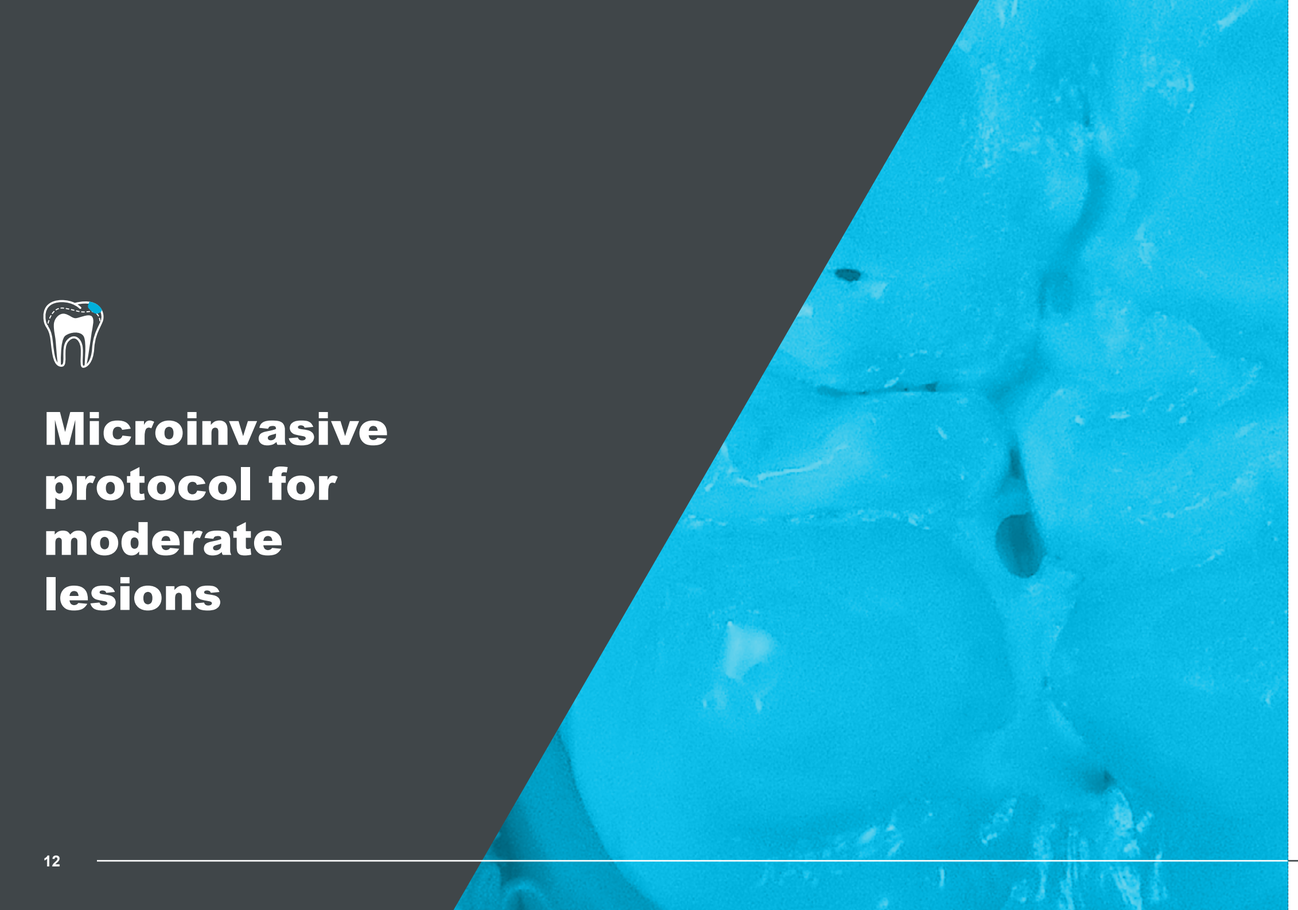
Fig 2 c: *Fluorid varnish*

Daylight mode

Tips & tricks: Used Ivory tooth separator, fluorid varnish after Silver Diamine Fluoride is optional.

Clinical benefits: reversion of the caries process.

Non-invasive protocol for initial lesions



Microinvasive protocol for moderate lesions

Conventionnal protocol

EXAMINATION

CONVENTIONNAL TOOLS

DIAGNOSIS

MODERATE LESION

TREATMENT

MONITORING

5% NaF varnish

1,23% AFP
(2/3 per year)

0,2% NaF mouth rinse
(once per week)

Proximal or occlusal restorations with composite

Recommended protocol

EXAMINATION

VISUAL EXAMINATION + PATIENT INTERVIEW

C50 CAMERA

CARIES RISK ASSESSMENT

MI Dentistry CRA App

DIAGNOSIS

MODERATE LESION | LOW CARIES RISK | HIGH CARIES RISK

TREATMENT

Moderate lesions

PROXIMAL

OCCLUSAL

NON ACTIVE LESION
Slot restoration with:
High Viscosity Glass Ionomer Cement (HVGIC)

ACTIVE LESION
Slot restoration with :
High Viscosity Glass Ionomer Cement (HVGIC)

NON ACTIVE LESION
Composite restoration if needed

ACTIVE LESION
Composite restoration with:
Glass Ionomer Cement (GIC) as dentine substitute

Restoration with:
High Viscosity Glass Ionomer Cement (HVGIC) or
Mineral Enriched (MEC)

Tips & tricks: For a more accurate diagnosis we recommend to clean before examination with airflow + Erythritol or Na bicarbonate powders.

MICROINVASIVE CLINICAL CASE

Patient: Disabled male 22 years old
Reason for consultation: secondary caries on composite restoration, several white spot, high caries risk

VISUAL EXAMINATION

Magnification tools: C50 camera, Zumax OMS3020, Reflect mirror.

Biofilm was revealed thanks to the FLAG concept by the way of fluorescine dye then removed with airflow.
The old restoration was removed with a round shape US insert

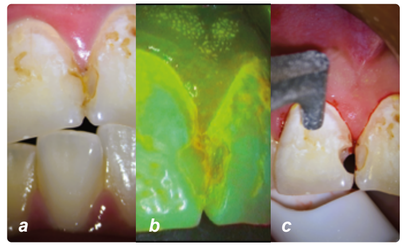


Fig 3 a: *Teeth 11 and 21 initial view*

Fig 3 b: *Flag dye plaque*

Fig 3 c: *Biofilm removing*

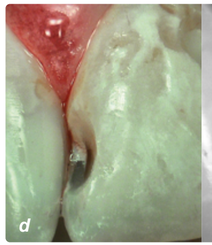


Fig 3 d: *Teeth 11 and 21. C50 view*

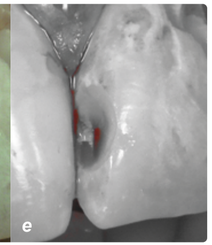


Fig 3 e: *C50 cario mode, red signal active caries*

Daylight+ mode

Cario mode

DIAGNOSIS

Caries score: ICDAS 2, 3 and 5 vestibular and secondary caries with High Carries Risk.

TREATMENT

Airflow with Na bicarbonate, resin inflitrant on enamel surface treatment, Excavus ultra-sonic insert to shape the cavity then composite restoration.

Fig 3 f: *C50 Excavus insert, resin infiltrant treatment*

Fig 3 g, h: *Final Views on teeth 11 and 21*

Daylight mode

Tips & tricks: Used half round US insert to avoid damaging the lateral tooth and protected lateral teeth with teflon, used resin infiltrant to mask all the white enamel shadows.

Clinical benefits: Less invasive treatments.

MIXTE MICROINVASIVE AND INVASIVE CLINICAL CASE

Patient: Male 22 years old
Reason for consultation: occlusal active cavitated caries, suspicious fissures and cavitated lesion on vestibular side

VISUAL EXAMINATION

Magnification tools:
C50 camera, Zumax OMS3020, Reflect mirror.

Caries score:
- ICDAS 3 on occlusal surface
- ICDAS 5 on vestibular surface

DIAGNOSIS

C50 views inform about the occlusal cavitation on distal side and the suspicious fissure in front. Red signals are given by caries debris and deposits due to Maillards reaction.

Occlusal surface

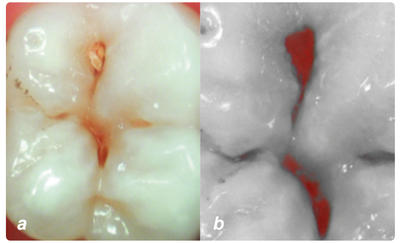


Fig 4 a: *C50 daylight occlusal view*

Fig 4 b: *C50 Cario mode after airflow. Red signal of active caries*

Vestibular surface

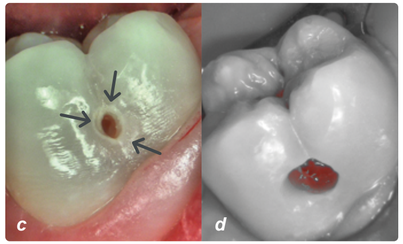


Fig 4 c: *C50 daylight+ vestibular caries. Grey shadow showing the caries extension (arrows).*

Fig 4 d: *C50 in cario mode after opening the vestibular caries showing the red signal of the active caries.*

Daylight+ mode | **Cario mode** | **Daylight+ mode** | **Cario mode**

Microinvasive protocol for moderate lesions

TREATMENT

Occlusal fissure is just cleaned, etched and sealed with combination of adhesive system and composite. Finally, the mesial groove does not show any cavitation.

Occlusal surface

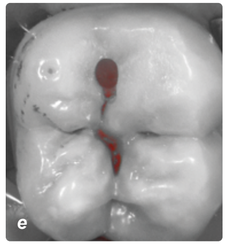


Fig 4 e: *Reduction of the photonic red signal in the occlusal preparation (Leathery dentine).*

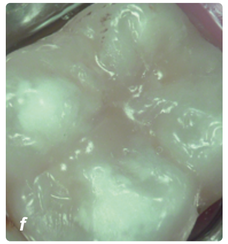


Fig 4 f: *C50 daylight final view.*

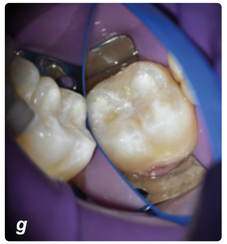


Fig 4 g: *Microscope final view*

Cario mode | **Daylight+ mode** | **Daylight mode**

Tips & tricks: First cleaned then observed with C50 camera.

Clinical benefits: The treatment focuses on non-iatrogenic airflow (no drilling) and sealing. Part of the Occlusal lesion and vestibular one are gently excavated and rebuilt with mineral enriched composite.

SLOT MINIMALLY INVASIVE RESTORATION

Patient: Female, 35 years old
Reason for consultation: Multiple active caries on proximal lesion and suspicious fissures

VISUAL EXAMINATION

Magnification tools: C50 camera, Zumax OMS3020, InfraRed camera, Reflect mirror.

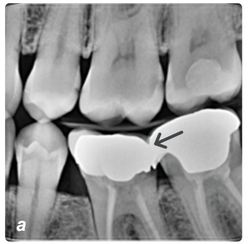


Fig 5 a: *X-ray bite-wing diagnosis of the distal caries on tooth 26 (arrow)*

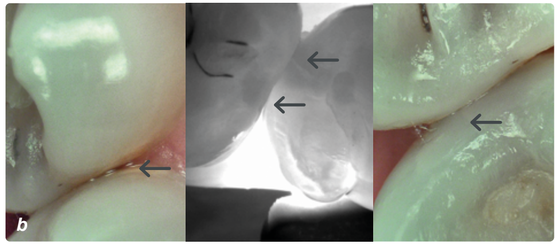


Fig 5 b: *C50 views and InfraRed views (arrows). Localisation of the caries point of entry (palatal or vestibular) and suspicious crack visible*

Daylight+ mode

Daylight+ mode

DIAGNOSIS

Caries score: ICDAS 4 active caries with Low Carries Risk.

TREATMENT

Airflow with Na bicarbonate, slot preparation with Excavus® inserts and rebuilding with Light Curing - Glass Ionomer Cements (LC-GIC).

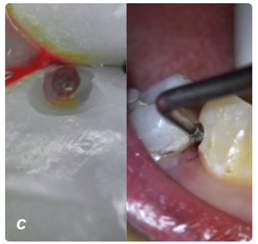


Fig 5 c: *Preparation with Excavus® insert and control with C50 fluorescence view*

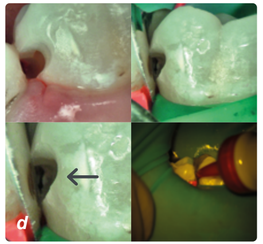


Fig 5 d: *C50 view of the slot cavity. Control of the preparation and Glass Ionomer Cements obturation*

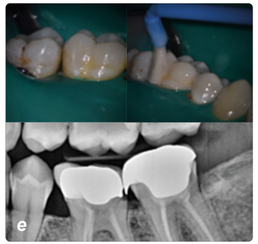


Fig 5 e: *Final microscope view of the distal side, fluorid varnish application, x-ray bite-wing control.*

Perio mode

Daylight mode

Daylight mode

Daylight mode

Tips & tricks: Use the camera to check the infected caries removal, prefered to use Light Curing - Glass Ionomer Cements, covered the lesionn with fluorid varnish.

Clinical benefits: Preservation of the marginal crest.

Invasive protocol for extensive lesions

Conventionnal protocol

EXAMINATION

CONVENTIONNAL TOOLS

DIAGNOSIS

EXTENSIVE LESIONS

TREATMENT

MONITORING

5% NaF varnish

1,23% AFP
(2/3 per year)

0,2% NaF mouth rinse
(once per week)

Composite restorations

Recommended protocol

EXAMINATION

VISUAL EXAMINATION + PATIENT INTERVIEW

C50 CAMERA

CARIES RISK ASSESSMENT

MI Dentistry CRA App

DIAGNOSIS

EXTENSIVE LESIONS | LOW CARIES RISK | HIGH CARIES RISK

TREATMENT

Extensive lesions[10]

PROXIMAL

OCCLUSAL

LOW CARIES RISK	HIGH CARIES RISK
INACTIVE CARIES & bondable enamel All technics **ACTIVE CARIES or little bondable enamel** Glass Ionomer Cement (GIC) as dentine substitute + composite (SDF conditionning optional)	Glass Ionomer Cement (GIC) as bulk material (Silver Diamine Fluoride optional) + New mineral enriched composite
INACTIVE CARIES All technics **ACTIVE CARIES** Glass Ionomer Cement (GIC) as dentine substitute + composite (SDF conditionning optional)	

Tips & tricks: If active caries, control it with C50 red signal, take time to reverse the caries.

INVASIVE CLINICAL CASE

Patient: Male, 25 years old
Reason for consultation: Multiple active caries and dental sensitivity

VISUAL EXAMINATION

Magnification tools: C50 camera, Zumax OMS3020, Reflect mirror.

White opaque zone visualizing the caries point of entry on 24.

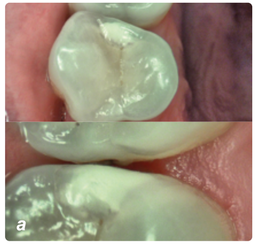


Fig 6 a: *C50 daylight+ mode*

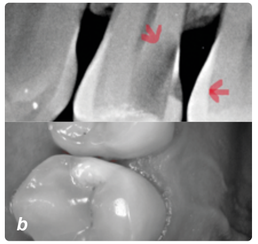


Fig 6 b: *X-ray bitewing and C50 Cario mode*

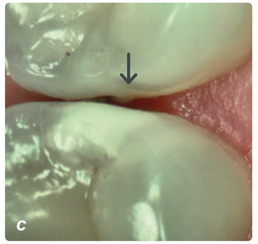


Fig 6 c: *Details of caries point of entry on 24 and new caries on 25 mesial side visible (arrow)*

Daylight+ mode **Cario mode** **Daylight+ mode**

DIAGNOSIS

Caries score: ICDAS 6 with High Caries Risk.

Invasive protocol for extensive lesions

TREATMENT

Treatment Silver Diamine Fluoride (SDF) + HV-Glass Ionomer Cement : Riva LC. Waiting the caries risk rebalancing: MI CRA application to control the caries risk reversion. After the diagnosis step, application of dye plaque (Flag Acteon, EMS, Triplaque GC) to evaluate the biofilm is needed. Use airflow with erythritol, or soft Na bicarbonate to remove the biofilm without injuring the dental tissue then start treating the caries.

The excavation step is a combination of hand instrument (Deppeler) for dentine removing and US insert (Excavus inserts) for shaping the cavity.

Fig 6 c: *Dye plaque application and rinsing step. Cleaning step with airflow is mandatory*

Fig 6 d: *After shaping the caries lesion on 24, confirmation of the caries lesion ICCMS 3 (arrow)*

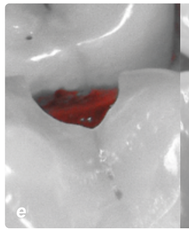


Fig 6 e: *C50 caries mode*

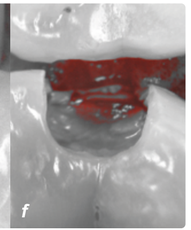


Fig 6 f: *C50 Caries mode view. Active caries looking red inside the cavity.*[11]

Fig 6 g: *C50 daylight mode. Active caries looking dark and yellow orange. Fragile enamel border.*

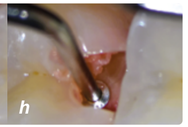


Fig 6 h: *Next steps, after setting the dental dam the ICCMS score 3 is treated with Silver Diammine fluorid (SDF).*

Fig 6 i: *QR code US insert video, microscope view.*

Daylight mode **Cario mode** **Daylight mode**

TREATMENT

These steps using Silver Diamine Fluoride (SDF) are supposed to stop the caries progression of the caries lesion score 3. Next steps will concern the tooth 24 rebuilding: matrix setting, dentine treatment with SDF then injection of the High Viscosity-Resin-Modified Glass-Ionomer Cements Light Curing (HV-RMGIC LC). C50 camera shows the “mummification” step of the dentine following the SDF treatment. (Fig 5)

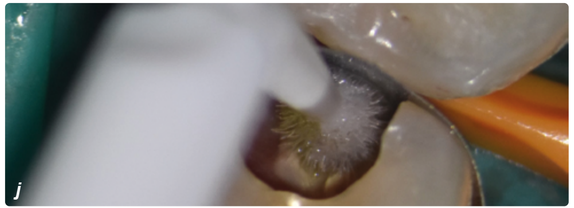


Fig 6 j: *Riva Aqua step 1*

Fig 6 k: *Riva Aqua step 2*

Daylight mode

Daylight mode

The way to treat this clinical case is based on the Bioactive dental Concept (Fig. 6 m). Facing a HCR patient with active caries an little bondable enamel it’s preferable to preserve the peripheral seal zone (12), modify the dentine structure with Silver Diamine Fluoride (SDF) solution, then rebuilt the tooth with an Ions Released Biomaterial high viscosity which will positively modify the affected dentine interface after 3 month.

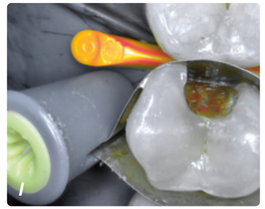


Fig 6 l: *C50 Perio mode view after Silver Diamine Fluoride (SDF) dentine treatment*

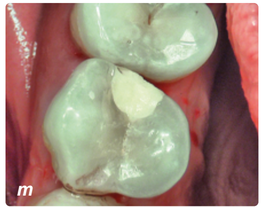


Fig 6 m: *HV- RMGIC C50 daylight + final view*

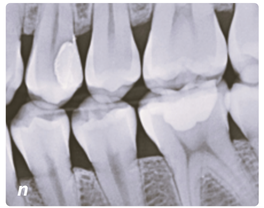


Fig 6 n: *Xray control*

Perio mode

Daylight+ mode

Tips & tricks: Combined Silver Diamine Fluoride (SDF) and High Viscosity Glass Ionomer Cement (HVGIC).

Clinical benefits: Give more time to reverse the caries process.

Conclusion

Understanding the biological concepts related to the device may help the clinician to use the C50 camera device properly but also to recognize the advantages and the limitations of this tool as the results of any imaging technology limited by the practitioner's interpretation.

This new caries detection device give advantage to perform in all, pre-per and post clinical steps, inform on the caries activity and accessibility of the lesion. It can also be beneficial when radiography is not possible (e.g. pregnant, geriatric or non-compliant paediatric patients).

Currently research attention is on computer-assisted image analysis to support dental procedures and future findings may benefit caries detection technologies as well.

Clinicians have to keep in mind that appropriate and thorough training on the use of any detection device is necessary to ensure good data collection and appropriate interpretation. Enjoy your daily practice with this new performing device.

This medical device is class I according to the European regulations. It is CE marked. This medical device for dental care is reserved for health professionals; it is not reimbursed by health care insurance. This device has been developed and manufactured in accordance with the EN ISO 13485 quality control certification system.
Manufacturer: Sopro® ACTEON Group (France)

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