

# DISCLOSING AGENTS IN PERIODONTICS: AN UPDATE

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## ABSTRACT

Dental plaque, colonies of harmful bacteria which form on tooth surfaces and restorations, cannot be flushed away by simply rinsing with water. Active brushing of the teeth is required to remove the plaque which adheres to tooth surfaces. It is a well-accepted fact that dental plaque, when allowed to accumulate on tooth surfaces, can eventually lead to gingivitis, periodontal disease, caries and calculus. Thus, it is apparent that effective removal of deposits of dental plaque is absolutely essential for oral health. Accordingly, proper oral hygiene practices which may be carried out by an individual on his or her own teeth or by a dentist would be facilitated by readily available means of identification and location of plaque deposits in the oral cavity.

**Key words:** Dental plaque; Disclosing agent; F.D. & C.; Plaque Control.

## INTRODUCTION

Dental plaque removal is an important issue in health promotion. Plaque deposition brings about the inflammatory changes on the periodontium that can lead to destruction of tissues and loss of attachment.<sup>1</sup> Since dental plaque is usually transparent and colorless and not easily visible, an individual frequently is not aware of the quantity or the location of dental plaque present in their mouth. Therefore, it is desirable to use plaque-disclosing compositions to identify areas of the mouth where plaque buildup is a problem. The use of disclosing compositions motivates a person in the early removal of dental plaque by showing

the presence and quantity of plaque.<sup>2</sup> Certain agents (dyes) may be used to make the supragingival plaques visible and such agents are called disclosing agents. Staining of bacterial plaque is an aid for patients in developing an efficient system of plaque removal and also in explaining and teaching the significance of plaque in dental disease.<sup>1</sup>

## HISTORY:

In 1914 Skinner<sup>3</sup> used the first disclosing solution i.e iodine to teach home care of the mouth and recommended the use of a disclosing solution to ensure that all "foreign substance" was removed, long before Loe et al. (1965)<sup>4</sup> and Axelsson & Lindhe (1974)<sup>5</sup> confirmed in their studies

that there is a strongly positive correlation between the presence of dental plaque and both caries and gingivitis. In 1920 Berwick introduced a dye that was the combination of brilliant green and crystal violet <sup>6</sup>, followed by Easlick (1935) who used bismark brown <sup>7</sup> and Raybin (1943) <sup>8</sup> used gentian violet and proved the advantages of non iodine dye. Soon after Skinner's iodine was superseded by organic dye solutions because of the objectionable features of iodine solutions.

Amim (1958,63) <sup>9,10</sup> had been most instrumental in popularising the use of disclosing agents and introduced the use of F. D. & C Red #3 (Erythrosin) dye and like Raybin (1945) <sup>11</sup> maintained that disclosing agents were bound to revolutionise the home care regimen. In 1971 Heffemen and his colleagues <sup>12</sup> noted that plaque, calculus and stains were more apparent under ultra-violet illumination, and the following year, Lang et al. (1972) <sup>13</sup> examined the applicability of a fluorescent disclosing agent used with the Plaklite®. In the same year Block et al <sup>14</sup> developed a twotone dye test which stained more mature plaque blue (F. D. & C. Green #3 and newly formed plaque red (F. D. & C. Red #3) thus providing a "colour guide' as to the age of the plaque.

#### **DEFINITION:**

A disclosing agent is a selective dye in solution, tablet, or lozenge form used to visualize and identify dental biofilm on the surfaces of the teeth.<sup>15</sup>

Raybin defined disclosing agent as a solution which when applied on the tooth, makes visible by staining roughness and foreign matter on the tooth. (Foreign

matter is meant to include mucinous plaque, calculus and material surfaces).<sup>8</sup>

Disclosing agents are solutions or wafers capable of staining bacterial deposits on the surfaces of teeth, tongue, and gingiva.<sup>16</sup>

A disclosing agent is a material, usually some form of dye in liquid or tablet form that is applied to teeth to stain plaque on the surfaces of teeth.<sup>17</sup>

#### **TYPES:**

- Disclosing Solutions
- Disclosing Tablets
- Disclosing Wafers
- Disclosing Lozenges
- Disclosing Mouth-rinses

#### **USE:** Fig 1

A disclosing agent is used for the identification of bacterial plaque, which might otherwise be invisible to the naked eye, for instruction, evaluation, and research.<sup>15</sup>

#### **PURPOSE:** <sup>1</sup>

- A. Personalized patient instruction and motivation.
- B. Self – evaluation by the patient.
- C. To evaluate the effectiveness of oral hygiene maintenance.
- D. Conducting research studies to gain new information about the incidence and formation of deposits on the teeth, the effectiveness of specific devices for dental biofilm control, and anti-

biofilm agents and to evaluate clinical and instructional group health programs.<sup>15</sup>

## **PROPERTIES: <sup>2</sup>**

### **A. Taste:**

Taste should be comfortable to the patient. Agent should be flavoured so that it encourages the patient co-operation.

### **B. Intensity of colour:**

A contrast colour should be evident. It should be differentiated from the surrounding environment.

### **C. Duration of intensity:**

Stains should not get washed off immediately. It should stay in oral environment.

### **D. Irritation to oral mucosa membrane:**

Solution should not cause irritation to oral mucosa and also it should not cause any allergy to oral mucosa.

### **E. Antiseptic properties:**

Application of an antiseptic before scaling is frequently advised and if an antiseptic disclosing agent is used, one solution serves dual purpose.

### **F. Diffusibility:**

The solution should be thin enough so that it can be readily applied to the exposed surfaces of the teeth, yet thick enough to impart an intense colour to the dental biofilm.

## **AGENTS USED FOR DISCLOSING PLAQUE:**

1. Iodine preparations
2. Mercurochrome preparations
3. Bismark brown
4. Merbromin
5. Erythrosine
6. Fast green
7. Fluoroscein
8. Two tone solution ( stains older plaque blue and newer red)
9. Basic fuchsin.
10. Buckley's solution
11. Berwick's solution
12. Talbot's solution
13. Iodo-glycerol solution
14. Metaphen solution
15. Allura red

## **FORMULAE: <sup>15</sup>**

A wide variety of disclosing agents has been used. Skinner's iodine solution was formerly the most widely used. Aniline dye has been shown to have carcinogenic potential. Therefore the use of basic fuchsin and beta rose has been discouraged.<sup>1</sup> The formulae of few of the disclosing agents are:

### **A. Iodine preparations**

1. Skinner's Iodine solution:

Iodine crystals - 3.3 g

Potassium iodide – 1.0 g

Zinc iodine – 1.0 g

Water (distilled) – 16.0 ml

Glycerin - 16.0 ml

2. Diluted Tincture of Iodine

Tincture of iodine – 21.0 ml

Water (distilled) – 15 ml

**B. Mercurochrome preparations**

1. Mercurochrome solution (5%)

Mercurochrome – 1.5 g

Water (distilled) to make – 30.0 ml

2. Flavoured Mercurochrome  
Disclosing solution

Mercurochrome - 13.5 gm

Water (distilled) - 3.0 l

Oil of peppermint - 3 drops

Artificial noncariogenic sweetener

**C. Bismark Brown (Easlick's  
Disclosing solution)**

Bismark Brown - 3.0 g

Ethyl alcohol - 10.0 ml

Glycerin - 120.0 ml

Anise (flavoring) - 1 drop

**D. Merbromin**

Merbromin, N.F. – 450.0 mg

Oil of peppermint - 1 drop

Water (distilled) to make - 100 ml

**E. Erythrosin**

1. Concentrate for application by Rinsing

F.D. & C Red No. 3 or No. 28 - 6.0 g

Water (distilled) to make – 100.0 ml

2. For direct Topical application

Erythrosin - 0.8g

Water (distilled) - 100.0 ml

Alcohol (95%) - 10.0 ml

Oil of peppermint - 2 drops

3. Tablet or wafers

F.D. & C Red No 3 - 15.0 mg

Sodium chloride - 0.747%

Sodium sucaryl - 0.747%

Calcium stearate - 0.995%

Soluble saccharin – 0.186%

White oil - 0.124%

Flavoring – 2.239%

Sorbitol to make 7-grain tablet

**F. Fast green:**

F.D. & C Green No. 3 - 5% or 2.5%

**G. Fluorosein:**

F.D. & C Yellow No.8 (used with special ultraviolet light source to make agents visible).

**H. Two tone**

F.D. & C Green No. 3

F.D. & C Red No. 3

Thicker (older) plaque stains blue thinner (newer) plaque stains red.

**I. Basic Fuchsin<sup>1</sup>**

Basic Fuchsin - 6 gm

Ethyl Alcohol (95%) - 100 ml

Add two drops of solution to H<sub>2</sub>O in a dappen dish.

### **MECHANISM OF TWO-TONE DISCLOSING AGENT:**

Gallagher et al carried out in-vivo and in-vitro tests to estimate the mechanism of the differential staining phenomenon of the Two-tone disclosing agent (Dis-plaque). The results demonstrated that the differential staining was thickness-dependent and not associated with bacterial or biochemical factors. Thus, it was concluded that the metachromasia of dental plaque stained with Two-tone disclosing agent (Dis-Plaque) was a result of a diffusion phenomenon in which one component diffuses more readily than another from plaque, rather than from any chemical changes that might occur in vivo.<sup>18</sup>

### **METHODS OF APPLICATION-<sup>15</sup>**

Gingival tissue evaluation should be done before application because disclosing agent will mask tissue colors.

#### **I. Solution for direct application (painting):**

- a. Ask the patient to rinse to remove food particles and heavy saliva.
- b. Apply water based lubricant generously to prevent staining of the lips.
- c. Dry the teeth with compressed air, retracting cheek and tongue.

- d. Use swab or small cotton pellet with cotton pliers to carry the solution to the teeth.
- e. Apply solutions to the crowns of the teeth only.
- f. Direct the patient to spread the agent over all surfaces of teeth with the tongue.
- g. Examine the distribution of the agent and request the patient to rinse if indicated.

#### **II. Rinsing**

A few drops of concentrated preparation is placed in a paper cup and water is added for the appropriate dilution. Instruct the patient to swish and rinse with the solution so that it is applied on all tooth surfaces.

#### **III. Tablets or wafer:**

Patient should chew the wafer or tablet. Swish it around for 30 to 60 seconds and rinses.

### **INTERPRETATION OF FINDINGS:<sup>15</sup>**

- a. Clean tooth surface do not absorb the coloring agent. When pellicle and bacterial plaque are present, they absorb the agent and are disclosed.
- b. Pellicle stains as a thin relatively clear covering, whereas bacterial plaque appears darker, thicker and more opaque.
- c. Two-tone Fig 2
  1. Red Biofilm: Newly formed, thin, usually supragingival.

2. Blue Biofilm: Thicker, older, more tenacious; usually it is seen at and just below gingival margin, especially on proximal surfaces and where brush or floss is not easily applied; may be associated with calculus deposits.

#### **PATIENT INSTRUCTION:** <sup>15</sup>

Because biofilm and pellicle are frequently invisible to a patient, a disclosing agent can provide a visual method for patient instruction.

##### **a. Explain dental biofilm:**

The patient needs to be informed about the composition and effect of biofilm in the production of gingival and periodontal infections, with particular reference to the individual mouth.

##### **b. Show location and distribution of biofilm:**

With a mirror, the patient can observe the teeth and the disclosed dental biofilm. A small mouth mirror is needed to show the lingual surfaces and posterior facial areas.

##### **c. Demonstrate methods for daily biofilm removal**

#### **TECHNICAL HINTS FOR DISCLOSING AGENTS:** <sup>15</sup>

- 1) Avoid using disclosing or antiseptic solutions on teeth that have tooth-color restorations because these materials may be stained by coloring agents.
- 2) Do not apply a disclosing agent before a sealant is to be placed.

- 3) Purchase solutions in small quantities. Do not keep solutions containing alcohol longer than 2 or 3 months because the alcohol will evaporate and render the solution too highly concentrated.
- 4) Use small bottles with dropper caps for solutions. Transfer solution to a dappen dish for use. Do not contaminate the solution by dipping cotton pliers with pellet directly into the container bottle.
- 5) Request local druggist to stock disclosing tablets for patients to purchase. Advise patients of the stores where the agents may be purchased.

#### **RECENT ADVANCES:** <sup>19</sup>

- Plaque Disclosing agents used in Photodynamic (PDT)

The PDT consist of mainly three components. These are light, oxygen, and a photosensitizer. Once the photosensitizer is irradiated with light of a specific wavelength, it absorbs photons of the wavelength and transfers the excitation energy to molecular oxygen which is in turn metamorphosed to its diamagnetic form, singlet oxygen with other reactive oxygen species (ROS) formed downstream such as superoxide anion, hydroxyl radicals, and hydrogen peroxide. Of the ROS, singlet oxygen plays a central role for cytotoxicity in PDT, indicating that the larger amount of singlet oxygen the target is exposed to, the more effectively undesired cells such as cancer cells and bacteria are killed.

Plaque disclosing agents, which are used to detect plaques on the tooth surface,

usually contain photosensitizers such as rose bengal, erythrosine, and phloxine, all of which are also used for food coloring. Thus, if these plaque disclosing agents are irradiated with light of a suitable wavelength for the photosensitizers, singlet oxygen is validly and locally generated around the plaques disclosed by the agents.

## CONCLUSION:

It is very rare to find any patient without even mild plaque present in his oral cavity, yet since long disclosing agent have proved to be a good adjunct for the patients' maintenance care. There is no conclusive evidence that disclosing of plaque in dental office aids patient motivation by improving subsequent plaque control, nor there is evidence that home use of a disclosing agent improves the standard of plaque control.

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## FIGURES



**Fig 1:** Use of Disclosing Agent (A) Appearance of the teeth before application of a disclosing agent. Dental biofilm and pellicle are usually invisible. (B) After use of a disclosing agent on the same teeth as those in A. Dental biofilm and pellicle takes on the colour of the dye used in the disclosing agent. As noted, soft deposits are extensive, and are especially thick on the proximal surface.



**Fig 2:** Plaque disclosed after application of Two-tone disclosing agent