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DISCLOSING SOLUTIONS USED IN DENTISTRY

[1]*Dr. Dipayan Datta, [2]Dr. S. G. Ramesh Kumar, [3]Dr. M. B. Aswath Narayanan, [4]Dr. A. Leena Selvamary and [5]Dr. A. Sujatha

[1]Postgraduate, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai- 600 003.

[2,4,5]Assistant Professor, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai- 600 003.

[3]Professor and Head, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai- 600 003.

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***Corresponding Author**
Dr. Dipayan Datta
Postgraduate, Department of Public Health Dentistry, Tamil Nadu Government Dental College and Hospital, Chennai- 600 003.

ABSTRACT

Dental caries and periodontal diseases are plaque mediated diseases. Poor oral hygiene and inappropriate dietary behaviour can lead to increased plaque accumulation. Dental plaque is a biofilm that is formed over the teeth and prosthetic appliances placed in the oral cavity. As dental plaque is not easily visible to the naked eye, its removal is difficult and complex. In order to remove dental plaque and improve the oral hygiene, the use of disclosing agents has been recommended. Disclosing agents are preparations containing dye or other colouring agents which is used for the identification of bacterial plaque that can be distinctly seen providing a valuable visual aid and help in the maintenance of good oral health.

KEYWORDS: Plaque, Periodontal diseases, Disclosing solutions, Oral health.

INTRODUCTION

Dental plaque is a structured, resilient yellow-grayish substance that adheres tenaciously to the tooth surfaces, restorations and different removable and fixed prosthetic appliances. Deposition of plaque causes inflammatory changes on the periodontium which can lead to destruction of tissues and loss of attachment. Usually, dental plaque is transparent, colourless

and not easily visible. Hence, an individual is not generally aware of the amount or the location of dental plaque in his oral cavity. Therefore, it is necessary to detect the plaque containing areas of oral cavity using disclosing solutions. A disclosing agent causes staining of bacterial plaque that can be an aid for patients to develop an efficient system of plaque removal.[1]

HISTORICAL TIMELINE

Table 1: Historical milestones of disclosing solutions.

Scientists	Year	Solution used
1. Skinner[2]	1914	Pioneer in using disclosing agent (used Iodine)
2. Berwick[3]	1920	Combination of Brilliant green and Crystal violet
3. Easlick[4]	1935	Bismark brown
4. Raybin[5]	1943	Gentian violet
5. Amim[6]	1963	F. D. & C. Red #3 (Erythrosin) dye
6. Lang[7]	1972	Plaklite® (fluorescent disclosing agent)
7. Block[8]	1972	Two tone dye (F. D. & C. Green #3 and F. D. & C. Red #3)

DEFINITION

Different authors have given the definition of disclosing agents in different ways.

1. According to Wilkins (1959), 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.[9]
2. According to Raybin (1943), disclosing agent is 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).[5]

MECHANISM OF ACTION

Disclosing solutions work by changing the colour of dental plaque so that it contrasts with the white tooth surface. Dental plaque has the ability to retain a large number of dye substances which can be used for disclosing purposes. This property is related to interaction, because of the polarity difference between the components of the plaque and the dyes. The particles are bound to the surface by electrostatic interaction (proteins) and hydrogen bonds (polysaccharides).[1]

Gallagher et al (1977) carried out in-vivo and in vitro tests to estimate the mechanism of the differential staining phenomenon of the Two-tone disclosing agent. It was noted that the differential staining was dependent upon the thickness of the plaque and not associated with the type of bacterial flora or other biochemical factors. Thus, it was concluded that the

metachromasia of dental plaque stained with Two-tone disclosing agent 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.[10, 11]

TYPES OF DISCLOSING AGENTS

Over the time, a variety of dyes have been used which are classified as follows.

A. Iodine Preparations.

1. Skinner's iodine solution

2. Diluted tincture of iodine

B. Mercurochrome Preparations:

1. Mercurochrome solution 50%

2. Flavoured mercurochrome disclosing solution

C. Bismark Brown

D. Merbromin

E. Erythrosine (FD & C Red No. 3/ No. 28)

F. Fast Green (FD & C Green No. 3)

G. Fluorescein (used with ultraviolet light source to make the agent visible)

H. Two Tone Solutions (FD & C Blue No. 1, FD & C Red No. 3)

I. Basic Fuchsin

J. Crystal Violet

PROPERTIES

Table 2: Desired properties of an acceptable disclosing agent[12]

1. Colour intensity	A distinct staining of deposits should be evident. The colour should contrast with normal colours of the oral cavity.
2. Duration	The colour should not rinsed off with ordinary rinsing methods or be removable by the saliva for the period of time required to complete the examination and instruction procedures.
3. Taste	The patient should not be made uncomfortable by an unpleasant or highly flavoured substance. The solution should be tasteless or pleasant enough to encourage patient cooperation.
4. Mucosal irritation	The agent should not irritate the oral mucosa
5. Diffusibility	The solution should be thin enough so that it can be applied readily to the exposed surfaces of the teeth yet thick enough to impart an intensive colour to the plaque.
6. Antiseptic action	It has been proposed that if a disclosing solution can have antiseptic property, then it can be able to protect an open wound in the oral mucosa from unnecessary contamination during the procedure

APPLICATION PROCEDURES

Disclosing solutions can be applied by the following methods:

1. Solutions for direct application: At first, the patient is asked to rinse his mouth well to remove all the food substances and heavy saliva. Then the water based lubricant is applied cautiously so that the lips don't get stained. After that, the teeth are made air dried. Now, the solution is carried to the teeth with the help of swab or small cotton pellet. The solution is applied to all the crowns of the teeth. Then the patient is instructed to spread the agent over all the surfaces of his teeth with his tongue. Finally, the distribution of the agent over the tooth surfaces is examined and the patient is advised to rinse his mouth.[10]

2. Rinsing agents: A few drops of concentrated preparation are 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.[10]

3. Tablets or wafer: Patient should chew the wafer or tablet. Swish it around for 30 to 60 seconds and rinses.[10]

4. Dentifrices: Plaque disclosing agents can be incorporated in dentifrices and thus they can help in dental plaque observation.[13]

TECHNICAL CONSIDERATIONS

Following things should be kept in mind during the application of a disclosing agent.

1. Disclosing or antiseptic solutions should not be used on teeth that have tooth-colour restorations because these materials may be stained by colouring agents.

2. Disclosing agent should not be applied before a sealant is to be placed.

3. Solutions containing alcohol should not be kept longer than 2 or 3 months as the alcohol will evaporate which will make the solution too highly concentrated.

4. The solution should not be contaminated by dipping cotton pliers with pellet directly into the container bottle. It is better to transfer the required amount solution to a dappen dish during application.[10]

INTERPRETATION OF FINDINGS

1. Clean tooth surfaces do not absorb the colouring agent. When pellicle and bacterial plaque are present, they absorb the agent and are disclosed.

2. Pellicle stains as a thin relatively clear covering, whereas bacterial plaque appears darker, thicker and more opaque.

3. For two-tone dye: a. Red biofilm indicates a newly formed, thin plaque which is usually supragingival. b. Blue biofilm indicates thicker, older, more tenacious plaque which is usually 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.[14]

USES

Disclosing agents are used in various aspects

1. To evaluate the effectiveness of oral hygiene maintenance[15]
2. For the preparation of plaque indices[16]
2. To personalise the patient instruction and motivation
3. For self-evaluation by the patient
4. For plaque control in special children[17]
5. In research studies with regard to the effectiveness of plaque control devices like toothbrushes, dentifrices etc.[18]
6. To evaluate the amount of removal of biofilm during and after respective periodontal surgeries[19]

ADVERSE REACTION

Plaque disclosing tablet containing PLAKSEE-MD (10mg Aryabhishek and Propyl paraben) has been reported to cause allergic reaction in individual suffering from eczema.[20]

RECENT ADVANCEMENTS

1. Caries risk assessment- Three‑tone plaque disclosing agent has been recently found to be effective in identifying pathological plaque. Thus it can be used in identifying cariogenic micro-organisms in caries risk assessment. It is based upon the principle of the pH selective response of 3 different dyes i.e. Rose Bengal, brilliant blue and FCF. These are incorporated in a glucose containing disclosing liquid and used to detect the age of the plaque and its acid production. As the plaque biofilm is sparse in the new plaque, the blue pigment is easily washed off and this gives the new plaque a pink/red color. But in case of the old plaque (>48 h plaque), the biofilm is matured and dense, so both the blue and red pigments are trapped and it gives it a blue/purple color. For extra high risk plaque, the sucrose in three tone plaque disclosing gel (GC Tri Plaque ID Gel™) is metabolized by within the plaque biofilm. Finally, the acid produced by those acidogenic bacteria lowers the plaque pH (<pH 4.5) and this helps the red pigment to disappear and gives it a light blue colour.[21]

2. Photodynamic Therapy- Photodynamic therapy (PDT) is an established treatment for localized tumours, involving the application and retention of an applied photosensitizing agent in malignant tissues. Upon irradiation with light of an appropriate wavelength the photosensitizer undergoes a transition from a low-energy 'ground-state' to a high energy 'triplet state'. This triplet-state photosensitizer can react with biomolecules to produce free radicals and radical ions, or with molecular oxygen to produce singlet oxygen. These cytotoxic species can cause oxidation of cellular constituents such as plasma membranes and DNA, resulting in cell death.[22]

A substantial body of work has shown that this photodynamic approach can also be used to kill bacteria. PDT treatment of the ubiquitous species Staphylococcus aureus has been studied using photosensitizers such as haematoporphyrin, phthalocyanine, 5-aminolaevulinic acid and photofrin.[23]

Bacteria that grow in biofilms, implicated in diseases such as cystic fibrosis (Pseudomonas aeruginosa) and periodontitis (Porphyromonas gingivalis), have been shown to be susceptible to PDT with photosensitizers such as methylene blue (MB), toluidine blue O and phthalocyanine.[24]

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 colouring. 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.[25, 26]

CONCLUSION

Dental plaque identification with the help of disclosing agents is one of the easiest and fastest ways to diagnose dental plaque. It favours the subsequent removal of the plaque. There is no conclusive evidence that disclosure 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.[10] Although, the motivation generated by the quality of professional supervision of oral hygiene may play a more relevant role in the efficacy of dental plaque removal than the use of a disclosing factor. Daly et al. (1996) in an analysis of the results obtained in a survey, reported that improvements in plaque scores may

be related to motivational effects resulting from study participation and anticipation of oral examinations.[27, 28]

REFERENCES

1. Viorica Chetruş, I.R. Ion, Dental Plaque – Classification, Formation, and Identification, International Journal of Medical Dentistry, April / June 2013; 3(2): 139-143.
2. Skinner, F. H. The prevention of pyorrhoea and dental caries by prophylaxis. Dental Cosmos, 1914; 56: 229-309.
3. Berwick, C. C. The disinfection of the oral mucosa with crystal violet and brilliant green. Journal of Dental Research, 1920; 2: 21-42.
4. Easlick, K. A. The dentist's management of young children, American Journai of Orthodontics, 1935; 21: 78-88. 8.
5. Raybin, M. Disclosing agents: their importance and uses. The Dental Outlook, 1943; 4: 159-162.
6. Amim, S, S. The use of disclosing agents for measuring tooth cleanliness. Journal of Periodontology, 1963; 34: 227-245.
7. Lang, N. P., Ostergaard, E. & Loe, H. A fluorescent plaque disclosing agent. Journal of Periodontal Research, 1972; 7: 59-67.
8. Block, P, L, Lobene, R. R, & Derdivanis, J, P. A two-tone dye test for dental plaque. Journal of Periodontology, 1972; 43: 423-426.
9. Esther. M. Wilkins, Clinical practice of the dental hygienist. 12th ed., Lippincott Williams and Wilkins, 2016.
10. Zoya Chowdhary, Ranjana Mohan, Vandana Sharma, Rohit Rai, Aruna Das, Disclosing Agents In Periodontics: An Update, Journal Of Dental College Azamgarh, 2015; 1(1): 103-110.
11. Gallagher IH, Fussell SJ, Cutress TW. Mechanism of action of a two‐tone plaque disclosing agent. J Peri‐ odontol, 1977; 48: 395‐396.
12. J. Micheal Skaggs, Robert E. Dckson, James H. Bowers & Edward A. Tavss. Plaque disclosing composition, 4992256, Feb 12, 1991.
13. Débora Dias da Silva, Camila da Silva Gonçalo, Maria da Luz Rosário de Sousa, Ronaldo Seichi Wada, Aggregation Of Plaque Disclosing Agent In A Dentifrice, J Appl Oral Sci, 2004; 12(2): 154-8.
14. Newman. Takei. Klokkevold. Carranza; Carranza's Clinical Periodontology; 9th edition; Elsevier, 2006.

15. Roxana Romaniţa Ilici, Christina Mihai, Lelia Mihai, Ruxandra Sfeatcu, Oral hygiene improvement by disclosing agents, Medical Connections, June 2014; 2(34).
16. Mayuri Bhikaji Nepale, Siddhartha Varma, Girish Suragimath, Keshava Abbayya, Sameer Zope, Vishwajeet Kale, A prospective case-control study to assess and compare the role of disclosing agent in improving the patient compliance in plaque control, Journal of Oral Research and Review, July-December 2014; 6(2).
17. Ana Paula Teitelbaum and Gislaine Denise Czlusniak, Control of Dental Biofilm and Oral Health Maintenance in Patients with Down Syndrome, Intech-open science, open minds, 2013, http://dx.doi.org/10.5772/53348
18. Napa Chounchaisithi, Busayarat Santiwong, Pornpun Asvanit, Use of a Disclosed Plaque Visualization Technique Improved the Self-Performed, Tooth Brushing Ability of Primary School children, J Med Assoc Thai, 2014; 97(2): S88-S95.
19. Marco Montevecchi, Vittorio Checchi, Maria Rosaria Gatto, Sascha Klein and Luigi Checchi, The Use of a Disclosing Agent During Resective Periodontal Surgery for Improved Removal of Biofilm, The Open Dentistry Journal, 2012; 6.
20. Sania, Mohanty S, Aggarwal MC, Chaubey KK. An Overaction to Plaque disclosing agent: An Unsual case, J Periodontal Med Clin Pract, 2016; 03: 51-55.
21. Mungara Jayanthi, Mangalampally Shilpapriya, Venumbaka Nilaya Reddy, Arun Elangovan, Rajendran Sakthivel, Poornima Vijayakumar, Efficacy of three‑tone disclosing agent as an adjunct in caries risk assessment, Contemporary Clinical Dentistry, Jul-Sep 2015; 6(3).
22. Dougherty TJ, Gomer CJ, Henderson BW et al. Photodynamic therapy. J Natl Cancer Inst, 1998; 90: 889–905.
23. Griffiths MA, Wren BW, Wilson M. Killing of methicillin-resistant Staphylococcus aureus in vitro using aluminium disulphonated phthalocyanine, a light-activated antimicrobial agent. J Antimicrob Chemother, 1997; 40: 873–6.
24. WoodSR, NattressB,KirkhamJetal. Aninvitrostudyoftheuseof photodynamic therapy for the treatment of natural oral plaque biofilms formed in vivo. J Photochem Photobiol B, 1999; 50: 1–7.
25. Kirika Ishiyama, Keisuke Nakamura, Hiroyo Ikai, Taro Kanno, Masahiro Kohno, Keiichi Sasaki, Yoshimi Niwano, Bactericiddal action of Photogenerated Singlet Oxygen from Photosensitizers used in plaque disclosing agents, PLoS ONE, May, 2012; 7(5).

26. Kirika Ishiyama, Keisuke Nakamura, Taro Kanno, Yoshimi Niwano, Bactericidal Action of Photodynamic Antimicrobial Chemotherapy （PACT） with Photosensitizers Used as Plaque-Disclosing Agents against Experimental Biofilm, Biocontrol Science, 2016; 21(3): 187－191.
27. Daly CG, Chapple CC, Cameron AC, Effect of toothbrush wear on plaque control, J Clin Periodontol, 1996; 23(1): 45-9.
28. Paulo Frazão, Mirella Sammarone, Silvia Halk Villa, Effect of Disclosing Agents in Oral Hygiene, Ciencia Odontológica Vol. 1, Nº 1, Enero-Junio, 2004; 52-59.