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Comparative Evaluation of Fluorescence-Based Plaque Detection and Traditional Disclosing Agents: A Clinical Study

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Abstract

The study was aimed to evaluate the efficacy of a fluorescence-based plaque detection device compared to traditional disclosing agents. A total of 100 participants underwent plaque assessment on the facial surfaces of anterior teeth using aforementioned methods. Plaque levels were scored using the Turesky modification of the Quigley–Hein Plaque Index. White-light images from the fluorescence device correlated well with clinical evaluations, whereas red auto-fluorescence showed a moderate correlation with disclosed plaque. Participants reported higher satisfaction with the fluorescence method due to its ease of use, absence of residual staining, rapid results, and improved comfort. Fluorescence-based plaque detection demonstrates promising potential as a patient-friendly, efficient, and accurate tool for clinical use and oral hygiene education. Although limitations exist in terms of auto-fluorescence correlation, the overall benefits support broader application. Further studies with diverse populations are recommended to confirm and expand these findings.

Keywords: Dental Plaque, Gingivitis, Periodontitis

Introduction

Dental plaque is a yellow-grayish, structured, and resilient biofilm that adheres firmly to tooth surfaces, restorations, and dental prostheses. It is composed primarily of bacteria, food remnants, and bacterial by-products**,** organized within an extracellular matrix. The biofilm develops continuously on intraoral surfaces**,** beginning shortly after tooth cleaning, and rapidly matures if undisturbed. When not effectively removed through proper oral hygiene, plaque accumulation acts as the primary etiological factor in the initiation and progression of oral diseases such as gingivitis, periodontitis, and dental caries.[1]

Plaque formation begins with bacterial colonization of tooth surfaces, forming a complex microbial biofilm. As the biofilm matures, both the quantity and pathogenicity

of the plaque increase. Routine mechanical disruption via brushing and flossing is essential for maintaining oral health. Early detection and management of plaque are critical to preventing the shift from reversible gingival inflammation to irreversible periodontal damage.[1]

Traditional clinical plaque assessment is typically conducted via visual inspection, often aided by disclosing agents—available as gels, tablets, or rinses—to enhance visibility. Several indices, including the University of Mississippi Oral Hygiene Index (UM-OHI), the Turesky modification of the Quigley–Hein Plaque Index (TM-QHPI), and the Silness and Loe Plaque Index (SLI), are commonly employed for clinical scoring.[2,3]

However, these traditional methods have limitations such as subjective interpretation, binary scoring systems, and inter-examiner variability. In addition, they lack the capability for image-based documentation, which restricts objective longitudinal comparisons.[4]

To address these challenges, image-based techniques have emerged to provide more reproducible, quantitative assessments. These methods allow for precise spatial mapping of plaque distribution and are sensitive to subtle hygiene-related changes.[5]

Plaque detection modalities include:

- Visual inspection
- Disclosing agents
- Ultraviolet (UV) fluorescence-based techniques

Fluorescence-based plaque detection systems offer enhanced diagnostic accuracy by visualizing bacterial metabolic products in real-time. These systems also provide immediate visual feedback to patients, potentially improving compliance and oral hygiene outcomes.[6,7]

The present study aims to evaluate the efficacy of a novel fluorescence-based plaque detection device compared to traditional disclosing agents, focusing on diagnostic accuracy, user experience, and potential application in clinical practice.

Materials and Method

After obtaining approval from the Ethical Committee, Guru Nanak Dev Dental College and Research Institute, Sunam, a total of 100 participants were selected from the Out-Patient Department of Department of Periodontics, GNDDC, Sunam. Plaque detection was carried out on the facial surfaces of the anterior teeth using two techniques, firstly with: (1) Fluorescence-Based Detection Device and then with (2) Disclosing Agent on the same patient.

For the Fluorescence-Based Method, standardized images of the vestibular surfaces of the maxillary and mandibular anterior teeth were captured using a fluorescence-enabled plaque detection device.

For the Disclosing Method, a cotton swab fully saturated with the dye solution was applied gently to the tooth surfaces. Participants then rinsed with tap water to remove excess stain.

Plaque levels were scored using the Turesky modification of the Quigley–Hein Plaque Index (TM-QHPI). An independent t-test was used to determine statistical significance between the two methods.

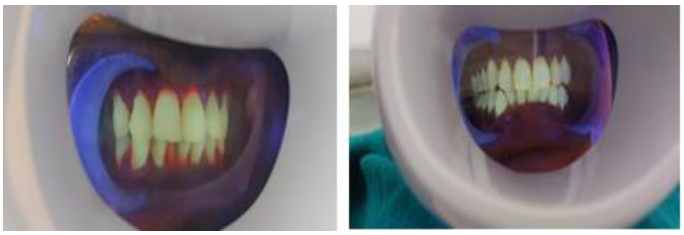

Figure 1: Fluorescent Indicator

Figure 2: Disclosing Agent

Table 1: Inter Group Comparison of plaque scores in Fluorescence Indicator and Disclosing Agent groups Independent t – test, statistical significance set as p<0.05*

Group	N	Mean	Std Error Mean	95% Confidence Interval Lower	Upper	P Value
Fluorescence Indicator	100	1.52±0.39	0.05	1.422	1.618	p<0.281
Disclosing Agent	100	1.59±0.24	0.03	1.531	1.649	

From the table, it is observed that the plaque scores are slightly lower in the Fluorescence Indicator group than the Disclosing Agent group. The confidence levels indicate that the difference between two groups may not be statistically significant.

Graph 1:

Results and Discussion

This study investigated whether Fluorescence-based plaque detection offers a viable alternative to conventional Disclosing agents. Overnight plaque on anterior teeth was evaluated using both white-light and red auto-fluorescence images captured by the plaque detection device. Scoring was conducted using the modified Quigley & Hein (mQH) index. Plaque scores obtained from white-light images correlated well with clinical evaluations. However, the correlation between red auto fluorescent plaque and disclosed plaque was weak to moderate. These results are consistent with prior studies.[8,9]

Based on the statistical analysis and findings from the study:

1. **Confidence Interval Analysis**

- The 95% Confidence Interval (CI) for the Fluorescent Indicator Group **is** 1.422 to 1.618**.**
- The 95% CI for the Disclosing Agent Group **is** 1.531 to 1.649**.**
- These values show that the Fluorescent Plaque Detector tends to have a slightly lower plaque score compared to the Disclosing Agent, but the difference is minimal.

2. **P-Value Interpretation**

- The p-value (<0.281) indicates that there is no statistically significant difference between the two groups.
- A p-value greater than 0.05 suggests that the difference observed could be due to chance**,** meaning that the Fluorescent Plaque Detector and the Disclosing Agent perform similarly in plaque detection.

The results of this study suggest that while Fluorescent Plaque Detection is a modern and potentially more efficient technique, its plaque detection ability does not significantly differ from traditional Disclosing Agents**.**

Clinical Implications

- The Fluorescent Plaque Detector is user-friendly**,** requires less time**,** and is easy to interpret compared to Disclosing Agents.
- However, the lack of a significant difference in plaque scores between the two methods suggests both are effective for plaque detection.

- The discussion section in the study compares findings with prior research, indicating that fluorescence-based plaque detection has advantages in terms of convenience and ease of use.
- Fluorescence-based plaque detection provides an effective, objective, and reproducible method for measuring dental plaque**,** with potential applications in clinical research, smoking cessation programs, and regulatory science[10].

Future Recommendations

- The study suggests the need for larger sample sizes and further research across different age groups to improve understanding.
- While the fluorescent plaque detector provides quick results**,** additional studies could assess its accuracy in long-term plaque detection and prevention efforts**.**

Conclusion

The findings indicate that both methods detect plaque effectively**,** but the fluorescent plaque detector is simpler, faster, and more convenient than conventional disclosing agents. However, statistically, there is no significant difference in plaque scores between the two groups. Given the established relationship between oral and systemic health, promoting effective oral hygiene using advanced and patient-friendly diagnostic tools could significantly contribute to overall well-being. Participants also reported higher comfort levels with the fluorescence-based system, reinforcing its potential for broader implementation in both clinical and community settings.

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