Fluorescent Intraoral Camera as a New Method to Motivate Oral Hygiene

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Abstract

Common oral diseases can be prevented by the consistent practice of oral hygiene. Over a long period, a tool that is easily demonstrated to a patient such as plaque disclosing material is found to be effective in motivating patients into practicing oral hygiene. As of today, the introduction of fluorescent intraoral cameras is a new contender of useful motivational tools. This research aims to compare the conventional erythrosine disclosing agent with the SoproCare intraoral camera in terms of clear demonstration to effectively motivate the patients into practicing oral hygiene. 52 subjects were recruited for this study and 4 subjects were dropped out so a total of 48 subjects remained in this study. The subjects were given a questionnaire before getting divided into two groups. Both groups received gingival index assessment and plaque staining to record their baseline plaque index. One group was shown plaques staining with erythrosine disclosing agent while another one was shown images taken with SoproCare intraoral camera. All subjects then received scaling in the first visit. The subjects then were recalled 2 weeks after for a re-evaluation of their gingival and plaque indices. The two groups showed no significant difference in regard to oral hygiene motivation. The group with an intraoral camera, however, saw a significant decrease in gingival index and plaque index. On the other hand, the erythrosine disclosing agent group also saw a decrease in both indices but was not of any statistical significance. The fluorescent intraoral camera that was used in this study has the ability to motivate the patient thanks to its technique to provide a clearer and easier comprehension of the oral hygiene status of the patients over the conventional erythrosine disclosing agent method.

Keywords: SoproCare, intraoral camera, motivation, dental plaque

1. Introduction

Despite 21st-century superior tools to facilitate oral hygiene, common oral diseases continue as a major health issue. Concurring to the WHO report, dental caries influences roughly 60–90% of children and numerous adults in developed nations. Without the right execution, no matter how developed the tools for oral hygiene are, it is futile for patients to prevent common oral diseases. The tools that could motivate patients' behavior in practicing oral hygiene should not be overlooked as it is equally important tools to facilitate oral hygiene. Especially during puberty, which can be a time of expanded caries activity and periodontal disease due to a decrease in the quality of oral hygiene behavior. It is most important for an effective improvement oral hygiene behavior program for this age group. (Scheerman et al., 2016).

Over a long period, visualizing tools such as dental plaque, a film of microorganisms that inhabits the surfaces of a tooth, is very effective in demonstrating to patients so that they are enthusiastic about practicing oral hygiene. The film is sticky and colorless at first, but as time goes by and it is left to accumulate more, it becomes brown or pale yellow, which later turns into periodontium-deteriorating calculus. The early detection of plaque and proper swift subsequent management is essential for decreasing the risk of oral disease progression.

However, dental plaque films are unable to distinguish old plaque from the newer one. As a result, the patient cannot assess the gravity of the increases in the rate of new plaque. Fortunately, fluorescent intraoral cameras are capable to do what dental plaque film could not achieve. The ability to distinguish newer plaque and demonstrated it to the patient may be beneficial in motivating them to practice oral hygiene.

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SOPROCARE is a high-performance intraoral camera set with blue and white LEDs whose light is captivated by dental tissues and recreated in the form of fluorescence. This fluorescence is selected and then chromatically amplified, which allows the identification of hard and soft tissues. It uses the properties of tissue autofluorescence as well as those of selective chromatic amplification to discover enamo-dentinal caries, calcified or noncalcified dental plaque, and gingival inflammation. Combining these two photonics technologies single intra-oral camera, SOPROCARE claimed to be the first and only system to do so. The camera lightens the dental tissues with a wavelength between 440 and 680 nm. The excited substance absorbs the energy and reconstitutes it as fluorescent light. In another word, the image obtained can be superimposed over the natural anatomical image and the nuances that are invisible in white light can be uncovered in real-time for each tissue.

Behavior change is the ultimate result of studies that aim at improving certain health behaviors, routine proper oral care being one of them. Behavior is a physical consequence of numerous psychological processes. To manipulate one's behavior and turn it into a more favorable one requires the control of its preceding psychological processes, in this case, the oral hygiene motivation; interventions by dental practitioners to get their patients to start looking after their own oral hygiene by their own efforts with the right knowledge capable of doing it.

Motivation to promote oral hygiene in adolescents, whose concerns for oral hygiene and esthetics are critical, yields a long-term positive outcome for them. The introduction of a fluorescent intraoral scanner that can disclose newly accumulated plaque, long-term plaque, and areas of gingival inflammation gives dental practitioners a brand-new method of revealing and communicating with the subjects about their oral hygiene status. Even though the existing conventional method that is practiced regularly by applying plaque disclosing agent and rinse can reveal plaque accumulation in the subjects, the fluorescent intraoral scanner eliminates the complaints regarding the taste, odor, allergic reaction, and coloration on lips and tongues, which are hard to get rid of. Moreover, plaque revealed from a fluorescent intraoral scanner may be more beneficial since it can be kept in the patients' records and can be compared easily between dental visits. Dentists can integrate data from the records into their oral hygiene instruction and adjust motivational support accordingly to their patients.

Therefore, this study will compare the difference in changes in oral hygiene behavior of the two patient groups after being presented with plaque accumulation results using 1) standard plaque disclosing solution versus 2) fluorescence intraoral cameras

2. Objectives

To determine whether the newly introduced fluorescent intraoral camera can motivate patients to practice oral hygiene than the traditional dental plaque disclosing solution.

3. Materials and Methods

This study recruited 52 subjects from Rangsit University among the age group of 18- 26 years old. The study was approved by the Ethics Committee of Rangsit University and the subjects were included in the study after signing informed consent and voluntarily agreeing to participate in this project. Two calibrated examiners held all the examinations. Intra-examiner and inter-examiner reliability were tested by Kappa analysis.

During the first visit, all subjects were given questionnaires to test their prior self-perceived of oral hygiene and habit and motivation questions to see their levels of oral hygiene motivation before the experiment. Subjects were then divided into two groups. One group received only the conventional plaque staining using Erythrosine and had their plaque indices recorded. Another group was shown Soprocare fluorescence images of their plaque. The two groups had their gingival index and Silness and Loe plaque index evaluated. Four surfaces from two posterior teeth and one anterior tooth in each arch were selected as candidates representing the gingival index and plaque level of all teeth. After that, both groups received scaling treatment to remove all plaque so all of them start at zero amount of plaque then and were given oral hygiene instructions.

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Oral hygiene instruction comprised modified Bass technique and flossing encouragement. They were given after plaque staining in both groups by watching the video.

In the final visit, 2 weeks after the first visit, subjects took the questionnaire this time to test their self-perceived oral hygiene and habit and motivation to see their levels of oral hygiene motivation after the experiment. Plaque indices, Gingival indices, and self-perceived oral health motivation of subjects in each group were recorded and compared to those of the first visit, then the subjects were given oral hygiene instruction by watching the video again

The method of the experiment is visualized as a workflow diagram in Figure 1 below.



Figure 1 Workflow diagram of the experiment detailing what interventions will be done to each group in each visit.

4. Results and Discussion

4.1 Results

This study was approved by the Research Ethics Office of Rangsit University (RSUERB 2020-015) and all the participants signed the informed consent before starting the clinical procedure. 52 subjects were recruited in this study and divided equally into two groups. However, 4 subjects were dropped out due to absence from the recall visit. Thus, the SoproCare group remained with 25 subjects, and the erythrosine plaque disclosing group remained with 23 subjects.

The subject demographics in the two groups were not statistically significantly different. The mean age of the subjects was 20.50±2.64 years old. The data in each group is shown in Table 1.

Table 1 Descriptive data of the subject's demographic are reported as Mean \pm S.D.				
Characteristic	Erythrosine Group	SOPROCARE group		
Number of subjects	23	25		
Age: mean \pm S.D.	20.30±2.84	20.68±2.49		
Gender				
Female	17(73.9%)	20 (80.0%)		
Male	6(26.1%)	5(20.0%)		

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The mean of the Self-Perceived motivation level in both groups was almost identical. Subjects in both groups felt positively motivated as shown in Table 2.

Table 2 Descriptive data and comparison of motivation level between SoproCare group and Erythrosineplaque disclosing group. Data are reported as mean \pm S.D. and median.

	Erythrosine Group		SOPROCARE Group	
Motivation	Mean ± S.D.	Median	Mean ± S.D.	Median
	3.70±0.47	4.00	3.72±0.54	4.00

There was no statistically significant difference between the baseline of plaque index (p = 0.368) between the two groups. After finishing the experiment, the result was no statistically significant difference between the two groups (p = 0.193).

Comparing the plaque index and gingival index in each group, the SoproCare group decreased statistically significantly; plaque index (p=0.01), and gingival index (p=0.018). Erythrosine group was not statistically significant; plaque index (p=1.156), gingival index (p=0.3156). The mean and median of each group as shown in Table 3 and Figure 2. The gingival index means and median of each group as shown in Table 4 and Figure 3.

Table 3 Descriptive data and comparison of a gingival index between the SoproCare group and Erythrosine plaquedisclosing group. Data are reported as Mean \pm S.D. and Median.

	Erythrosine Group		SOPROCARE Group	
	Mean ± S.D.	Median	Mean ± S.D.	Median
1 st Visit PI	0.84±0.30	0.75	0.78±0.35	0.75
Recall visit PI	0.74±0.46	0.67	0.57±0.31	0.58



Figure 2 Comparison of plaque index (PI) between SoproCare group and Erythrosine plaque disclosing group. Data reported as mean.

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 Table 4 Descriptive data and comparison of a gingival index between the SoproCare group and Erythrosine plaque disclosing group. Data are reported as Mean ± S.D. and Median.

	Erythrosine Group		SOPROCARE Group	
	Mean ± S.D.	Median	Mean ± S.D.	Median
1 st Visit GI	0.71±0.43	0.54	0.89±0.44	0.83
Recall visit GI	0.78±0.54	0.79	0.66±0.51	0.54



Figure 3 Comparison of Gingival index (GI) between SoproCare group and Erythrosine plaque disclosing group. Data are reported as mean

4.2 Discussion

Motivation is defined as the revitalization of behavior to achieve a goal. Cerasoli et al. (2014) raised two types of motivation; intrinsic and extrinsic patterns. Individuals with an intrinsically motivated pattern would be more interested in performing a thing on their own with the right internal push, and that includes oral hygiene motivation. Dentists play a substantial role in improving their patient's oral hygiene motivation and compliance with oral hygiene instructions. The dentists' push results in extrinsic into intrinsic motivations. Thus, motivation is the significant key element for the patient to adopt healthy oral habits and ultimately improve their oral hygiene. Motivation is mentioned in many studies aiming to change oral hygiene-related behaviors and clinical outcomes. It is also effective in the prevailing health education strategy in eliciting positive changes in the patients' oral hygiene behaviors, especially in young and adolescent groups. (Schwarzer et al, 2008; Ab Mumin, Yusof, Marhazlinda, & Obaidellah, 2021; Wu et al., 2017)

According to Soldo et al, motivation becomes fruitful and tangible when the action is performed several times and continuously. The consistency of action is key to preventing a possible decline in performing oral hygiene measures and their results. (Soldo, M. et al, 2020). Thus, a dental visit ideally requires several follow-ups to keep motivating and reinforcing the patient's good behavior.

This study aimed to determine the difference in oral hygiene motivation between the standard erythrosine disclosing agent group and another group with a fluorescent intraoral camera. From the results, the two groups showed no significant difference in regard to oral hygiene motivation. The group with the intraoral camera, however, saw a significant decrease in gingival index and plaque index. On the other hand, the erythrosine disclosing agent group also saw a decrease in both indices but was not of any statistical significance.

The oral hygiene education method was performed by using the videos. Since Ziebolz et al. (2018) found that this method is as effective as the one-on-one instruction method. The oral hygiene instruction method that is taught could help reduce the plaque index and gingival index in patients with fixed appliances. Furthermore, in younger patients, using video instruction in the dental situation has proven effective in

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improving the attitude of young children toward dental treatment (Machen & Johnson, 1974; Fields & Pinkham, 1976).

In younger patients, the changes in oral hygiene behaviors are highly associated with visual technologies (pictures and video clips), which reinforce the impact on learning and behavior. The intraoral camera can be very useful for such visually-aiding technology in dentistry. Araujo et al, (2019) found that patients who were shown photos of their own teeth that were taken by an intraoral camera had a higher increase in the tooth brushing and flossing habits than those who did not, which corresponds to the decrease in bleeding on probing. As aforementioned, it can be concluded that the age of participants could affect oral hygiene and habit. So, the younger participants tend to have a positive response to the intraoral camera and video education.

Besides, an intraoral camera has several advantages in terms of data collection and detecting more details such as old plaque and new plaque. Giving oral hygiene instruction and showing images via intraoral camera could be more beneficial when comparing plaque pictures between patient visits.

The study had some limitations since most of the recruited subjects were young adults with mild gingivitis and had mild to moderate plaque accumulation, which may not reflect the general population that has more severe forms of gingival diseases. A study with more varied age groups and the severity of gingival diseases would see a more dramatic result. Also, the recall visit should be more than one visit to encourage patients to a stronger and more consistent motivation. However, due to the coronavirus circumstance that arose in the country, another recall visit was not made.

5. Conclusion

The fluorescent intraoral camera that was used in this study, has the ability to motivate the patients due to its technique to provide a clearer and easier comprehension of the oral hygiene status of the patients over the conventional erythrosine disclosing agent method. Moreover, the additional benefits of intraoral cameras, being the electric format of data collection and the ability to disclose plaque thoroughly, may instigate a newer trend in oral hygiene motivation that could be explored further upon.

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